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Car Builders' Cyclopedia

Of American Practice

Definitions and Typical Illustrations of Cars, Their Parts and Equipment; Descriptions and Illustrations of the Tools and Methods Employed in Their Construction and Repair; Cars Built in America for Industrial Operations and for Foreign Railroads

Tenth Edition—1922

Compiled and Edited
for the
American Railway Association—Division V, Mechanical
(Formerly Master Car Builders' Association)

EDITOR

ROY V. WRIGHT

Managing Editor of the *Railway Age* and
Editor of the *Railway Mechanical Engineer*

MANAGING EDITOR

CHARLES N. WINTER

Managing Editor of the *Locomotive Cyclopedia* and
Associate Editor of the *Railway Age*

ADVISORY COMMITTEE

W. F. KIESEL, JR., *Mechanical Engineer, Pennsylvania Railroad*
R. L. ETTENGER, *Consulting Mechanical Engineer, Southern Railway*
L. K. SILLCOX, *General Superintendent Motive Power, Chicago, Milwaukee & St. Paul*
G. E. SMART, *Mechanical Assistant Car Department, Canadian National Railway*

Published and Printed in U. S. A.

By

Simmons-Boardman Publishing Company

Woolworth Bldg., New York, N. Y.

Transportation Bldg., Chicago, Ill.

4300 Euclid Ave., Cleveland O.

Maison Blanche Annex, New Orleans, La.

Home Life Bldg., Washington, D. C.

First National Bank Bldg., Cincinnati, O.

34 Victoria St., Westminster, S. W. I. London, England

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Foreword

This volume, the tenth edition of this work, has been transformed from what might be termed an illustrated dictionary, to cyclopedia. The data have been compiled in a manner differing radically from that of previous editions; all information relating to a specific subject is contained within a single chapter instead of being placed in several separate groups. In former editions each of these groups—American Railway Association specifications and drawings, general illustrations, and manufacturers' descriptive pages—are in different sections of the book, necessitating considerable cross reference and inconvenience in obtaining complete information on any subject. In this edition, the material is arranged and indexed so that reference to the general index on page seven, or the list of contents on page nine, gives the location of each class of cars or appliances, while the complete detailed index, embodied in the definition section—pages eleven to ninety-six gives a reference to each specific car or part.

Former editions of this work contained the American Railway Association "Rules of Interchange" and diagrams of the "Loading Rules" but as these rules are obtainable in convenient booklet form it is not deemed necessary to include them in this volume. The 1919 edition also contained a complete group of railroad cars designed by the United States Railroad Administration and typical representations of railroad equipment used by the American Expeditionary Forces. These illustrations are omitted from the present edition.

Since the publication of the 1919 edition there have been developed many new designs of cars and appliances and the field of car construction covered by this Cyclopedia includes the latest practices in American car building.

The work of compiling data and rearranging the book has entailed a vast amount of research and revision. Valuable assistance has been given by an Advisory Committee appointed by the Mechanical Division of the American Railway Association, by many other railway men, and by the manufacturers of railway supplies.

Car Builders' Cyclopedia

At the Fifth Annual Convention of the Master Car Builders' Association, held in Richmond, Virginia, in 1872, it was

"Resolved, That a committee be appointed with power to publish an illustrated book, defining the proper terms or names of each and every part used in the construction of railway cars, and a description of the use of the same."

This committee consisted of F. D. Adams, M. C. Andrews, Leander Garey, A. Steinbach, C. A. Smith, Joseph Jones and I. W. Van Houten, the actual compilation of the dictionary being done by Matthias N. Forney, assisted by Messrs. Garey and Smith of the committee.

At the Fourteenth Annual Convention, held in Detroit in 1880,

"The committee to which was assigned the duty of preparing a dictionary of terms used in the construction of cars submitted a copy of the book and reported that it had finished its work, and it was discharged."

Revised editions were compiled in 1884 and 1888 by A. M. Wellington, assisted by members of the executive committee of the Master Car Builders' Association.

Revised in 1895 and 1898 by Professor John C. Wait, assisted by R. H. Soule, Norfolk & Western; A. E. Mitchell, New York, Lake Erie & Western, and C. A. Smith, Union Tank Line.

Revised in 1903 by Rodney Hitt, assisted by A. M. Waitt, New York Central & Hudson River; J. S. Lentz, Lehigh Valley; and W. P. Appleyard, New York, New Haven & Hartford.

Revised in 1906 by Rodney Hitt, and in 1909 by Francis E. Lister, under the supervision of C. A. Seley, Chicago, Rock Island & Pacific; H. F. Ball, Lake Shore & Michigan Southern; J. E. Muhfeld, Baltimore & Ohio.

Revised in 1912 by Roy V. Wright, managing editor of the Railway Age Gazette and editor of the American Engineer, assisted by Andrew C. Loudon, under the supervision of R. B. Kendig, Chicago, Burlington & Quincy; C. B. Young, Chicago, Burlington & Quincy, and Robert L. Ettenger, Southern Railway.

Revised in 1916 by Roy V. Wright, managing editor of the Railway Age Gazette and editor of the Railway Mechanical Engineer, and Andrew C. Loudon, associate editor of the above publications, assisted by George Mitchell, under the supervision of H. C. Manchester, Delaware, Lackawanna & Western; William Schlafge, Erie Railroad, and G. W. Wildin, New York, New Haven & Hartford.

Revised in 1919 by Roy V. Wright, managing editor of the Railway Age and editor of the Railway Mechanical Engineer and Charles N. Winter, associate editor, under the supervision of F. W. Brazier, New York Central Lines, G. W. Rink, Central Railroad of New Jersey, and H. C. Manchester, Delaware, Lackawanna & Western.

The General Committee, in session in Chicago, in 1921, adopted a resolution as follows:

"WHEREAS: It is deemed desirable to change the arrangement of data in the book formerly known as the Car Builders' Dictionary.

BE IT RESOLVED: That the General Committee formally approve the report of the Advisory Committee on Revision of the Car Builders' Dictionary and endorse the proposed sectionalizing plan which provides that the editorial and manufacturers data be grouped in major sections as follows:

Definitions; Freight Cars; Freight Car Details; Passenger Cars; Passenger Car Details; General Section—containing data common to both freight and passenger cars, such as trucks, brakes, etc.; Light, Heat and Ventilation; Materials; Railway Service Cars; Industrial and Foreign Cars; Shop Equipment and Operation; Rules; Miscellaneous.

These sections are to be subdivided into chapters treating the various phases of car railway construction.

BE IT FURTHER RESOLVED: That the title of the book be changed to Car Builders' Cyclopedia of American Practice.

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A Dictionary of Terms

Railway Car Practice

A

"A" Car Roof. A car roof with straight carlines, meeting at a point like rafters in the center of the upper deck. See CAR ROOF.

"A" Frame. A strut in the form of the sides of the letter A, to which the boom guys of a steam shovel are fastened.

Accelerator. A special fitting used in connection with the hot water circulation heating system to quicken the circulation of hot water. Fig. 2211.

Accordion Hood. A term sometimes applied to the top transverse portion of a vestibule diaphragm. See DIAPHRAGM.

Acetone. A colorless liquid, obtained from the destructive distillation of wood, which resembles alcohol and which has the property of absorbing acetylene gas under pressure in a high degree.

Acetylene Gas. A colorless gas, C_2H_2, produced when water is brought in contact with calcium carbide. It has a distinctive odor and burns with a bright, luminous flame. It is used in car lighting with success.

Acetylene Gas Lighting System. A system of car lighting using acetylene gas. The gas may be generated in an apparatus inclosed in one end of the car; in a gas generator mounted under the car; or may be generated in gas stations at terminals and stored under pressure in tanks which are placed under the car, replacements being made when the tanks are empty. See TRAIN LIGHTING. Figs. 2523-2532; Page 891.

Adjustable Foot Rest. A sliding foot rest, supported by various mechanical devices—as by a ratchet arc or on rabbet pieces. A foot rest or rail under a seat, which can be adjusted to suit the passenger using it. See FOOT REST.

Admission Valve. (Car Heating.) Used in connection with steam heat system.

Agasote. A substitute for wood; used extensively in place of wood for headlinings, side panels, floors and outside roofs. Its composition is secret, but it does not contain rosin or any acid compound injurious to paint or steel. Panels made from this material can be scraped, planed, molded or sawed on any wood-working machine and will not split under various changes of temperature and humidity. Used extensively for interior finish of steel cars, owing to its insulating and sound-deadening properties. The material used in steel cars is fire resisting. Page 963. See also LIGNOMUR.

Air Brake. Any brake operated by air pressure, but usually restricted to systems of continuous brakes operated by compressed air, in distinction from vacuum brakes, which are operated by creating a vacuum. The air is compressed by some form of pump on the locomotive, or a motor compressor on electric cars, and is conveyed by pipes and flexible hose between the cars to cylinders and pistons under each car, by which the pressure is transmitted to the brake levers, and thence to the brake shoes. This system is termed the straight-air brake. It is now obsolete in steam road practice, having been replaced by the AUTOMATIC AIR BRAKE. See also ELECTRO-PNEUMATIC BRAKE TRACTION AIR BRAKE, VACUUM BRAKE, EMPTY and LOAD BRAKE EQUIPMENT, HIGH SPEED BRAKE, QUICK ACTION AUTOMATIC AIR BRAKE. Figs. 1870-2000; Pages 767, 780, 783, 785, 791, 793, 812, 813, 818.

Air Brake Hose. Laminated rubber and canvas tubing which is attached to a nipple that screws in the angle cock at the end of the brake pipe. The other end of the hose is fitted with a coupling which engages with a similar coupling on the adjoining car and thus forms a flexible connection between the brake pipes of the two cars through which the compressed air for operating the brakes is conducted. See ARMORED BRAKE HOSE.

Air Brake and Train Air Signal Instructions. Pages 769, 777, 821, 832, 835.

Air Brake, Cleaning and Testing. Pages 821-835.

Air Brake Defect Card. Fig. 1881.

Air Brake Hose Clamp. See HOSE CLAMP.

Air Brake Hose Coupling. A contrivance for coupling the ends of brake hose together, so that the air by which the brakes are operated can pass from one vehicle in a train to another. The couplings for train air signal apparatus are similar to brake hose couplings, but are arranged so that they will not couple to the latter. Fig. 1880.

Air-Brake Hose Couplings, Gage for. Fig. 1884.

Air Brake Hose Coupling Case. A hollow casting which joins the main part of a coupling to which the hose is attached.

Air Brake Hose Label. A label of red or white rubber vulcanized to the air-brake hose near one end. On the label is branded the initials or name of the railroad or other purchaser; the name of the manufacturer; the date of manufacture; the hose serial number; and the monogram of the mechanical association. Page 778.

Air Brake Hose Nipple. A short metal tube fitting into the end of the brake hose and fastened by a suitable clamp and screws. One end is threaded and screws into the angle cock.

Air Brake Hose Gasket. Fig. 1885.

Air Brake Hose Coupling Packing Ring Gage. Fig. 1883.

Air Brake Instruction Car. A car, usually a passenger equipment car, in which is installed the apparatus

necessary to illustrate and explain the construction and operation of the air brake. It is used for the instruction of railroad employees and is stationed at different points along the line for a week or two at a time. Regular classes are conducted and lectures given by the instructor in charge, who is usually provided with living quarters in the car. See CAR. Fig. 2713-2717.

Air Brake Repairs. See AIR BRAKE CLEANING and TESTING (REPAIRS).

Air Brake, Testing. See AIR BRAKE, CLEANING and TESTING.

Air Compressor. In car construction, a motor driven air pump which supplies compressed air for operating the air brakes on electrically operated cars. Figs. 1982-1987, 1991, 1992; Page 818.

Air Compressor Cylinder (Motor Compressor). A hollow cast iron cylinder with a piston which compresses the air required to operate the brakes. The pistons in the air cylinders are connected with rods to a crank shaft geared to a small motor.

Air Compressor Cylinder Head (Motor Compressor). The cover for the low end of the air cylinder of a motor driven air pump for an air brake.

Air Compressor Governor. An adjunct to the electrically driven air compressor, designed to open or close automatically the motor circuit when the air pressure in the reservoir exceeds or falls below certain predetermined limits—usually 95 and 80 pounds for automatic brake service and 65 and 50 pounds for straight-air brake equipments. Figs. 1988, 1989.

Air Compressor Governor, Synchronizing System. An arrangement for insuring an equal division of work of furnishing compressed air for braking and other purposes among all the motor-driven air compressors in a train. The current supply to the motor of the motor-driven air compressor is controlled by a compressor switch operated by air pressure, as in the ordinary form of compressor governors, except that the cutting-in and cutting-out of this switch is controlled by the operation of a magnet valve. In addition, a master governor is used on each motor car or locomotive, similar in all respects to a compressor governor except that instead of controlling the current supplied to the motors of the motor-driven air compressors, it acts simply as a pilot or master switch to control the current to the magnets which operate the compressor switches. The magnets of the compressor switches are connected in parallel between the trolley (or positive battery terminal) and the synchronizing wire which runs the entire length of the train. The cutting-in of any master governor connects the synchronizing wire to ground (or negative battery terminal) and thereby operates all the compressor switch magnets. With all the compressors cut out and the pressures in the main reservoir line equalized, as soon as this pressure is decreased to a point at which any one of the master governor controlling mechanisms operates the closing of this master governor switch supplies current to the magnets of each compressor switch in the train, causing them to operate so as to cut-in these switches and start all the compressors simultaneously. Whether one or more of the master governors cut-in at the same time is immaterial since the compressor will continue to operate and raise the pressure in the main reservoirs on each vehicle and in the main reservoir line throughout the train, until the controlling portion of the last master governor remaining cut-in operates to open the circuit to the compressor switch magnets, which causes all the compressor switches to cut out and stop the operation of all the compressors simultaneously. In this manner, all the compressors operate the same length of time, thus avoiding a condition in which some compressors are overworked while others are not working up to their full capacity. Fig. 1989.

Air Compressor Switch. See ELECTRO-PNEUMATIC COMPRESSOR SWITCH.

Air Gage (Air Brake). A gage to register the pressure of air in the reservoirs, brake pipe or brake cylinders, similar to an ordinary steam pressure gage. They are made either with a single pointer, or with two pointers, to indicate on one dial both the reservoir pressure and the brake pipe pressure. The latter type is called a duplex gage. See GAGE. Fig. 2009.

Air Gaps (Generators). The clearance between the body or iron core of the rotating armature and the stationary field poles or pieces of a generator. Small air gaps are beneficial in that they permit of smaller, lighter, slower speed and cheaper machines than is the case with larger air gaps. On the other hand, the bearings of machines with small air gaps require closer attention and more frequent renewals and are more apt to give trouble at the commutators and brushes than machines with large air gaps.

Air Inlet. An opening for the admission of air to an air compressor or to a refrigerator car. The term includes both the air strainer and air pipe.

Air Pipe (Air Brake). More properly brake pipe. Often called train pipe.

Air Pipe Strainer. See BRAKE PIPE AIR STRAINER.

Air Pump. See AIR COMPRESSOR.

Air Pump Governor. See AIR COMPRESSOR GOVERNOR.

Air Signal. See BACK-UP AIR SIGNAL.

Air Signal Reducing Valve. See REDUCING VALVE.

Air Space (Refrigerator Cars). A space left between the linings to aid in insulation. It is sometimes called dead air space in distinction from the ventilating passages, as the air in it is confined or dead and is not being constantly changed. Unless air is confined so that it does not continually change it is a poor insulator. See Fig. 200.

Air Strainer. See BRAKE PIPE AIR STRAINER.

Air Valve (Steam Heating). A small outlet valve which will pass air but not water, applied to the ends of storage heaters to allow the air to escape when the steam or hot water is turned on.

Aisle. The longitudinal passageway through a passenger car, between the seats.

Aisle Seat End. The end or arm of a transverse car seat next to the aisle. See also WALL SEAT END.

Alcohol Burner. Sometimes used for heating refrigerator or produce cars when transporting perishable products during cold weather.

Alcohol Stove. See STOVE.

Alcove. A recess. See WATER ALCOVE.

Alcove Faucet. A faucet in a water alcove connected with a water cooler to supply drinking water.

Alley Apartment. A compartment in a passenger equipment car, reserved for mail, and serving the same

purpose as a postal car on runs where an entire car is not required for mail. It occupies only a part of the width of the car and has an alley or passageway at one side.

Alley Lamp. A lamp placed in a recess in the side of a car. Also called Panel Lamp, as it is usually covered by a panel.

Alleyway. More properly a corridor. A narrow passage at the side of staterooms or compartments in parlor or sleeping cars.

American Continuous Draft and Buffing Apparatus. An apparatus by which the drawbars at both ends of the car are connected by two rods with loops at the ends, that hook over the ends of a bar or key passing through the shank of each drawbar. Each car is in this manner pushed from the rear end and all the pull is transmitted through the train by the draft rods. It has two buffer springs and two follower plates at each end of the car. Not now used in new construction. See BUFFER.

Ammeter. An instrument for measuring electric current in amperes.

Ampere. The unit of electric current.

Ampere-Hour Meter. An instrument which measures the rate of flow of electric current in units of ampere-hours. The quantity passing through is indicated by a series of dials on the face of the meter.

Angle Cock. (Air Brakes). A cock placed in the brake pipe under each end of the car just back of the hose connection. In train operation this must always be open except at the rear end of the last car, where it must be closed to prevent escape of air from the brake line and setting of the brakes. Figs. 1873, 1886.

Angle Cock Holder. A clamp or bracket for securing the angle cock at the end of a car. Fig. 2022; Pages 2022, 2024.

Angle Iron or Angle. A general term applied by makers to iron or steel rolled in the form of an L.

Anti-Collision Bulkhead. See ANTI-TELESCOPING DEVICE.

Anti-Friction Car Door Hanger. See DOOR HANGER.

Anti-Friction Center Plate. Devised to reduce the friction between the body and truck in curving. See ROLLER CENTER PLATE and BALL BEARING CENTER PLATE.

Anti-Friction Side Bearing. Devised to reduce the friction between body and truck in curving. See ROLLER SIDE BEARINGS, BALL BEARING SIDE BEARINGS, GRAVITY SIDE BEARINGS and ROCKER SIDE BEARING.

Anti-Slip Surface. See SAFETY TREAD.

Anti-Telescoping Device. A type of end framing in which the end sill is greatly strengthened by an end sill stiffening plate, an end sill stiffening angle bar, corner angle posts, and end plate strengthening angles or knee irons. Its object is to prevent one car from entering or telescoping another in a collision. An anti-telescoping plate is intended for the same purpose. Another device in use for this purpose on many subway cars consists of a corrugated face secured to the end sill. As adjacent cars come together the corrugations are forced into each other thus transmitting the shock of collision to the underframe. Figs. 345-348.

Anti-Telescoping Plate. See ANTI-TELESCOPING DEVICE.

Apprentices, Car Shop. An individual paper by I. S. Downing, describing the apprentice courses on the New York Central Lines, will be found in the 1912 M. C. B. Proceedings, page 337. See pages 1162, 1163.

Arbitration Committee. A committee of members of the American Railway Association whose duty is to settle disputes arising between the members under the Rules of Interchange; to recommend at each convention such changes, suggestions, amendments or additions to the Rules of Interchange as may be thought advisable from the experience of the preceding years.

A general review of the decisions which had been made by the Arbitration Committee, previous to 1903, was prepared by George L. Fowler and will be found in the M. C. B. Proceedings for 1903, page 295.

Arbor. A spindle or axle for a wheel or pinion; a mandrel on which a ring or wheel is turned in a lathe.

Arch (Elliptic Spring). The height from the center of the scrolls at the ends of the elliptics to the under side of the main leaf of the spring. Twice the arch of an elliptic spring, less the thickness of the spring bands, is the set and is the maximum amount which an elliptic spring can be compressed. In a half elliptic spring the arch and set differ only in the thickness of the spring band.

Arch Bars. The wrought iron or steel bars which form the top and bottom members of a diamond arch bar truck side frame. They are attached to the bolster guides or truck columns by column bolts and to the journal boxes by the journal box bolts. See also CENTER BEARING BRIDGE. See pages 600, 601.

Arch Bars, Column and Journal-Box Bolts.

Arch Bar Truck. See DIAMOND ARCH BAR TRUCK.

Arched Roof. A roof, the surface of which is curved, and which has no upper deck or clere-story. It is sometimes used for passenger cars. See TURTLE BACK ROOF.

Argand Lamp. A lamp invented by Argand, a native of Geneva, about the year 1784. The burner consists of two concentric cylindrical tubes in which is the annular wick. The tube inclosing the wick is closed at the bottom and communicates by a pipe with the oil reservoir. The interior tube being open, free access of air is allowed to the interior and exterior of the flame, insuring more perfect and equal combustion. Some gas lamps used in car lighting are constructed on this principle.

Arm Cap. A metal plate, wooden cap, or piece of upholstery with which the top of a seat end, arm rest or chair arm is covered.

Arm Pivot. See SEAT ARM PIVOT.

Arm Rest. A wooden or metal bar or ledge attached to the side of a car, and not, like an arm cap, to the top of a seat end.

Arm Rest Bracket. A bracket supporting the arm rest of a car seat.

Armature. The rotating part of a motor or dynamo. It consists of a laminated iron cylinder or core keyed to a shaft, and in the slots of which are wound the armature coils of insulated copper wire or ribbon. At one end of the core on the shaft is mounted the commutator, a copper cylinder composed of insulated segments, which are connected to corresponding armature coils. Figs. 2274, 2284, 2322-2325.

Armature Spider (Electric Motor). A skeleton center fastened to the armature shaft and surrounded by the

laminated iron core in which the armature coils are imbedded.

Armored Brake Hose. Brake hose covered with a woven wire fabric, steel, or other material, to protect it from injury or abrasion. Vacuum brake hose, for vacuum brakes, is usually lined with coiled wires on the inside to prevent collapsing, but such is not properly termed an armored brake hose. The A. R. A. standard brake hose is not armored.

Asbestos Felt. A preparation of asbestos in sheets similar to felt, for use as a non-conductor. It is largely used in refrigerator cars and is manufactured for that purpose in rolls. It must be handled with care to prevent tearing.

Asbestos Protected Metal. A material used as roofing, side walls, partitions and ceilings in buildings; also for inside box car roofs, passenger car and locomotive cab roofs, head linings and interior finish for passenger cars.

Asphalt Car Roofing. A saturated and coated felt applied in sheets.

Atmospheric Brake. This term, but little used, includes both the air brake and the vacuum brake. See AIR BRAKE, VACUUM BRAKE.

Automatic Air Brake. An air brake system with which the brake will be applied automatically in case of an accident which permits air to escape from the system. Figs. 1888-1890, 1911-1914; Pages 783, 785, 791, 793.

Automatic Connector (Steam and Air Pipes). A device by means of which the steam, air brake and signal pipes are automatically coupled by impact. Allowance is made for vertical and lateral movement, and arrangement is provided for interchange with cars not equipped with the device. See EMERGENCY HEAD BACK-UP CONNECTION. Figs. 2080-2104; Page 854.

The M. C. B. committee on steam line connections reported in 1904 that because of the experiments with automatic couplings a new committee should be appointed to study this situation; 1905 M. C. B. Proceedings, page 206.

The new committee made a progress report and recommended that the railroads discourage the use of such connectors until some arrangement could be made for the interchangeability of the different devices; M. C. B. Proceedings, 1906. Page 416.

The committee report in the 1908 M. C. B. Proceedings, page 271, explains the steps which the committee had taken with a view to getting the manufacturers to make their devices interchangeable.

Automatic Lubricator. A device for feeding at regular intervals a certain quantity of oil or lubricant to a cylinder or some mechanism requiring lubrication. See LUBRICATOR.

Automatic Reducing Valve. See REDUCING VALVE, AUTOMATIC.

Automatic Slack Adjuster. See SLACK ADJUSTER.

Automatic Straight Air Brake. See Air Brakes. Figs. 1945, 1946; page 767.

Automatic Switch (Electric Lighting). A device connected to the armature of the generator, by which the current is automatically turned onto the lights and batteries when the armature has reached a predetermined speed of rotation and consequent voltage output.

Automatic Train Stop. A valve mechanism mounted on the car or locomotive, operated by a track trip, and connected with the brake system so as to produce an automatic emergency application of the brakes at predetermined points when the conditions within any block are such as to forbid train movement into it.

Automatic Ventilator. A ventilator which is self-adjusting, so as to exhaust air from a car if the train runs in either direction. See VENTILATOR.

Automatic Window Catch. A device to hold a window sash from being shoved up or down. See SASH LOCK.

Automobile Car. A box car for carrying automobiles and having exceptionally large side or end doors. See CAR, BOX CAR.

Auxiliary Belt Rail. A strip of wood nailed to the belt rail as a reinforcement. See BELT RAIL.

Auxiliary Brake Equalizing Lever (Six-Wheel Truck). A short lever to which the brake lever connecting rod is fastened, and which divides the power equally between the center pair of wheels and the outside pair of wheels. See BRAKES.

Auxiliary Compression Beam Brace. The same as a CENTER COMPRESSION BEAM BRACE.

Auxiliary Contactor (Motor Cars). A contactor applied to a control system to open and close the main motor circuits at a point remote from the platform controller, thus eliminating heavy arcing in the controller.

Auxiliary Reservoir. A cylindrical reservoir attached to the under side of a car or tender. It serves to hold a supply of compressed air to operate the brakes of each car, and is supplied from the main reservoir on the engine through the brake pipe. See RESERVOIR.

Auxiliary Reservoir Hanger. A support for the auxiliary reservoir.

Axle. A shaft made of wrought iron or steel to which a pair of car wheels is attached. The wheels are usually rigidly fastened to the axle by making a hydraulic press fit. In a few cases in steam railroad service where roller bearings have been used the axle does not rotate but is fixed and the wheels turn on the roller bearings. Figs. 1584-1590; Pages 677-678, 679, 680.

Axle Collar. A rim or enlargement on the end of a car axle, which takes the end thrust of the journal bearing.

Axle Generator (Electric Lighting). A small direct current generator usually mounted on a car or tender truck and driven by a belt, gear, or chain from the axle. These generators are always provided with some automatic device, forming either a part of the machine itself or being in the form of an auxiliary device mounted inside the car, for preserving the polarity of the terminals or leads of the generator.

The fact that a car may run in either direction and thereby cause rotation in either direction of the armature of the generator renders an automatic device of this kind absolutely necessary.

Axle Guard. A beam or bar supported by a truck frame and extending over the axles. Iron straps attached to this beam form a support for the axle in case of breakage. See END AXLE GUARD.

Axle Guard Truss. A wrought iron forged bar connecting the iron transoms of a six-wheel truck, and carrying the middle axle guard.

Axle Lighting. See ELECTRIC LIGHTING.

Axle Pulley. The belt pulley mounted upon the car

axle for driving the axle generator. When a chain is used the pulley is commonly termed a sprocket wheel.

Axle Pulley Bushing. A bushing or sleeve, split longitudinally and bored conically inside to fit the tapering car axle and turned cylindrically outside to fit the hub of the axle pulley.

Axle Safety Bearing (Passenger Car Trucks). The axle guard of a truck above the axle and the axle safety hanger below it, together forming a circle around the axle, are sometimes called axle safety bearing.

Axle Safety Hanger. A strap connected to an axle guard and passing under the axle to support it in case of breakage. See AXLE GUARD.

Axle Seat. The bearing surface of a car wheel which comes in contact with the axle. The corresponding part of an axle is called the wheel seat or wheel fit.

Axles, Specification for. Pages 677-678.

Axle Testing Machine. Pages 677-678.

B

Babbitt Metal. An alloy, consisting of tin and copper, used for journal boxes; so called from its inventor, Isaac Babbitt, of Boston. The term is commonly applied to any white alloy for bearings, as distinguished from the box metals or brasses in which copper predominates.

Babbitt Metal Bearings. A style of bearing of which a great variety of forms exist, which in effect substitutes Babbitt metal in some of its many forms for brass as a bearing surface. Lead lined bearings are different in that they merely use a thin sheet of lead over the brass, to correct slight irregularities and give an even bearing surface.

Back Cylinder Head (Air Brake Cylinder). See NON-PRESSURE HEAD.

Back Face Plate (Steel Tired Wheels). The inner one of the two plates connecting the tire with the hub.

Back Guy (Steam Shovel). An iron rod running from the top of the "A" frame to an anchor over the body bolster under the boiler.

Back Seat Bottom Rail (Longitudinal Seat). A horizontal wooden strip at the back edge, to which a wooden seat bottom is attached.

Back Stop Timber. See BUFFING SUB-SILL.

Back-Up Air Brake. A device on the rear end of the train by which the brakeman can blow a warning whistle or apply the brakes when backing up. Fig. 2014.

Back-Up Air Brake Cock. A cock which is operated by the brakeman in applying the back-up air brake.

Back-Up Air Signal. A warning signal which can be operated at the rear of the train when backing up.

Baggage-Buffet Car. A passenger train car with club and dining facilities and a compartment for carrying baggage. See CAR.

Baggage Car. A car run in passenger service, having wide side doors for the admittance of baggage and with or without windows and end doors. See CAR. Figs. 408-421, 469, 2843, 2844; Pages 420, 421.

Baggage Car Generator. See ELECTRIC LIGHTING.

Baggage and Express Car. A car similar to a baggage car, used for baggage or express matter. See CAR.

Baggage and Postal Car. A car run in passenger service and providing facilities for both baggage and mail matter. See CAR. Figs. 435, 469, 2843; Page 314.

Baggage Rack. See BASKET RACK.

Bail. A curved handle of a more or less semi-circular form for a pail, bucket, lantern or other utensil.

Baker Car Heater. A heater arranged to heat water in a coil of pipe in the inside of a stove, and cause it to circulate through a series of pipes laid near the floor of the car. The fireproof heater has a single coil, 30 feet in length, or a double coil, in a flexible steel, jointless, fireproof safe, with no apertures large enough to permit the escape of live coals. This inner fire pot or safe is enclosed in a flexible steel outside casing, with asbestos sheets between the safe and casing, and between the ash pit bottom and sheet iron bottom; a safety plate covers the feed chute at the top, and a cinder-proof door effectually closes the ash pit at the bottom. The smoke pipe and smoke flue base may be destroyed and leave the fire pot practically fireproof. Not being installed in modern steam railway cars. Page 864.

Balance Hanger. See BRAKE BEAM ADJUSTING HANGER.

Balance Spring (Passenger Truck Brake Gear). A flat spring from which the brake beam adjusting hanger is suspended and which keeps the brake head balanced in its proper position.

Balance-Valve Pressure Regulator. A valve for automatically regulating the pressure in the steam pipes in a car-heating system. See PRESSURE REGULATOR.

Balanced Side Bearing Truck. See SIDE BEARING TRUCK.

Ball-Bearing Butt Hinge. A butt hinge, the washer of which is a ball-bearing.

Ball-Bearing Center Plate. A center plate fitted with ball-bearings to reduce the friction in turning.

Ball-Bearing Side Bearing. A side bearing fitted with ball-bearings to reduce the friction in curving. See SIDE BEARING.

Ballast Car. A car for carrying ballast for repair and construction work, usually of either the flat or gondola type. See CAR. Fig. 2686.

Ballast Plow. Figs. 2683-2685.

Ballast Spreader. Fig. 2690.

Ballast Unloader. Figs. 2684, 2685.

Band (for Seat Backs). More properly SEAT BACK MOLDING.

Bar Sash Lift. A sash lift having a short horizontal metal bar attached to two flanged studs or stanchions; used for the large sashes of sleeping and parlor cars.

Bar Shackle (of a Padlock). A rectangular, instead of U-shaped, shackle.

Bars, Wrought Iron, Refined, Specifications for.

Base Washer (Passenger Equipment Car Platform Posts). A metal ring or plate, which forms a bearing for the post on the platform end timber.

Barrel Car. A flat car provided with a rack so as to carry many empty barrels. These cars are made long, and the racks are very high in order to make up a carload weight.

Barrel Door Bolt. A door bolt made of a round metal bar and held in a round tube or "barrel." It is constructed so that when it is either engaged or disengaged from its keeper it can be turned by a short lever

or knob and held in either position by suitable stops.

Base Board Corner Molding. A light molding at the junction of the base board and the floor.

Basin. A hollow vessel made of porcelain or metal, and in cars usually fixed in a suitable stand with pipes and other attachments for filling it with water and emptying it. Such basins are used as lavatories in sleeping and other passenger cars. They are emptied at the bottom through a pipe connected to the basin by a basin coupling, or basin bushing, which is closed by a basin plug. The basin plug is attached to a basin chain, which again is fastened to a stanchion called the basin chain holder. See also FOLDING LAVATORY. Figs. 1041-1071.

Basin Bushing and Plug. See BASIN.

Basin Pump. A pump of peculiar construction for supplying the basin of sleeping and parlor cars from the tank carried under the slab. It is called single or double acting, according as the upward stroke only, or both the upward and downward strokes, eject water. Double acting is most used. The use of basin pumps has been practically discontinued on standard sleeping cars, the water being carried in tanks under the car and forced through the pipes by compressed air. They are still in use, however, on many tourist sleeping cars, chair cars and day coaches. Figs. 1052, 1053.

Basin Valve. The valve which allows the water to escape from the basin is usually in the form of a plug or waste cock. See BASIN.

Basket Rack. A receptacle made of metal ends and rods, or a combination of rods and wire netting for holding parcels and hand baggage. They are attached to the sides of passenger cars, above the heads of the passengers, so as to be out of the way. Continuous basket racks extend the full length of the car, and are increasing in favor. Now commonly called BAGGAGE RACK. Figs. 980-992; Pages 954, 957, 958.

Basket Rack Bracket. A light metal support for the end or center of a basket rack.

Basket Rack Netting. Wire netting with very large meshes, which forms the bottom or back of a basket rack.

Basket Rack Rod. Small round metal bars, with which form the main portion of a basket rack, and to which the netting, when used, is fastened.

Batten. In car construction a narrow and thin strip of wood or metal used to cover joints or cracks where two pieces of headlining or sheathing come together.

Battery. See STORAGE BATTERY.

Bayonet Catch. A general term derived from the manner of fastening on a bayonet to a gun, applied to the mode used in many forms of hardware and mechanical construction for connecting separate parts so as to be firmly united and yet easily removable. Many lamps are held in place by a form of bayonet catch.

Bead. A small salient molding of semi-circular section. Also the strips on the sash frame which form a guide for the sash. These beads are known as the inside bead, outside bead and parting bead. The term is frequently applied to any form of small, light molding of simple outline.

Beam. The term beam is generally applied to any piece of material of considerable sectional area and length, whether subject to transverse strain or to longitudinal strains of compression and tension.

The term has of late years come to be applied to pieces or bars of iron and steel. Thus we have iron I-beams and deck beams to take the place of wooden beams in structures. The term is also used to designate the beam of a balance or scales, brake beam, etc.

Bearing. That which supports or rests on something, and is in contact with it. Thus a block or stone on which the end of a timber rests is called a bearing. The metal block or bushing in contact with a journal is called a bearing. Figs. 1465-1520; Pages 607, 609, 649, 651, 653, 656, 968, 970.

Bearing Casting (Tip Cars). A casting, one of a pair attached to either the car body or to the truck which supports the car body and its load. In tip cars it is pivoted or hinged so as to permit the body to tip or rock laterally and to thus discharge its load.

Bearings, Journal. See JOURNAL BOXES AND DETAILS.

Bell Cord. See SIGNAL CORD.

Bell Crank. An L-shaped lever, often with the two extremities connected so as to be of triangular form, for changing the direction of motion by 90 degrees, more or less.

(Hand Car.) A crank attached to the propelling lever shaft, giving more favorable direction to the power applied to the levers.

Bell Rope. See SIGNAL CORD.

Belt Aligning Device (Electric Lighting). Mechanism consisting of screws and slip collars for adjusting the alignment of the belt, by shifting the generator so that its pulley shall be in the same vertical plane with the axle pulley.

Belt Molding. A molding passing entirely around the interior of a passenger car directly above the windows.

Belt Rail. A part of a passenger car frame below the windows on the outside, extending the whole length of the car body and attached to each post. It is usually framed into the posts and supports the window sills. The upper belt rail is a similar strip directly above the window. See AUXILIARY BELT RAIL.

Belt Rail Cap. A strip of wood nailed to the top of a belt rail, and forming a seat for the window sill.

Belt Rail Stiffener. A reinforcing member riveted to a belt rail in steel passenger cars.

Belt Tension. Mechanism consisting of springs, rods and nuts for adjusting and maintaining the tension of a belt used for driving an axle generator.

Bench Cap. Transverse timbers resting upon the side sills of a coal or ore car, to tie the sills together and prevent spreading, and also to support the doors or winding shaft about which the winding shaft chain is wound.

Berth. A bed in a sleeping car; also, the shelf or support on which the bed rests. There are two such beds in the space occupied by two double seats, which is called a section. The lower berth is made up on the seats and the upper one on a shelf, which can be raised or folded up out of the way when not in use. Figs. 391, 392.

Berth Arm. See BERTH BRACE.

Berth Brace. A metal rod, chain, or wire rope sometimes attached to the side and near the top of a sleep-

ing car, and at the other end to the outer edge of a berth, which is supported by the brace. In modern designs it is done away with, the berth being supported by the berth chain.

Berth Brace Eye. A metal plate with suitable lugs for fastening the brace to the top of the car or to the berth.

Berth Bracket. A bracket on which an upper berth of a sleeping car rests when lowered.

Berth Chain. A chain passing from the berth spring through the overhead pulley and to the corner of the upper berth to support it. The berth spring is attached to the chain to counteract the weight of the berth. The berth chain does the service of the berth spring rope and berth brace.

Berth Chain Pulley. A pulley attached to the roof of a sleeping car, over which a berth chain runs. Fig. 393.

Berth Curtain. A curtain hung in front of a sleeping car section to afford privacy to occupants. Usually a single curtain covers both berths, and is hung from the berth curtain rod; sometimes separate upper and lower curtains are used. Figs. 391, 392.

Berth Curtain Hook. A metal hook attached to a berth curtain, and by which the latter is hung on a rod above the berths; usually covered with leather to prevent rattling. Figs. 398, 399.

Berth Curtain Pole. See BERTH CURTAIN ROD.

Berth Curtain Rod. A rod usually made of metal tubing, fastened above a section of a sleeping car to support the berth curtains. They are now made in sections, supported by folding brackets, and swing into the upper berth out of sight, except when berths are made up. See BERTH CURTAIN ROD BRACKET.

Berth Curtain Rod Bolt. A small vertical bolt, usually tipped with an ornament fastening the curtain rod in the coupling on the bracket.

Berth Curtain Rod Bracket. A metal bracket attached to the deck of a sleeping car, which forms a support for a berth curtain rod. Such brackets usually have a coat and hat hook attached to them. A hanger is sometimes used as a substitute for a bracket at certain points. The stationary bracket has been replaced by the folding curtain rod bracket, which folds, with the rod attached, into the upper berth and out of sight when the curtains are not in use. See CURTAIN ROD FOLDING BRACKET.

Berth Curtain Rod Coupling. A fastening by which a berth curtain rod of a sleeping car is secured to a bracket. It usually consists of a bolt or screw.

Berth Curtain Rod Socket. A metal flanged ring which supports the berth curtain rod. Also called berth curtain rod bushing.

Berth Front. The bottom or front of an upper berth.

Berth Headboard. See HEADBOARD.

Berth Hinge. A hinge or joint by which the back edge of an upper berth of a sleeping car is attached to the side of a car. Fig. 401.

Berth Hinge Bushing. A hollow metal socket in which the spindle of a loose berth hinge works.

Berth Hinge Plate. A plate which takes the place of a berth hinge bushing.

Berth Lamp. A lamp for lighting a sleeping car berth. See ELECTRIC LAMPS.

Berth Latch. A device for holding the upper berth of a sleeping car up in its place when not in use. To obviate the danger of the berth shutting up in case of overturning of the car, the safety berth rope and attachments are used. Safety berth latches have also been used to obviate the necessity of using a safety rope. See SAFETY BERTH LATCH, BERTH SAFETY ROPE. Fig. 393.

Berth Latch Bolt. A bar or pin of an upper berth latch which engages in a corresponding strike plate or keeper to hold the berth up.

Berth Latch Keeper. Also called STRIKE PLATE. See BERTH LATCH BOLT.

Berth Latch Lever. The part by which the berth latch handle operates the berth latch bolt; also called a berth latch rocker plate.

Berth Latch Rocker Plate. See BERTH LATCH LEVER.

Berth Lock. See BERTH LATCH.

Berth Mattress. The mattresses which cover the seat cushions of the lower berth and the springs of the upper berth. When the berths are made up for day travel the mattresses are stored in the upper berth.

Berth Numbers. Figures or numbers, usually made of metal or porcelain, for numbering the berths or sections of sleeping cars. They usually are secured to the curtains, but sometimes are sewed to plush panels and hung from the berth curtain rods.

Berth Partition. The partition between the upper berths of two adjacent sleeping car sections. It is of the same outline as the upper berths' cross-section.

Berth Safety Rope. A wire rope fastening the upper berth of a sleeping car to the fixed arms of the lower berth, to prevent accidental closing up of the upper berth in case of overturning of the car. The rope is fastened to the upper berth by a berth safety rope fastener and to the lower berth by inserting a knob into a berth safety rope holder. See SAFETY BERTH LATCH.

Berth Safety Rope Hook. A hook for holding a berth safety rope.

Berth Spring. A spring usually made in a spiral form, like a watch spring, coiled within a device called the berth spring fusee and attached to the upper berth of a sleeping car by a berth chain so as to counteract the weight of the latter and make it easy to raise and lower. Fig. 393.

Berth Spring Frame. A metal support which holds a berth spring and fusee.

Berth Spring Fusee. See FUSEE.

Berth Spring Lug or Clip. The means by which the end of a berth chain is fastened to the upper berth, sometimes called a berth chain end plate.

Berth Striker Plate. A Berth Latch Keeper.

Beveled Washer. A washer used to give an even bearing for rods which stand at an acute angle to the surface on which the nut or bolt head bears. Sometimes two such washers which come near together are cast in one piece, and are then called double beveled washers. See TRIANGLE WASHER.

Bezel. A term applied by watchmakers and jewelers to the groove and projecting flange or lip by which the crystal of a watch is retained in its setting. A similar method is used on the globes of some types of gas lamps used in car lighting.

Bibb Cock. Literally, a cock with a curved nozzle or

spout, but commonly restricted to a cock with a plain valve without springs, moved by the hand only.

Billet Car. A low side gondola car, built of steel throughout for transportation of hot steel billets or other heavy material.

Bit (of a Key). The part of a key which enters the lock and acts upon the bolt and tumblers. The bit consists of the web and wards. The web is the portion left after the wards are cut out. The wards consequently are those spaces which fit over the wards of a lock. Some bits have no wards.

Bleeding Valve or Bleeding Cock. Another term for Release Valve or Release Cock. The operation of releasing the brakes when applied upon car detached from the locomotive is sometimes called bleeding. The bleeding valve is located on the auxiliary reservoir, and the brakes may be released by opening it and allowing the air in the brake cylinder and auxiliary reservoir to escape.

Blind. A Window Blind. They are sometimes single, but usually double, distinguished as lower and upper. Flexible window blinds are rarely used now, having been displaced by window shades.

Blind Ceiling (Refrigerator Car). A layer of light boards next above the inside ceiling in the roof of the car.

Blind End Car (Passenger Equipment). A term sometimes used to designate non-vestibuled cars, but more properly a car without end doors, either non-vestibuled (dummy) or with open platforms.

Blind Floor (Refrigerator Cars). A layer of boards under the sub-floor and fastened to ceiling strips secured to the bottom of the sills.

Blind Lining (Refrigerator Cars). A thin layer of boards between the outside sheathing and the inside lining; also sometimes called intermediate lining.

Block. A heavy piece of timber or wood, usually with one plane surface; rectangular and thick rather than long.

A pulley or system of pulleys mounted on its frame or shell, with its band or strap. A block consists of one or more pulleys or sheaves, in a groove of which the rope runs, fastened in a shell or frame by pins, on which they revolve. The interior wheels are termed sheaves, which latter term is often used to designate the whole block or pulley. A snatch block is a block with only one sheave, and with an opening at the side for the ready insertion and removal of the rope. Blocks without this opening, however, are also sometimes termed snatch blocks.

Block and Tackle. A general term applied to a pair or more of pulleys and the accompanying rope. Also termed fall and tackle, or simply tackle.

Blocking. A mode of fastening together the vertical angles of woodwork by blocks of wood glued or nailed in the inside angle. The method is largely used in every form of carpentry, where great strength is not required in the joint. In car work, generally known as furring blocks

Blocking, Continuous (Passenger Equipment Car Framing). A term used to designate planks, or blocking used to strengthen the side frame.

Board. A piece of timber sawed thin, and of considerable length and breadth compared with the thickness, used for building cars with wood superstructure and for other purposes.

Boarding Car. A term commonly applied to a car used as a place of lodging for workmen. In the case of wreck trains, they are more often called dining and sleeping cars.

Body (of a Car). The main or principal part in or on which the load is placed. American cars usually consist of a body carried on two trucks.

(Of a Valve, Cylinder, etc.) The main or principal part, to which the other parts are attached, as cylinder body, etc.

Body Bolster. The transverse members of the underframe over the trucks which transmit the load carried by the longitudinal sills to the trucks through the center plates. A double body bolster is a wide bolster with two transverse members, and is used on cars equipped with six-wheel trucks. Figs. 603-616; Pages 955, 965.

Body Bolster Bottom Cover Plate. The bottom cover plate used on a bolster of the built-up type. Also known as the Body Bolster Compression Bar and Body Bolster Tie Plate.

Body Bolster Compression Bar. The lower or compression member of a built-up body bolster. Also designated as the Body Bolster Bottom Cover Plate.

Body Bolster Cover Plate. See Body Bolster Top Cover Plate and Body Bolster Bottom Cover Plate.

Body Bolster End Pocket Casting. A cast cap that fits over the end of a combined wood and steel body bolster, through which the truss rods pass, and on which the truss rod nuts bear. It is a body bolster truss rod washer enlarged so as to cover the entire end of the bolster.

Body Bolster Filler. A plate or casting forming the filling piece between the cover plates of a built-up body bolster. The term also applies to Truck Bolsters. Also frequently called Diaphragm and sometimes Spider.

Body Bolster Flitch Plate. A plate of iron or steel sandwiched between pieces of wood and bolted together to give a wooden bolster greater strength. Frequently called body bolster sandwich plate.

Body Bolster Sandwich Plate. See Body Bolster Flitch Plate.

Body Bolster Tension Bar The upper or tension member of a built-up body bolster. Also designated as the Body Bolster Top Cover Plate.

Body Bolster Thimble. See Bolster Thimble.

Body Bolster Tie Plate. See Body Bolster Bottom Cover Plate.

Body Bolster Top Cover Plate. The top cover plate used on a body bolster of the built-up type. Also known as the Body Bolster Tension Bar.

Body Bolster Truss Block. A block of wood or distance piece on the top of a wooden body bolster between the center floor timbers and underneath the bolster truss rods.

Body Bolster Truss Rod. A metal rod, used on some built-up body bolsters, which is tied to the ends and passes above the center of the bolster over the truss rod bearing, so as to form a truss; generally two are used for each bolster.

Body Bolster Truss Rod Bearing. See Body Bolster Truss Rod.

Body Bolster Truss Rod Washer. An iron bearing plate on the end of a body bolster; often made to take two or more rods.

Body Brace. An inclined member of the body side or end of the car. In the construction of freight cars the braces are inserted in the panels between the bolster and the center of the car, inclining toward the center of the car, while the counter braces are framed in the panel between the bolster and the end of the car, inclining toward the end of the car. See Brace and Counterbrace.

Body Brace Rod. An inclined iron rod in the side or end of a car body frame, which acts as a brace. They are distinguished as end and side body brace rods. A brace straining rod is a short vertical rod in the side of a passenger car under the window.

Body Center Plate. The center plate attached to the under side of the body bolster. See Center Plate.

Body Check or Safety Chain Eye. An eye bolt or clevis for fastening a truck check chain or safety chain to the car body.

Body Check or Safety Chain Hook. An iron hook on the check chain, which enters into the check chain eye.

Body Counter Brace Rod. Usually an inclined iron rod in the side frame of a car body, between the bolster and the end of the car. It may be a diagonal brace rod in a Pratt truss, which runs counterwise with those rods which carry the load. It may then be between the bolsters.

Body Cross Tie. A metal bar extending across a hopper or other form of open-top freight car and fastened to the sides to prevent their bulging.

Body End Furring. Furring in the end of a car. See Furring.

Body End Plate. A transverse member in the end of a car connecting the side plates. See End Plate.

Body End Rail. See Wainscot Rail.

Body Framing. The framework of that part of a car above the underframe, so called to distinguish it from the underframe. It is commonly subdivided into side, end and roof framing. Figs. 622-625.

Body Post (Freight Car Bodies). An upright timber which is framed into the sill and plate of a freight car. The body posts and corner posts form the vertical members of the side frame of a car body. See Post and Side Post.

Body Queen Post. See Queen Post.

Body Side Bearing. The upper one of the two side bearings, which is attached to the body bolster. See Side Bearings.

Body Transom. A name sometimes given to a Needle-beam or Cross Tie.

Body Truss Rod. A rod extending from end sill to end sill, passing over the body bolsters on truss rod saddles and under the truss rod queen posts hung from the cross tie timbers. With the sills they form a truss and support the car body, preventing the sills from sagging between the bolsters. In passenger cars truss rod anchor irons are sometimes used, which are fastened to the sills near the bolsters. The truss rods are then attached to these anchors and are not brought out through the end sills. Truss rods are distinguished as center, intermediate and side or outside truss rods.

Body Truss Rod Bearing. See Queen Post.

Body Truss Rod Hopper Strap. A term applied to a strap passing under and supporting the hopper of a gondola car, the ends of which are fastened to the body truss rods, which carry the stress to the end sills.

Body Truss Rod Saddle. A block of wood or a casting which forms a distance piece on top of a bolster, and on which a continuous body truss rod bears. Properly speaking, a saddle means a common bearing for a pair of rods with a central support, but it is not restricted to such use.

Body Truss Rod Washer. A heavy iron washer on the outside face of the end sills, on which the nut on the end of the body truss rod bears.

Bogie. A British term for a swiveling car truck. American eight-wheel cars are termed bogie carriages, or wagons, in Great Britain.

Bogus Plate (Refrigerator Cars). A horizontal timber attached to the posts on the inside of the car, a short distance below the plate. The bogus plates support horizontal cross timbers, called meat timbers, or hanging bars, to which hooks are attached for hanging meat.

Bolster. A cross timber or beam on the under side of a car body and in the center of a truck, through which the weight is transmitted. The bolsters carry the body and truck center plates, the body bolster resting on the truck bolster.

Truck bolsters are either swing bolsters, admitting of lateral motion to mitigate shocks, or rigid bolsters, which permit no lateral motion. All passenger trucks have swing bolsters. In freight car service the rigid bolster has the preference, and rigid bolster trucks are the more numerous. See Body Bolster, Double Body Bolster, Swing Bolster and Truck Bolster. Figs. 603-616, 1425-1463; Pages 631, 632, 637, 955, 962, 965.

Bolster Bridge (Six-Wheel Truck). See Side Bearing Arch.

Bolster Center Casting. A hollow rectangular shaped casting placed between the center sills and body bolster plates; the king bolt passes through it. Sometimes called a bolster center filler.

Bolster Center Filler. See Bolster Center Casting.

Bolster Chafing Plate. This is an iron plate attached to the side of the transom to prevent wear from abrasion by movement of the bolster. More properly, transom chafing plate. The corresponding casting on the side of the bolster, which is, strictly speaking, the bolster chafing plate, is commonly called friction block or friction plate.

Bolster Diaphragm. See Body Bolster Filler.

Bolster Flitch Plate. The iron or steel plates of a built-up bolster, sandwiched between wood pieces. Rarely used now.

Bolster Guide Bars (Diamond Arch Bar Trucks). More commonly called columns. Posts between the arch bars, held in place by column bolts, which form a guide for the end of the bolster. These columns are sometimes also required to perform the office of a brake hanger carrier. An offset shoulder is then cast on the column near the top and on the inside with a jaw, to which the brake hanger is fastened by a pin.

They are also often combined in one casting with the spring seats.

Bolster Hanger. See SWING HANGER.

Bolster Hanger Carrier. A Swing Hanger Pin Bearing.

Bolster Jack Screw (Wreck Cranes). A jack screw attached to the spring plank for the purpose of taking the load off the springs and making the entire truck and car body one rigid structure when the derrick of the crane is in use.

Bolster Plate (Passenger Equipment Trucks). Wrought iron plates bolted to the sides of wooden bolsters to strengthen them.

Bolster Sandwich Plate. See BOLSTER FLITCH PLATE.

Bolster Spring. The main spring of a car, carried on the spring plank and supporting the truck bolster, on which the weight of the car body rests.

Bolster Spring Cap. See SPRING CAP and SPRING SEAT.

Bolster Spring Seat. See SPRING SEAT.

Bolster Thimble. A small filler sometimes used between the cover plates of a bolster when the main filler or web does not extend clear to the end of the bolster.

Bolt. A pin or bar of metal used to hold or fasten anything in its place; ordinarily a bolt has a head on one end and a screw and nut on the other, while a rod has a nut on both ends.

Bolster, Specifications for Cast-Steel. Page 1066-1068.

Bolster, Truck, Gages for Cast and Pressed Steel. See TRUCK BOLSTER. Fig. 1360.

Bolster, Truck; Specifications and Tests for Pressed Steel. Page 644.

Bolt Heads and Nuts. See SCREW THREADS, BOLT HEADS and NUTS. Pages 1080, 1081.

Bolted Commutator (Motor Cars). A motor commutator in which the segments and mica insulation are held in place between two retaining rings by bolts.

Boom (Steam Shovel). The heavy swinging arm which carries the boom engine and ratchet beam. It is stepped at the foot of the "A" frame and held in its inclined position by boom guys.

Boom Cap Clevis (of a Derrick, Steam Shovel or Crane). A clevis sometimes attached to the upper end of the boom, to which the fixed end of the hoisting rope is attached. In other cases the clevis for this purpose is carried on the hoisting block.

Boom Engine (Steam Shovel). An engine mounted on the boom to operate the ratchet beam.

Boom Foot Sheave (Steam Shovel). A fixed sheave or pulley at the bottom of the boom over which the hoisting chain is passed.

Boom Guys (Steam Shovel). Iron rod extending from the point of the bottom to the top of the "A" frame, holding the boom in its inclined position.

Boom Idler Sheave (Steam Shovel). A fixed sheave mounted on the boom, the purpose of which is to slightly change the direction of the hoisting chain.

Boom Point Sheave (Steam Shovel). The pulley at the outer end of the boom over which the hoisting chain runs. See BOOM SHEAVE.

Boom Sheave (of a Derrick, Steam Shovel or Crane). A sheave carried at the upper extremity of the boom, over which the hoisting chain passes.

Boom Shoe (of a Derrick or Crane). A casting carried at the foot of the mast and constructed so as to be able to revolve against the boom base. It is supported by boom shoe rods.

Boom Shoe Rods (of a Derrick or Crane). Iron rods attached to the head block or cap at the top of the mast and supporting the boom shoe.

Boom Shoe Rollers (of a Derrick or Crane). Rollers at the foot of the mast upon which the boom shoe revolves.

Boom Step and Trunnion (Steam Shovel). The socket in which the boom is seated and about which it turns.

Booster (Electricity). A direct electro-motive force generator arranged to add its E. M. F. to that of another circuit, or "boost" the same. Direct opposite of bucker.

Boring Machine. Page 1175.

Boss or **Hub** (of a Wheel). The central portion, through which the axle passes. Boss is the usual British term, but little used in the United States.

Bottom Arch Bar. See ARCH BAR.

Bottom Chord (of Trusses). See LOWER CHORD. Neither term is regularly used to designate any part of car trusses, but the side sills are bottom chords in trussed side frames.

Bottom Connecting Rod. The brake rod connecting the bottom ends of the live and dead truck brake levers.

Bottom Door Rail. The lower transverse piece of a door frame.

Bottom Door Track. A door track, usually a metal bar, below a sliding door. Sliding doors are often provided with rollers or slides, which rest on the track. Freight car doors usually slide on a TOP DOOR TRACK.

Bottom Rod. See BRAKE ROD and BOTTOM CONNECTING ROD.

Bottom Truck Connection. See BOTTOM CONNECTING ROD.

Bow. See PLATFORM HOOD BOW.

Bowl. A glass bowl used on center and vestibule gas lamps. See also BASIN.

Box. See JOURNAL BOX.

Box Car. A car with sides enclosed and having a roof; doors are placed in the sides or sides and ends. Used for general service and especially for lading, which should be protected from the weather. See CAR. Figs. 1-37, 2845-2862, 2937-2939, 2944, 2945, 2949, 3045; Pages 109, 121, 276, 960, 965, 966, 967, 1123, 1126, 1127, 1144.

Box Car Door. Used on both the sides and ends of the car. Figs. 650-724; Pages 393-398, 401, 403, 405. See END DOOR.

Box Cars, Framing for. See general views of cars. Figs. 4-433 and Figs. 575, 617-635.

Box Cars, Height and Width of. See page 363.

Box Cars, Inside Dimensions of. See page 363.

Box Car End, Design and Strength. See page 367.

Box Car Inspection, Overhead. A thorough report as to the causes of damage to freight because of defective box cars is included in a report of the committee in the 1912 M. C. B. Proceedings, page 275; other reports by the committee will be found in the 1913 Proceedings, page 480; 1914 Proceedings, page 302; and 1915 Proceedings, page 347.

Box Car Side and End Door Fixtures. See DOOR FIXTURES.

Box Car, Ventilated. See VENTILATED BOX CAR.

Box Cover. See JOURNAL BOX LID.

Box Cushion. A cushion for passenger car seats made on a wooden frame. In distinction from a squab cushion, now little used, which is a loose pad on the seat. Box cushions are sometimes stuffed with hair or other elastic material alone, but usually steel springs are used in addition.

Box Fruit Car. See VENTILATED BOX CAR.

Box Guide. See PEDESTAL.

Box Lid. See JOURNAL BOX COVER or LID.

Box Packing. See JOURNAL PACKING.

Box Section Bolster. A bolster whose cross-section has a box of rectangular shape.

Box Steps. A term sometimes used to distinguish platform steps made with wooden stringers or sides from open steps.

Box Stock Car. An ordinary box car with large grated openings for ventilation, but excluding rain. Little used except for horses. See STOCK CAR.

Brace. An inclined beam, rod, or bar of a frame, truss, girder, etc., which unites two or more of the points where other members of the structure are connected together, and which prevents them from turning about their joints. A brace thus makes the structure incapable of altering its form from this cause, and it also distributes or transmits part of the strain at one or more of the joints toward the point or points of support, or resistance to that strain. A brace may be subjected to either a strain of compression or tension. In the former case, in car construction it is called simply a brace; in the latter it is called a brace rod. They are called right or left handed, according to the inclination of their top to a person standing facing the car. See BERTH BRACE, BODY BRACE, BRAKE LEVER BRACKET BRACE, BRAKE SHAFT, STEP BRACE, COMPRESSION BEAM BRACE, DOOR BRACE, END BRACE, ROOF BRACE, SIDE BRACE, SIDE LAMP BRACE.

Bracing. A committee report on lateral bracing of the steel freight car will be found in the 1908 M. C. B. Proceedings.

Brace Pocket. A casting which forms a socket for holding the ends of the braces in the car body framing. See POST POCKET.

Brace Rod. An inclined iron rod which acts as a brace. A vertical rod acting in conjunction with a brace is called a sill and plate-tie rod, or, in passenger cars, for short rods below the window, brace straining rod. See BODY BRACE ROD, COUNTERBRACE ROD.

Brace Rod Washer. A bearing plate for the nut or head of a brace rod, sometimes made in a triangular or beveled shape, and sometimes a flat bar of iron bent to fit into a notch cut in the timber.

Brace Straining Rod (Passenger Car Framing). A vertical iron rod in the side or end frame of a car body by which the upper end of a brace is connected or tied to the sill of the car. The brace rods are members of the truss, of which the sill, braces, posts or plates, etc., form parts. Such rods often have hook heads at the upper ends, against which the braces bear, and nuts at the lower ends by which they are screwed up, and are thus brought into a state of tension and the braces into compression. An equivalent in freight service is the sill and plate-tie rod.

Brace and Tie Rod Washer. See BRACE ROD WASHER.

Bracket. An angular stay in the form of a knee to support shelves and the like.

(Framing for Bridges or Cars.) An L-shaped angle plate riveted to each of two members which it is desired to connect at right angles to each other, as an end sill bracket or sill knee iron. A stronger form, now used in car construction, is called a gusset plate.

(Wheels.) The stiffening ribs cast on the plate.

Bracket Gas Burner. A gas burner attached to the side of a car. See BRACKET LAMP.

Bracket Lamp. A lamp attached to a wall by a suspension in the form of a bracket.

Bracket Steps (Hopper Cars). Steps secured to the side of the car on the inside to serve as a substitute for a running board.

Brake or **Brake Gear.** The whole combination of parts by which the motion of a car is retarded or arrested. The foundation brake gear includes all the parts by which the pressure of the air in the brake cylinder is transmitted to the wheels. See HIGH SPEED BRAKE, QUICK ACTION AUTOMATIC AIR BRAKE, STRAIGHT-AIR BRAKE, FOUNDATION BRAKE GEAR, TRACTION AIR BRAKE, VACUUM BRAKE. Figs. 1804-1993; Pages 755-757, 761, 766, 783, 785, 791, 793, 812, 813, 815.

Brake Beam. Transverse members to which the brake heads and shoes are attached. They are either inside hung or outside hung, and are often trussed, especially in passenger service. Figs. 1687-1772, 1867, 1869; Pages 731, 743, 745, 747, 748, 761, 766, 965.

Brake Beam Adjusting Hanger. A link sometimes attached to a brake beam to cause the latter and the brake head and shoe to maintain the same relative positions when the brakes are released, so as to prevent the ends of the brake shoes from coming in contact with the wheel when the brakes are released. It is attached to the truck frame or truck bolster by a projecting brake beam adjusting hanger carrier, and to the brake beam by an eye or clip.

Brake Beam Chafing Plate. A plate attached to a brake beam against which a brake spring bears, designed to resist the wear due to the action of the spring.

Brake Beam Eye Bolt. An eye bolt in the brake beam to which the safety hanger is attached.

Brake Beam Fulcrum. See BRAKE LEVER FULCRUM.

Brake Beam Gage. A metal templet for ascertaining or regulating the several dimensions of brake beams. Fig. 1693.

Brake Beam Hanger. See also BRAKE HANGER.

Brake Beam King Post. See BRAKE BEAM STRUT.

Brake Beam Release Spring. See RELEASE SPRING.

Brake Beam Safety Chain. A chain sometimes attached by eye bolts to a brake beam to act as a safety device in the same manner as a brake beam safety hanger.

Brake Beam Safety Chain Eye Bolt. An eye bolt attached to a truck or car body to hold a brake beam safety chain.

Brake Beam Safety Hanger. A metal strap suspended from a truck frame and surrounding a brake beam, so that in case of a broken brake beam hanger the beam will not drop to the track.

Brake Beam Specifications and Tests. Pages 719-721.

Brake Beam Strut. A post or distance piece which forms a bearing for the truss rods of a broken beam.

In metal brake beams the brake lever is attached to it, and it then becomes a brake lever fulcrum. Figs. 1687, 1688, 1700-1788; Pages 731, 743, 745, 747, 748, 766.

Brake Beam Suspension. An overhead arrangement attached to the truck frame and to the Brake Beam Truss Rod at the center, thus keeping the Brake Beam in balance.

Brake Beam Support. A spring attached to the spring plank or other part of the truck and supporting the tension member of the brake beam by means of a sliding chair casting which is attached to the brake beam strut. Figs. 1845-1860; Page 761.

Brake Beam Truss Rod. A rod used to truss or strengthen a brake beam.

Brake Block. Another name for a Brake Head.

Brake Burn. A condition of the wheel surface due to excessive heating of the metal by the too prolonged and severe application of the brake, which weakens the structure, sometimes causing shelling out and also flange failure.

Brake Carrier. See Brake Hanger Carrier.

Brake Chain. See Brake Shaft Chain.

Brake Chain Connecting Rod. An iron rod connecting the hand brake chain to one of the brake levers, usually the floating lever.

Brake Chain Drum. The enlarged end of the hand brake shaft, on which the chain is wound.

Brake Chain Sheave. An iron wheel or pulley around which the brake chain passes.

Brake Chain Worm. A conical casting attached to the brake shaft with a screw-shaped groove for the brake chain. Its object is to produce a rapid motion at first and increase the power when the brake shoes are brought to a bearing.

A cylindrical casting with a screw-shaped groove, intended only to make the chain wind evenly.

Brake Clevis. A Brake Lever Fulcrum.

Brake Connection. See Brake Rod.

Brake Connection Pin. A pin used for connecting brake rods and levers.

Brake Cord Guide. A guide similar to a signal cord guide for the air-brake cord, which passes through cars fitted with automatic air brake apparatus, and operates the conductor's valve.

Brake Cut-out Cock. A valve inserted in the branch pipe from the brake pipe to the triple valve, which can be closed and the brakes on that one car put out of action in case they are not working properly. The closing of this valve does not interfere with the operation of the brake under any other car in the train. Figs. 1932, 1981.

Brake Cylinder (Air Brake). A cast-iron cylinder attached to the frame of the car, containing a piston which is forced outwardly by the compressed air to apply the brakes, and when the air pressure is released is returned to its normal position by a release spring coiled about the piston rod inside the cylinder. On passenger cars the brake cylinder is fitted with two heads, the pressure head and the non-pressure head. For freight cars the brake cylinder and the auxiliary reservoir are usually combined, the reservoir being bolted to one end of the cylinder and forming one of the cylinder heads. The piston rod of the passenger brake cylinder has a crosshead at its outer end, to which is attached the cylinder lever. The piston rod of the freight brake cylinder is hollow and loosely encloses a push rod, which is attached to the cylinder lever. A somewhat similar cylinder is used in the vacuum type of brake. Figs. 1895, 1896, 1900, 1906-1910, 1924, 1926, 1933, 1935, 1945, 1964, 1965, 1994; Pages 783, 785.

Brake Cylinder Block. A block of wood shaped to fit over the curved surface of a brake cylinder and act as a filler between the cylinder and the sill to which it is attached.

Brake Cylinder Lever. See Cylinder Lever.

Brake Cylinder Lubricator. A device for lubricating the brake cylinder.

Brake Cylinder Pipe (Air Brake). The pipe which connects the brake cylinder with the triple valve.

Brake Cylinder Plate. The steel plate to which a brake cylinder is bolted and by which it is attached to the sills.

Brake Cylinder Support. See Brake Cylinder Plate.

Brake Dog. A Brake Pawl.

Brake Foot Board. A Break Step.

Brake Gear. The whole combination of parts by which the motion of a car is retarded or arrested. See Air Brakes, Foundation Brake Gear.

Brake Gear, Foundation. See Foundation Brake Gear.

Brake Guard Rail. A rail sometimes placed around the hand brake wheel on box and other house cars to prevent the brakeman falling off in case he misses his footing while applying the hand brakes.

Brake Handle. A Brake Lever.

Brake Hanger. A link or bar by which brake beams and attachments are suspended from a truck frame. It is attached to the truck by a brake hanger carrier. Figs. 1812, 1830-1832, 1841, 1842; Page 757.

Brake Hanger Carrier. An eye or U-bolt, a casting or other fastening by which a brake hanger is attached to the truck or body of a car.

Brake Hanger Pin or Bolt. A pin passing through the brake hanger carrier and brake hanger, and supporting the hanger.

Brake Head. A casting attached to a brake beam which carries the detachable brake shoe. Figs. 1687-1690, 1694-1868; Page 743.

Brake Head Gage. Fig. 1692.

Brake Hose. See Air Brake Hose.

Brake Jaw. Jaws which may be fastened to standard rods to form brake rods.

Brake Lever (Air Brakes). A general term designating all the levers in the Foundation Brake Gear. Also a lever used for applying the hand brake in vestibuled passenger-equipment cars where there is not room for the use of a brake wheel. See also Dead Lever, Live Lever, Floating Lever, Cylinder Lever. Figs. 1815, 1837, 1844; Page 756.

Brake Lever Bracket A knee on the under side of a car, to which the fulcrum of a brake lever is sometimes attached.

Brake Lever Bracket Brace. A diagonal wrought iron brace to stiffen the brake lever bracket.

Brake Lever Clevis. A Brake Lever Fulcrum.

Brake Lever Coupling Bar (Inside Hung Brakes). See Bottom Connecting Rod.

Brake Lever Connecting Rod. See Brake Lever Connection.

Brake Lever Connection. A rod connecting two brake levers. Most commonly used to designate the lower ends of the truck brake lever.

Brake Lever Fulcrum. A forked iron attached to a brake beam, by means of which a brake lever is connected to the beam. In some designs it forms a fulcrum for and also connects the two center levers of a six-wheel truck. In a trussed metal brake beam the king post of the brake beam becomes the brake lever fulcrum. Figs. 1804-1811, 1817-1821, 1828, 1829, 1839, 1840; Pages 747, 748.

Also a bracket attached to an underframe to support a brake lever, and to which the lever is held by a pin in such a manner that it moves about the pin.

Brake Lever Fulcrum Tie Plate. A U-shaped plate, riveted at both ends to a plate which acts as a bracket. The brake lever is inserted in the opening between the two and held in place by a pin passing through all three. See Brake Lever Fulcrum.

Brake Lever Guide. An iron bar which guides the upper end of a brake lever. Further distinguished as live lever and dead lever guides, the latter provided with pins for readjustment as the brake shoes wear, and also called a brake lever stop. See Dead Lever Guide. Figs. 1808, 1819, 1820, 1844.

Brake Lever Jaw. A Brake Lever Fulcrum.

Brake Lever Stop. See Dead Lever Guide.

Brake Lever Strut. A brake lever coupling bar or bottom rod connection.

Brake Mast. See Brake Shaft.

Brake Pawl (Hand Brake). A small pivoted iron bar for engaging in the teeth of a brake ratchet wheel to prevent the wheel turning backward, and thus releasing the brakes. It is placed in such a position as to be worked into engagement by the foot or a brake pawl weight, and out by the foot. Figs. 1843, 2048, 2050.

Brake Pawl Carrier. See Brake Pawl and Brake Ratchet.

Brake Pawl Weight. A pivoted casting serving as a weight to throw up the brake pawl so that it will engage with the ratchet when the latter is located on the under side of the brake ratchet wheel. Also sometimes applied to an eccentric which holds a pawl against a ratchet wheel.

Brake Pin or Brake Lever Pin. A small metal pin used in the brake lever connections.

Brake Pipe (Air Brake). A pipe extending from one end of the car to the other under the car body and connected to the pipes on adjoining cars by flexible brake hose. The air from the air pump or compressor is conveyed through the brake pipe to the auxiliary reservoir under each car. The brake pipe is normally filled with compressed air at 70 pounds pressure and the auxiliary reservoirs with air at the same pressure. A reduction of this pressure in the brake pipe of from 5 to 20 pounds causes the triple valves to open communication between the auxiliary reservoir and the brake cylinder, so that the compressed air stored in the reservoir acts on the piston and brake levers and applies the brakes. This is called a service application. In case the train parts or a hose bursts, the air is suddenly and completely released from the brake pipe and the triple valves automatically apply the brakes as before, only with more speed and greater power at first. In an emergency application the full main reservoir pressure of 90 to 110 pounds is turned into the brake pipe and this increase of pressure causes the triple valves to open communication from the brake pipe direct to the brake cylinder, applying the brakes with great force and very suddenly. To release the brakes the brake pipe pressure is restored to normal and the triple valves equalize the pressures in the auxiliary reservoirs and the brake pipe, at the same time opening the brake cylinder to the atmosphere and releasing the brakes. This pipe is sometimes called train pipe, train line, or train brake pipe, but its proper name is brake pipe to distinguish it from the signal and steam heating pipes.

Brake Pipe Air Strainer. A wire strainer inserted in the brake pipe to prevent foreign matter from entering the brake apparatus under the car. See also Centrifugal Dirt Collector. Figs. 1872, 1943, 1977, 1986; Page 812.

Brake Pipe Anchor. Figs. 2023, 2024; page 961.

Brake Ratchet (Hand Brake). A wheel attached to a brake shaft, having teeth in to which a pawl engages, thus preventing the wheel and shaft from turning backward. In some forms the ratchet wheel has the teeth on the under side, instead of on the edge, the brake pawl being automatically pressed upward against the teeth by a Brake Pawl Weight, and without being adjusted by the foot of the brakeman. The brake pawl is pivoted in the Brake Pawl Carrier, the latter being bolted to the roof of the car.

In 1879 the M. C. B. Convention recommended that the practice of placing the ratchet gear on a small platform or brake step be discontinued, and that it be fastened to a suitable casting on the roof. The recommendation has not been universally adopted, though it is a very common practice.

Brake Ratchet Wheel. See Brake Ratchet.

Brake Rod. A rod connecting brake levers and through which the braking force is transmitted. Fig. 1870.

Brake Rod Guide. A wrought iron bracket attached to an underframe as a support for a brake rod.

Brake Safety Strap. See Brake Beam Safety Hanger.

Brake Shaft. An iron shaft, usually vertical, and having a hand wheel, or a handle and ratchet, on one end, by means of which a chain connected to the brake levers may be wound on the shaft and the brakes applied. It is sometimes made horizontal. See also Safety Appliances, Drop Brake Shaft, and Brake Staff Height. Figs. 2034, 2035, 2039, 2043-2045, 2049-2064; Page 843.

Brake Shaft Bearing. A metal eye by which a brake shaft is held in its place, and in which it turns. Sometimes called brake shaft guide. See Brake Shaft Step, Lower Brake Shaft Bearing, Upper Brake Shaft Bearing.

Brake Shaft Bevel Gear Wheel. A bevel gear on the lower end of the brake shaft engaging with a similar gear on the horizontal brake chain worm.

Brake Shaft Bracket. A support for holding a brake shaft in its place.

Brake Shaft Chain. A chain connecting the brake shaft with the brake levers through the brake shaft connecting rods, to the end of which it is attached. The force exerted on the shaft is transmitted by this chain.

Brake Shaft Chain Sheave. A roller over which a brake shaft chain passes. A sheave attached to the end sill for the chain of a horizontal brake shaft to work in. A sheave or pulley is sometimes attached to the end of the hand brake connection and the brake chain, secured at one end to the end sill of the car, is passed around this sheave and back to the brake shaft winding drum. It thus doubles the power of the hand brake, but also doubles the amount of chain to be wrapped and is objectionable from this standpoint.

Brake Shaft Connecting Rod. A rod which is attached at one end to a brake chain and at the other to one of the levers in the foundation brake gear.

Brake Shaft Gear Wheel. A bevel gear wheel attached to the brake shaft, by which the power applied to the brake hand wheel is conveyed to a horizontal winding shaft or worm, called a brake chain guide casting.

Brake Shaft Guide. See Brake Shaft Bearing.

Brake Shaft Holder. See Brake Shaft Bearing.

Brake Shaft Sleeve. That part of a brake shaft on which the brake chain is wound.

Brake Shaft Step. A bearing which holds the lower end of a brake shaft. It usually consists of a U-shaped bar of iron, the upper ends of which are fastened to the car body, with a hole in the bar which receives the end of the shaft. The brake shaft step should not be confounded with a brake step, which latter is a shelf on which the brakeman may step when applying brakes. Figs. 2052, 2058.

Brake Shaft Step Brace. A wrought iron brace sometimes attached to the brake shaft step to resist the pull of the brake chain.

Brake Shaft Thimble. An iron bushing attached to the end of the car to form a bearing for a brake shaft.

Brake Shoe. A block of metal shaped to fit the tread of a car wheel and attached by a key or otherwise to a brake head. The brake shoe is thus held against the wheel when the brakes are applied. See also Wheel Trucking Brake Shoe. Figs. 1694, 1789-1793, 1802, 1803; Pages 723, 749, 751.

Brake Shoe Back. Steel backs are often used for cast shoes to reinforce and strengthen them.

Brake Shoe Key. A key or wedge by which a brake shoe is fastened to a brake head. It is inserted through a keyway in the face of the brake head and the lug on the brake shoe. Figs. 1694, 1782, 1824.

Brake Shoe, Specifications for. Page 723.

Brake Shoe Tests. Page 723.

Brake Slack Adjusters. A device to take up any slack in the brake gear between the air brake cylinder and the brake shoe, so that the piston travel shall not be too great. See Slack Adjuster.

Brake Spool. See Brake Shaft Sleeve.

Brake Spring. See Release Spring.

Brake Staff. See Brake Shaft.

Brake Step. A small shelf or ledge on the end of a freight car near the top, on which the brakeman stands when applying the brake from the top of a car. Also called a brake footboard. Should not be confounded with a Brake Shaft Step, which is a bearing for the lower end of a brake shaft.

Brake Step Bracket. An iron bracket to support a brake step.

Brake Strut. A compression bar or strut between the live and dead levers of a truck with inside hung brakes. Probably the term brake strut is more common than brake lever coupling bar. Brake strut should not be confused with brake beam strut. A bottom connection rod. See Brake Beam Strut.

Brake Treadle. A lever for applying brakes with the foot. Used on hand-cars and other small cars.

Brake Valve (Air Brakes). The valve operated to apply and release the brakes. Also called operating valve. Figs. 1960-1963, 1967; Page 812.

Brake Van (British). American equivalent caboose, or baggage car. A covered vehicle in which the guard (conductor) of a train travels, and which is fitted with a powerful screw hand brake. On passenger trains it carries the passengers' luggage (baggage), etc. On goods (freight) trains it is weighted with pig iron, and is primarily used as a source of brake power. Also called guard's van. Fig. 2936; Page 1122.

Brake Wheel. See Hand Brake Wheel.

Brake Windlass. A term sometimes used to designate the brake shaft, with all its attached parts.

Brakeman's Step. A step on the inside of a wide vestibule for the use of trainmen in applying hand brakes.

Branch Pipe (Air Brake). A pipe extending from the triple valve to the brake or train pipe.

Branch Pipe Strainer. A strainer used in the branch pipe.

Branch Pipe Tee (Air Brake). A tee used to connect the branch pipe to the brake or train pipe.

Brass. An alloy of copper and zinc. A term commonly used to designate a Journal Bearing.

Bridge. In car construction the term bridge means a timber, bar or beam which is supported at each end.

Bridging (Passenger Equipment Car Framing). Short transverse distance blocks between the sills of an underframe to keep the sills from displacement or buckling. A sill tie rod is usually employed to keep the sills drawn tightly against the bridging. It is toe-nailed and sometimes tenoned into the sills with small tenons.

Broad Gage. A term applied to a gage when the distance between the head of the rails is greater than 4 ft. 9 in. See Narrow Gage, Standard Gage.

Broiler and Oven. Adapted for use in dining, parlor and buffet cars and using gas or electricity as fuel. Figs. 377-379.

Bronze. An alloy composed of copper and tin, sometimes with zinc and lead.

Brush. A device bearing on an armature, and through which current is supplied to an electric motor and received from an electric dynamo or generator.

Brush Holder. A support for the brushes of an electric motor, providing by means of springs for a constant pressure of the brushes on the commutator. Figs. 2314, 2315.

Brush Rigging. The apparatus pertaining to the brushes of a motor or generator.

Bucker (Electric Lighting). A machine somewhat like

a small dynamo which has a field and a revolving armature and which is used for automatically maintaining a constant predetermined voltage in the lamp circuit regardless of the speed of the dynamo or the demand for lights. See also Booster.

Bucket (Automatic). A bucket usually made in two or more parts and provided with mechanical means of opening and closing. It is used for handling various materials such as coal or earth. Page 996.

Buffer. An elastic apparatus or cushion attached to the end of a car to receive and absorb the shocks caused by other cars running against it. The term is generally applied to those attachments in which springs are used to give the apparatus elasticity. See also American Continuous Draft and Buffing Apparatus. Figs. 1086-1097; Pages 497, 501, 503, 505, 955, 1130.

Buffer Beam Extension. A buffer block on the platform end sill of a passenger car.

Buffer Block. Usually one of a pair of buffing devices placed on either side of the coupler to receive severe shocks and prevent damage to the car. It also acts in the same capacity as a Dead Wood, the latter sometimes being termed Buffer Block. See Dead Wood.

Buffer Block Face Plate. A metal plate bolted to the face of a wooden buffer block or dead wood to protect the wood from wear. Usually called striking plate.

Buffer Plate (Passenger Equipment Cars). An iron or steel plate (usually bolted to the end of the buffer stems) which bears and rubs against the opposing plate of the next car of the train. The vestibule face plate is bolted or riveted to, and carried by, the buffer plate. Figs. 774, 775, 1086-1097.

Buffer Safety Lug. A projecting horn cast on top of freight couplers to bear against a buffer block and relieve the draw gear from excessive compressive strains. Coupler Horn is the more common name. Also called striking horn.

Buffer Shank. The square part between the buffer head and buffer stem.

Buffer Sill. See Buffer and Platform End Sill.

Buffer Spring (Passenger Equipment Cars). The springs that resist the compression of a train or the impact when they come together as in coupling. In passenger equipment this thrust is not taken by the drawbar alone, but by the buffers, which transmit it to the buffer springs, which absorb or transmit it to the car body.

(Freight Cars.) A draft spring.

Buffer Stem (Three-Stem Equipment). The round bar which passes through the buffer springs. The term is sometimes applied to the buffer bar, which includes the round stem and the square shank. Figs. 1086-1097; Pages 497, 503, 505.

Buffer Stem Guides. Iron bushings inserted in the platform end sill, in which the buffer stems work. They protect the wood from abrasion and wear.

Buffet Car. The cars in which buffets are most used are parlor, sleeping, observation, library and smoking cars. In such cases the cars are termed buffet-sleeping, buffet-observation, or observation-buffet, buffet-library and buffet-smoking cars. See Car.

Buffing Sub-Sill. A sub-sill bolted to the center sills on the underside and forming a continuous buffing sill in conjunction with the draft timbers. They are bolted and keyed to the center sills with key blocks and bolts. Also called back stop timber.

Bulkhead (Refrigerator Car). A partition which separates the ice chamber from the part of the car in which the lading is placed. Figs. 202, 254.

(Passenger Equipment Cars.) A partition which divides the car into rooms or compartments.

Bull's-Eye. A convex glass lens, which is placed in front of a lamp to concentrate the light so as to make it more conspicuous for a signal.

Bumper. A term sometimes used to designate a buffer.

Bunk. A rough form of sleeping berth built against the side of a car.

(Logging Cars.) A cross piece similar to a body bolster, on which timber is loaded. Figs. 2895-2897.

Bunk Apron. A board attached on the deck sill of a sleeping car and projecting below it to cover the edge of the upper berth when it is closed. In the later designs of sleeping cars it is not used.

Bunk Panel. A panel below the cornice and behind the upper berth in sleeping cars, shutting off the upper part of the side windows.

Bunk Truss (Logging Cars). An iron strap used to stiffen the bunk.

Burlap. A coarse fabric of jute or hemp sometimes used in upholstery.

Burner. That part of a lighting apparatus at which combustion takes place. See Lamp Burner.

Burner Cock (Pintsch System of Gas Lighting). A cock used for wall and other lamps. It is opened and closed with a key.

Bushing. Usually a metal cylinder which is inserted in an opening and forms a bearing for some other object, as a shaft or valve. Often contracted to bush.

(Pipe Fitting.) A short tube with a screw cut inside and outside, used to screw into a pipe to reduce its diameter. Generally this type of bushing has a hexagonal head by which it is turned. More commonly termed reducer.

Business Car. A term frequently applied to a car used by railway officials while traveling. See Car and Private Car. Figs. 355, 2826.

Butt Hinge. A hinge for hanging doors, etc., which is fastened with screws to the edge of a door, so that when the latter is closed the hinge is folded up between the door and its frame. A hinge, the two parts of which are so fastened together that they cannot readily be detached is called a fast-joint butt hinge. A loose-pin butt hinge is one having a removable hinge pin, and a loose-joint butt hinge is one with which the doors may be lifted off of the hinges when desired.

By-Pass Valve. A valve which, either through manual control or automatically, will pass a gas or fluid through a direct route or an alternate route, as may become necessary in connection with the operation of the particular apparatus to which it is applied.

C

Cabin Car. A term sometimes applied to Caboose Cars. but more particularly to the four-wheeled type. See Caboose.

Cabinet Lock. It may be applied either to the inner edge of the door or drawer or be set into a mortise.

Cabinet locks vary from the cheapest type to the pin-tumbler type which gives the highest possible security.

Caboose or Caboose Car. A car which is attached to the rear of freight trains for the accommodation of the conductors and trainmen, and for carrying the various stores, tools, etc., required on freight trains. Sometimes called conductor's car, cabin car, train car, way car or can. See CAR. Figs. 311-322.

Caboose Deck or **Cupola Lamp.** A signal lamp used in a caboose cupola.

Café Car. A passenger equipment car having a kitchen, usually in the center, and one end arranged as a café or dining room, the other end being fitted for use as a parlor or smoking room. See CAR.

Café Coach. A combined day coach and café car. See KITCHEN CAR and LUNCH COUNTER CAR.

Café-Parlor Car or **Parlor-Café Car.** A combined café and parlor car.

Calcine Car. A hopper car specially designed to carry calcined ore. Fig. 2905.

Cam. A device used to convert rotary into reciprocating motion; commonly an eccentric disc.

Camber. The upward arching or bend of a beam, girder, or truss.

Candelabra. A term applied to an ornamental lamp; sometimes shaped like a candlestick.

Candle. A special candle of large diameter called car candle was at one time used for lighting passenger cars and burned in CANDLE LAMPS.

Candle Bracket Lamp (Pintsch System). For use in emergency, as in case gas gives out. May be attached to the wall or to any center lamp.

Candle Lamp. A lamp for burning candles, sometimes elaborated into a chandelier with two or three burners. Candles, however, are now almost never used except in emergency bracket lamp when the gas or electric lights fail. Fig. 2495.

Cane Car. A car usually having a superstructure of the rack type, provided with slat floors and having various provisions to facilitate the handling of sugar cane. They are sometimes constructed with the gondola body. Various types of cane cars are known as Side Discharge, End Discharge, Chain Lift, etc. See SUGAR CANE CAR. Figs. 2910-2930, 2947, 3043; Pages 1126, 1144.

Canopy. A term sometimes applied to the SMOKE BELL of a lamp. A platform hood is sometimes called a canopy. See LAMP CANOPY.

Cant Rail (British). American equivalent, plate. A horizontal timber running along the top of the upright pieces in the sides of the body, and supporting the roof and roof timbers. Its upper edge is cut to the bevel of the roof; hence its name.

Cantilever. A term sometimes, but not desirably, applied to a Cross Bearer. See CROSS BEARER.

Cantilever Cover Plate. See CROSS BEARER or CROSS TIE COVER PLATE.

Cantilever Diaphragm. See CROSS BEARER DIAPHRAGM.

Cantilever Truss (Overhang of Underframe). An inverted truss which bears upon the side sill directly over the body holster. The inner end is connected by a tie rod to the inner end of the truss at the other end of the car body, while the outer end supports the overhang of the underframe by a vertical tie rod and by a diagonal brace rod similar to the overhang truss rod of the old Pullman wooden framing.

Canvas. A coarse cloth, made of cotton, used for upholstering seats, and sometimes for the finish of the ceiling of passenger cars when it is painted or otherwise decorated. Roofing canvas is also used for covering passenger equipment cars.

Car. A vehicle used on railways for the transportation of passengers or material. See BOX CAR, AUTOMOBILE CAR, etc. Figs. 1-569, 2587, 2588, 2597-2599-2741, 2825-3046.

Car Axle. See AXLE.

Car Box. A JOURNAL BOX.

Car Closet. See DRY CLOSET and WATER CLOSET.

Car Construction. Reports of the committee on car construction will be found in the 1913 M. C. B. Proceedings, page 613; 1914 Proceedings, page 389; 1915 Proceedings, page 351; and 1916 Proceedings, page 371. See pages 363-371.

Car Discharge Valve (Train Air Signal Apparatus). A valve placed in the end of the car and connected with the signal cord. When the cord is pulled the car discharge valve is opened and air escapes, resulting, through the construction of the apparatus, in the blowing of the signal whistle in the locomotive or motorman's cab. See TRAIN AIR SIGNAL APPARATUS.

Car Door Sheave. See DOOR SHEAVE.

Car Drain Cup (Air Brake). An attachment to the brake pipe of a car to collect the water of condensation, which is drawn off from time to time through a hole at the bottom closed by a plug; it is usually combined with an air strainer and so called.

Car Dumping Machine. Pages 965, 997.

Car Heater. Any apparatus for heating cars by convection; that is, by conveying hot water, steam or warmed air into, or through, the car. It generally refers to any arrangement for warming cars other than stoves. With most steam heating systems the steam is taken from the locomotive, but in many cases a heater is supplied to the car to take care of emergencies. See PASSENGER TRAIN HEATING, BAKER CAR HEATER.

Car Lighting. See ELECTRIC LIGHTING, TRAIN LIGHTING.

Car Moldings. See MOLDING.

Car Receptacle. A device placed on a car for use in charging storage batteries. A connector carries the current from a charging plug to the car receptacle, from which it enters the batteries.

Car Replacer. A device for getting a derailed truck back on the track. It usually consists of an inclined plane or a curved surface, by which the wheels are raised when the car is pulled, so that the flange of the outside wheel can ride upon and over the rail. Figs. 2639-2643.

Car Repairs. See pages 1145-1176.

Car Roof. A covering for a car supported by carlines and purlins. Several types of roofs are used on freight cars. A double board roof may be built, with or without felt or other material between the boards. Inside metal roofs are formed of metal protected by a covering of roughly matched boards. Outside metal roofs have a metal covering over a single layer of roof boards. Metallic or all-metal roofs use metal only in their construction. See PLASTIC CAR ROOF.

Passenger car roofs are usually covered with can-

vas, tin, galvanized iron or steel sheets. See Arched Roof, "A" Car Roof.

The report of the committee on car framing, roofs and doors in the 1910 M. C. B. Proceedings, page 397, contains certain recommendations as to the construction of car roofs. Figs. 725-772; Pages 421, 425, 427, 429, 431, 435.

Car Seal. A device to secure freight car doors against opening by making it impossible to do so without destroying the seal. Figs. 683, 686, 687.

Car Seat. The complete set of fixtures on which passengers sit in a car. It ordinarily consists of a seat frame, seat cushions, seat back, arm rest, foot rest, and their attachments. Ordinarily, the seats in American cars are placed crosswise of the car, and are made for two passengers. The backs of the seats are generally made reversible. The seats of parlor cars are commonly called chairs, and are usually revolving. In private and parlor cars, sofas, placed longitudinally against the side of the car, are sometimes used. In order to give an inclination to the seats which makes them more comfortable, various devices have been introduced. See Glideover Seat, Parlor Car Chair, Reclining Chair, Reversible Car Seat, Rocker Car Seat, Walkover Seat. Figs. 993-1028; Pages 482, 483, 485.

Car Seating Covering. Pages 963, 969.

Car Seat Moldings. Metal Bands, usually used to finish seat backs. See Molding.

Car Signal Valve (Train Air Signal Apparatus). A Car Discharge Valve.

Car Spring. A general term applied to springs on which the weight of a car rests. See also Bolster Spring, Elliptic Spring, Spiral Spring, Spring. See Figs. 1650-1686; Pages 705-712, 713, 714, 715, 716, 717, 718.

Car Steps. See Platform Steps.

Car Wheel. See Wheel.

Carburetor. See Vapor System.

Card Board. A small board, secured to the outside of a freight car, on which are tacked cards giving shipping directions or warning of dangerous lading, etc.

Card Rack. A small receptacle on the outside of a freight car to receive cards giving shipping directions.

Carline. Bars of wood or iron which extend across the top of a car from one side to the other, and support the roof. In passenger cars carlines are divided into main carlines; passing entirely across the car; short carlines or deck carlines, which are confined to the upper deck, and rafters, which are confined to the lower deck. The main carlines are usually compound, i. e., built up of wood and iron. They sometimes pass directly from side to side of the car across and under the upper deck, when they are termed continuous or straight carlines, but usually they are bent to the outline of the clere-story and are termed profile carlines. Figs. 758-768. Other carlines having special names are: Compound Carline, End Carline, Platform Hood Carline, Platform Roof Carline, Platform Roof End Carline.

Carline Knee Iron. An angle iron which connects the end carline to the plate. Also termed inside corner iron.

Carpet Eyelet. See Eyelet.

Carpet Knob. An Eyelet Nail.

Carriage Bolt. A bolt made square under the head so as to prevent it from turning when in its place. They have button-shaped heads and are used for fastening wooden pieces together.

Carry Iron. See Drawbar Carry Iron, Draft Gear Carry Iron.

Cartridge (Acetylene Gas Lighting). A cylinder used for holding carbide in the generation of the gas.

Casing. See Window Casing.

Caster. A small wheel on a swivel attached to furniture and on which it is rolled on the floor.

Casting. Any piece of metal which has been cast in a mold.

Castle Nut. A nut having several slots cut crosswise in the upper portion. The nut is screwed on a bolt so that one of the slots coincides with a hole through the bolt. A cotter pin is then inserted, thus securing the nut. Figs. 2782, 2812; Pages 1081, 1086.

Catch. A device to prevent a gate, door or window from opening.

Catch Lever (Three-Stem Equipment). A crank lever passing vertically through the catch, by means of which it is caused to release the knuckle for uncoupling.

Catch Spring (Three-Stem Equipment). A coiled spring on the catch spring bolt operating the catch.

Cattle Car. More properly Stock Car.

Ceiling. The inside or under surface of the roof or covering of a car. This term is sometimes used to mean Sheathing. The ceiling of a passenger car is generally termed Head Lining. Deafening Ceiling is boarding under the sills of a car, the space between it and the floor being either left empty or filled with shavings, or some similar substance to deaden the noise of the wheels. See Agasote, Head Lining, Lignomur. Page 963.

Ceiling Furring. Strips or pieces fastened to the under side of the carlines, to which the paneling or veneering of the ceiling is applied.

Ceiling Veneers. Thin boards with which the ceilings of passenger cars are covered. The term is also misapplied to the thin preparations of papier maché, etc., in imitation of natural wood veneers. See Veneer.

Cell. An electro-chemical device for producing electrical energy, consisting of two metaloid elements immersed in a liquid electrolyte. When the two plates are connected by an exterior conductor a current of electricity is caused to flow from one element to the other through the liquid electrolyte and the exterior circuit. Such a device is called a voltaic or primary cell. A group of such cells connected is called a battery and a single cell is also commonly referred to as a battery. The parts of the elements are referred to as a plate or electrode. See Storage Battery.

Center Anchor. An arrangement of plates, which are riveted to the tank and to the center sills at the center of a tank car. These plates anchor the tank to the frame and supplant head blocks and double anchors at the ends. Fig. 292; Pages 243, 267.

Center Axle Guard. The axle guard for the center axle of a six-wheel truck. See Axle Guard.

Center Bearing. The place in the center of a truck where the weight of the body rests. A body center plate attached to the car body here rests on a truck center plate attached to the truck. The general term

center bearing is used to designate the whole arrangement and the functions which it performs, in distinction from Side Bearing. See also CENTER PLATE. Figs. 1464-1469; Page 656.

Center Bearing Arch Bar. See CENTER BEARING BRIDGE.

Center Bearing Beam. See CENTER BEARING BRIDGE.

Center Bearing Bridge (Six-Wheel Trucks). A structure formed by the top and bottom center bearing arch bars to support the center plate block or center bearing beam and transmit the weight of the car to the bolsters, on which its extremities rest.

Center Block Column. A column placed on top of the center plate block or bearing beam, and between it and the center bearing arch bar.

Center Buffer Spring. A spiral spring situated above the draft springs in some forms of passenger draft gear and intended for buffing purposes only.

Center Buffer Stem. See BUFFER STEM.

Center Compression Beam Brace. In wooden passenger equipment car framing, a brace for the compression beam in the center of the side truss.

Center Counterbrace. A counterbrace in the body of the car between the trucks, to stiffen a compression beam brace. See also COUNTERBRACE.

Center Cross Beam. A cross timber framed into the two intermediate sills of a coal or ore car, to which the center doors are hung.

Center Cross Beam Cap. A cap piece to cover the center cross beam.

Center Cross Tie Timber. A cross tie timber in the middle of a car, generally placed between the double drop doors of a gondola car.

Center Door Rail. See MIDDLE DOOR RAIL.

Center Draft Drawbar. A drawbar which is connected directly with the king bolt of a truck. It is especially designed for use on very sharp curves. Sometimes termed radial draw-gear.

Center Draft Tube (Argand Lamp). The hollow passage for air in the center of the burner.

Center Dump Car. A car which will discharge its entire load between the rails. See also CONVERTIBLE CAR.

Center Floor Timbers. The CENTER SILLS.

Center Frame. See TRUCK CENTER FRAME.

Center Girth. See DOOR CENTER GIRTH.

Center Pin or **King Bolt.** A large bolt which passes through the center plates on the body bolster and truck bolster. The truck turns about the bolt, but the stress is taken by the center plates. It is, therefore, a mere pin and not a bolt in the usual sense. The name king bolt is derived from the name of the corresponding part of the front wheels of a wagon. Center pin, however, is the more common term. Fig. 1469.

Center Pin Floor Plate. A plate or casting set into the floor of a passenger equipment car to cover the head of the center pin.

Center Plate. One of a pair of plates which fit one into the other and which support the car body on the trucks, allowing them to turn freely under the car. The center pin or king bolt passes through both, but does not really serve as a pivot. The body center plate or male center plate is attached to the under side of the body bolster or in cast steel bolsters is made an integral part of the casting. The female or truck center plate is attached to the top side of, or cast integral with, the truck bolster. When the car is tilted, as on a curve, part of the weight is carried on the SIDE BEARINGS. See ANTI-FRICTION, BALL BEARING and ROLLER CENTER PLATES. Figs. 1464-1469; Page 656.

Center Plate Block. The member supporting the center plate of a six-wheel truck.

Center Rod (Postal Car). A device which fits in a socket at the top of the pedestals, and to which the ends of the two rods, which support the distributing trays, etc., near the center of the car, are fastened.

Center Sill. The central main longitudinal members of the underframe of a car which are usually close together in the center of the car. They form as it were the backbone of the underframe and transmit most of the buffing shocks from end to end of the car. In steel underframe cars the center sills are usually heavy I-beams, channels, deep built-up fish-belly girders or pressed steel fish-belly girders, often with reinforcing flange angles. See CENTER SILL WEB PLATE, CENTER SILL BOTTOM ANGLE, and CENTER SILL COVER PLATE. Figs. 277, 278, 571-573.

Center Sill Bottom Angle. The angle at the bottom of a center sill of the built-up type.

Center Sill Bottom Cover Plate. See CENTER SILL COVER PLATE.

Center Sill Cover Plate. A flat plate riveted across steel center sills, either above or below, to give additional strength.

Center Sills, Splicing of. Figs. 571-573.

Center Sill Stiffener. A filling piece riveted between the center sills to act as a brace for holding them rigid.

Center Sill Top Angle. The angle at the top of a center sill of the built-up type.

Center Sill Top Cover Plate. See CENTER SILL COVER PLATE.

Center Sill Web Plate. The plate which forms the web of a center sill of the built-up type.

Center Stay (of a Chandelier). The central support around which the lamps are grouped. In some cases it is the only method of attaching the chandelier to the ceiling, and in others there are several inclined roof braces or vertical lamp arms in addition.

Center Stop (Tip Car). A bracket or block attached to a draw timber to restrain the body from moving longitudinally.

Centering Device. See DRAWBAR CENTERING DEVICE.

Centering Gage. A gage to fix the middle point of an axle.

Central Filling Piece (Steel Tired Wheels). The part surrounding the hub and connecting it with the tire. Also termed the skeleton. A wheel center is a hub and central filling piece combined.

Centrifugal Dirt Collector. A device connected in the branch pipe between the brake pipe and distributing valve, or triple valve, and so constructed that due to the combined action of centrifugal force and gravity, all dirt and foreign material is automatically eliminated from the air flowing through the collector chamber and by means of a plug may be removed without breaking any pipe connections whatever. When this device is used, the brake pipe air strainer may be omitted. Fig. 1872.

Chafing Plate. A metal plate to resist wear, used on truck transoms, etc. Figs. 1393.

Chain. A series of links or rings connected or fitted into one another, usually made of some kind of metal. See BERTH CHAIN, BRAKE CHAIN, CHAIN DRIVE, CHECK CHAIN, HAND BRAKE CHAIN, SAFETY CHAIN, etc. Fig. 2780.

Chain Drive. A series of metal links used in place of solid belts to drive machinery.

Chain Holder (for Basin Plug). A stanchion provided with a screw thread and nut for passing through the marble slab. Also called a chain post, or chain stay.

Chain Post or Stay. See CHAIN HOLDER.

Chain, Specifications for. Pages 1076-1078.

Chair. The usual designation for the seats of parlor cars. Ordinary chairs are used in dining cars. See RECLINING CHAIR, REVOLVING CHAIR.

Chair Arm Plate. A metal plate for the top of a chair arm. If for passenger car seats, it is called an arm cap.

Chair Car. A day coach or passenger car equipped with reclining chairs, providing more comforts than a day coach for passengers traveling at night who do not desire to use a sleeping car. See PASSENGER CAR. Figs. 352, 353.

Chandelier. A lamp or lamps having an elaborate form of suspension from a roof or ceiling.

Changeover Valve (Air Brakes). A valve used with double capacity brakes to enable changing from "empty" to "load" brake. Figs. 1899, 1902-1904; Page 785.

Channel. A rolled steel commercial bar shaped like a trough or channel. It is extensively used in steel car construction.

Channel Section Bolster. A bolster whose cross section has the shape of a channel.

Chapel Car. A car whose interior is arranged as a chapel.

Chaplet. A piece of metal, usually formed of thin wire or thin perforated sheets, used in a mold for a casting, to hold a core in its place.

Charging Car. Figs. 2988, 3012, 3014.

Charging Plug. An electric fitting or connection device to which wires leading to a yard charging plant or electric-light circuit are attached. The plug is made to fit the receptacle in such a manner that the positive wire from the charging plant will invariably be connected to the positive battery wire. By inserting the plug in the receptacle the battery on the car may be connected with and charged from the stationary charging plant. These devices are used principally in straight storage work where no generating plant is carried on the car. Figs. 2266, 2267.

Charging Receptacle. An electric fitting or connection device attached to the under side of the car body from which wires lead to the storage battery. There is generally one on each side of a car. Figs. 2266, 2267.

Check Chain or Safety Chain. A chain attached to a truck and the body of a car to prevent the former from swinging crosswise on the track in case of derailment. Such chains are usually attached either to two or to each of the four corners of a truck and to the sills of the cars. See SAFETY CHAIN.

Check Chain Chafing Plate. A plate attached to a truck timber to resist the wear of a Check Chain.

Check Valve (Triple Valve). The valve under the emergency valve which prevents the escape of brake cylinder pressure back into the train line when a hose bursts or the train parts. In an emergency application the emergency valve opens and allows the brake pipe pressure to enter the brake cylinder through the check value which is raised off its seat. Figs. 1973-1975.

Check Valve Case (Triple Valve). See CHECK VALVE.

Cheek Casting. See DRAFT CASTING.

Chill. A kind of crystallization produced when melted cast iron is cooled suddenly. It is usually accomplished by bringing the molten iron in contact with a cold metal (usually iron) mold. The hardened part of a cast iron car wheel is called the chill. The mold in which a chill is produced is sometimes called a chill, but the name chill mold has been given to this. See WHEELS, SPECIFICATIONS FOR.

Chill Crack. An irregular crack developed upon the chilled surface of the tread of car wheels in the process of casting. See WHEELS, SPECIFICATIONS FOR.

Chimney (Gas Lamps). See MICA CHIMNEY.

Chipping (of Chilled Car Wheels). A scaling off of small portions of the chilled metal, due to imperfect or irregular crystallization. See WHEELS, SPECIFICATIONS FOR.

Chock or Chock Piece. In shipbuilding a wedge or triangular-shaped block or timber used to unite the head and heel of consecutive timbers. Also intended as a filling piece to give form or shape. Hence in a snow plow a timber which joins successive timbers, and fills to give shape.

Chock Block. A triangular piece used on the bunk of a logging truck to hold the logs in place.

Chord (of a Truss). The long horizontal members at the top and bottom of a truss. The side sills and plates of a car body are top and bottom chords of the side trusses, but the terms are not used in car building.

Cinder Deflector. See DUST DEFLECTOR.

Circuit Breaker. A device for automatically opening the circuit from the trolley or third rail shoe to the controller when the current exceeds a predetermined amount. Figs. 499, 500, 527, 528, 537.

Circuit Breaker Cylinder. A cylinder included in the Safety Control Equipment, which, when air is admitted to it through the action of the controller pilot valve, operates to open the circuit breaker and thereby break the power circuit.

Circulating Drum (Baker Heater). A cast iron vessel with hemispherical ends, on top or inside of the car, filled with water, and connected by two pipes with the coil in the stove and with the pipes which extend through the car. As the water in the coil becomes heated it ascends to the drum, and from there it descends through the other pipe to the radiating pipes in the car. After passing through them it is brought back by return pipes to the coil, when it is again heated. Thus a continuous circulation is kept up. Also called expansion drum. Not used in modern railway cars.

Circulating Pipes (Car Heaters). A general name for the pipes which carry the steam or heated water through the car and return it again to the heater. The term radiating pipes is also used.

Circumference Measure, Wheels. Fig. 1599; Pages 691, 1176.

Clam Shell Bucket. A form of digging or shoveling apparatus, operated by power, and taking its name from its similarity to a clam shell. Page 996.

Clamp. A device for holding or binding two or more parts together. See PIPE CLAMP, HOSE CLAMP.

(Carpentry.) A frame with two tightening screws, by which two portions of an article are tightly compressed together, either while being formed or while their glue joint is drying.

Clamp Lock (Steam Couplers). A COUPLER LATCH.

Clasp Brake. An application of brakes in which two brake shoes are used on each wheel, and opposite to each other, instead of one brake shoe per wheel as is the ordinary practice. The brake pressure per square inch of bearing service is thus greatly reduced. Used on heavy high speed passenger train cars. Figs. 1856-1859, 1861-1866, 1868, Page 766.

Classification of Cars. See CAR.

Claw Jack. A jack having a step or projection at the bottom of the movable column, used when a bearing close to the ground is required. A foot lift jack.

Cleaning Air Brakes. See AIR BRAKE CLEANING AND TESTING OF.

Cleaning Passenger Cars. See PASSENGER CAR CLEANING.

Clearance or **Clearance Limit.** The limiting dimensions of height and width for cars in order that they may safely clear all bridges, tunnels, station platforms and other structures. See also THIRD RAIL CLEARANCES. Figs. 2742, 2743.

Clearance Car. A car with a light frame built out on all sides to the extreme width and height required for any car that is to pass over the road. The clearance car is used to ascertain the maximum cross-section of tunnels, bridges, etc., over a road so that cars can be built within the limits determined by the clearance car. Figs. 2738-2741.

Cleat. A strip of wood or iron fastened across other material.

Clere-Story. See DECK.

Clevis. A stirrup-shaped metallic strap used in connection with a pin to connect a draft chain or tree to a plow or other tool. The term is applied to various kinds of irons resembling a plow clevis in shape, and also to bolts with forked ends.

Clip. A U-shaped strap for attaching any body, more particularly a pipe, to the side of a partition. More broadly a device permanently attached to one part, whose function it is to hold another part in place which can readily be slipped into position. See RELEASE SPRING CLIP, PIPE CLIP.

Close Return Bend. A short cast iron tube made in a U shape, for uniting the ends of two pipes. It differs from an open return bend in having the two branches in contact with each other.

Closet. A small room, usually for storage.

A retiring room more commonly called a SALOON. See also DRY CLOSET and WATER CLOSET. Figs. 1072-1083; Pages 495, 956.

Closet Hopper. See HOPPER.

Club Car. See LOUNGING CAR.

Coach. A term commonly used to designate passenger cars which are used for day travel. See CAR; PASSENGER CAR. Figs. 323-348, 2825-2836; Pages 314, 964.

Coach Screw. See LAG SCREW.

Coal Car. A car for carrying coal; usually a hopper or gondola car, but box and stock cars are frequently used for this purpose. See also CAR.

Cock. A spout; an instrument to draw out or discharge liquid from a cask, vat or pipe. See BIBB COCK, MAIN COCK, FAUCET.

Coil Spring. See HELICAL SPRING.

Coke Car. A car of large cubic capacity for carrying coke. Modified forms of hopper cars with doors which discharge the load to one or both sides of the track are commonly used. Frequently a coke rack is applied to the sides of gondola cars. Box and stock cars are often used for carrying coke. See CAR, and COKE RACK. Fig. 2865.

Coke Quenching Car. A car with an inclined floor, into which coke is discharged from the furnace and quenched with water. Fig. 2865.

Coke Rack. A slatted frame or box applied above the sides and ends of gondola cars to increase the cubic capacity for the purpose of carrying coke or other freight in which the bulk is large relative to the weight.

Coke Rack Angle. A commercial angle used in forming the coke rack on a steel coke car. Commonly termed end and side coke rack angles, and further designated top, center, intermediate or bottom, as the case may be.

Coke Rack Stake Pocket. A metal socket fastened to the sides and ends of a gondola car to receive the stakes of a coke rack.

Cold Shot. Small globules of iron resembling ordinary gun shot, which are found in the chilled portion of cast iron wheels. Caused by a cold-shot when the metal is poured into the mold.

Cold-Short. A seam in a casting caused by the congealing of the metal so rapidly as to prevent a proper filling of the mold.

Collar. A ring or round flange upon or against an object.

(Of a Journal.) A rim or enlargement on the end of the car axle which takes the end thrust of the journal bearing.

Colonist Sleeping Car. See EMIGRANT SLEEPING CAR, SLEEPING CAR.

Color Coat (Painting). The coat or coats which follows the rough stuff or scraping filling coat in painting passenger car bodies. See FINISHING VARNISH and PAINTING. Pages 1058-1064.

Column (Diamond and Other Trucks). Another name for a BOLSTER GUIDE BAR.

(Of Crane.) Another name for the mast, particularly when entirely supported from below.

Column Bolt. A bolt passing through the arch bars and holding the truck column or bolster guide bar in place and the truck frame together.

Combination Baggage Car. A baggage car having compartments for express or mail, or both, as well as for baggage. See COMBINATION CAR.

Combination Car or **Combined Car.** A passenger train car divided into two or more compartments for the accommodation of different classes of traffic. See CAR.

Combination Cock (Baker Heater). A cock with funnel attached, used at the top of the water tank for filling.

When opened with the key it allows the inward passage of the water, and at the same time the outward passage of air through a separate channel, hence the name.

Combination Lamp. A lamp arranged for two lighting systems, as gas and electricity.

Combination Support and Safety Device. Consists of a combination of rigid safety guard and a flexible brake beam support. Figs. 1845-1855.

Combination Valve (Steam Heating).

Combined Platform and Double Body Bolster. A passenger equipment car platform frame and double body bolster made in one piece. See Double Body Bolster and Body Bolster.

Combined Stop and Lock. See Door Stop.

Combined Triple Valve, Reservoir and Brake Cylinder (Freight Air Brake). To lessen the complication and reduce the cost of freight brake gear these three parts, which are separate in passenger brake gear, are combined.

Commutator. See Armature, Bolted Commutator.

Commutation-Pole Motor. A railway motor in which four auxiliary coils and pole pieces, called commutating poles, are mounted between the four main field poles. The windings of these poles are connected in series with each other and with the armature. The commutation is improved and the poles perform their functions equally well regardless of the direction in which the motor is run. See also Armature. Figs. 490-521.

Compartment. A subdivision of a passenger car. In American parlor and sleeping cars, when used, it runs only partially across, leaving room for a passage or corridor at the side. Often called Stateroom. In British railway carriages it usually runs entirely across the car.

Compartment Sleeping Car. A sleeping car which is divided into staterooms all opening into a common corridor which runs the whole length of the car. See Sleeping Car.

Compensating Valve. A valve designed for use on high speed trains to regulate the brake cylinder pressure so that the maximum retarding power may be obtained without injury to the wheels. Fig. 1944; Page 769.

Composite Car. A freight car with a combination steel and wood frame.

Composite Framing. A type of framing which combines iron and wood, in the sills, posts, plates, etc. The sills and plates of the body and deck consist of two pieces of wood with an iron or steel flitch plate between, the three pieces being bolted together as one.

Compound Carline. A carline having the main or central portion of wrought iron, with a piece of wood on each side. Commonly used for wooden cars with clerestories, and sometimes called profile carline, owing to their following the shape of the clere-story.

Compressed Air Jack. See Pneumatic Jack.

Compression Beam. A horizontal timber in the side framing of a wooden passenger-equipment car body, which acts as the compression member of a truss. The compression beam brace abuts it. The compression beam is sometimes made double, one piece above the other, with separate braces (main compression brace and center compression brace) acting upon each. See End Compression Beam.

Compression Beam Brace. A timber used in connection with a compression beam to form a truss in the side framing of a wooden passenger-equipment car. It is sometimes stiffened by a center counter brace, and sometimes two or more braces are used. It is then termed main compression brace.

Compression Faucet. A spring faucet with a flat disc on top. The valve is opened by pressing this disc and closed by a spring when the pressure is removed.

Compression Member. Any bar, beam, brace, etc., which is subjected to strains of compression, and forms part of a frame truss, beam, girder, etc. Struts, body braces, etc., are compression members. Similarly a tension member is used for tensile strains.

Concealing Water Closet. A form of closet covered with a small seat and sometimes placed in the corner of compartments or staterooms in private and sleeping cars.

Condensation Meter (Car Heating). A device for measuring the steam consumption of car heating systems.

Conductor (Refrigerator Car). The drip pipe from the ice pan.

Conductor's Car. A Caboose Car.

Conductor's Lantern. One with an extra-sized bail attached to it by which it can be held on the arm, leaving the hands free.

Conductor's Switch. A device used in connection with electro-pneumatic air signal equipments for traction roads, which, when the signal cord is pulled, energizes the signal magnet, opening the magnet valve and admitting air to the signal whistle.

Conductor's Valve. A valve for applying the train brakes and placed at some convenient point in each passenger car, usually in the saloon. Figs. 1938, 1978.

Conductor's Valve Discharge Pipe. A pipe leading from the conductor's valve down through the floor of the car to carry off the escaping air.

Conductor's Valve Pipe. Connects the brake pipe with the conductor's valve.

Conduit, Electric Wiring. A light weight iron pipe treated with a rust preventative consisting of a compound, galvanizing or sherardizing. Used to protect insulated electric wires from injury. Figs. 2485-2491; Page 943.

Connecting Chain (Steam Shovel). A pitch chain, connecting the pitch gear on the two axles of a truck, used for making the car self-propelling.

Connecting Rod. A rod which connects two or more parts or objects.

(Hand Car.) The iron rod which connects the bell crank and the crank shaft. See Brake Rod.

Connections. See Steam Heat and Air Connections, and Automatic Connectors.

Connection Angle. A piece of commercial angle or a bent plate riveted to two members of a steel frame to hold them rigidly together.

Connection Clip. See Connection Angle.

Construction Car. A car used in building a new line of railroad or making repairs to roadbed and structures. The cars used as eating and sleeping cars for the men employed on construction work are frequently placed under this heading, as well as ballast cars, etc. See Ballast Car, Contractor's Car, Industrial Cars.

Contactor. A magnetic switch used to make or break a circuit in a motor control system. See AUXILIARY CONTACTOR and CONTROL SYSTEM.

Container Car. A flat car equipped with a number of removable containers which may be lifted off the car and transported by dray or auto truck to any desired destination remote from the rail line. Figs. 35-37.

Continuous Basket Rack. See BASKET RACK.

Continuous Brake. A system of brakes so arranged that by connecting the brake apparatus on the different cars forming a train it can be operated on all of them from the engine or from any of the cars. See AIR BRAKE, VACUUM BRAKE.

Continuous Carline. A carline, which passes directly from side to side of the car, across and under the clere-story or upper deck, in distinction from a profile carline, which is bent to follow the outline of the clere-story.

Continuous Draft Gear. A draft gear, having a continuous rod or rods extending throughout the length of the car from the drawbar at one end to the drawbar at the other end, whose office is to transmit the tractive stresses and relieve the draft timbers. See AMERICAN CONTINUOUS DRAFT AND BUFFING APPARATUS.

Continuous Truck Frame. An iron bar which is welded together in a rectangular shape so as to form the sides and ends of a truck frame.

Contractor's Car. A car used by contractors in construction work; usually a dump car. See DUMP CAR.

Controller (Electric Motor Car). A device for regulating the speed and direction of rotation of the electric motors.

Control System. See MULTIPLE UNIT CONTROL, UNIT SWITCH CONTROL.

Control Valve (Air Brake). A device which performs all the functions of the triple valve and, in addition, provides a maintained brake cylinder pressure; automatic emergency should the brake pipe pressure be depleted below a predetermined point; full emergency braking power at any time during or following a service application; and maximum braking power more quickly than by the use of the triple valve. Figs. 1918, 1919.

Controller Pilot Valve. A valve, included in the Safety Control Equipment, which, when the motorman removes his hand from the controller handle for any reason, as by accident or through carelessness, operates through the coincident action of other devices to break the power circuit and cause an emergency application of the brakes.

Convertible Car. A car so built that it may be converted without reconstruction, from one type to another, as stock to box or center dump gondola to side dump gondola. Figs. 73-93, 191-193; Pages 144, 145, 149.

This term is also applied to a type of street cars which may be used either as open or closed cars.

Conveyor Car. A freight car equipped with motors for moving freight under special conditions, as on a coal wharf.

Cooking Utensils. For use on dining, café-parlor, buffet cars, etc.

Cope. The upper portion of a mold or flash used in making metal castings.

Core Oven Car. Fig. 3024.

Corner Angle Post. A corner post in the body framing of a car which consists of an angle bar, sometimes in combination with a wooden post.

Corner Brace. A diagonal member in the underframe between the end sill and transverse floor member or bolster. See END SILL DIAGONAL BRACE.

Corner Brace or **Corner Plate** (Freight Car Bodies). A wrought or cast iron angle plate or knee on the outside corner, to strengthen and protect the frame. There are usually three corner plates, upper, lower and middle. Very commonly a push pole pocket is combined with lower corner plate. Also used on the inside corners.

(Passenger Equipment Car End Framing.) An angle iron applied to the corner of the deck end plate to protect it from abrasion and to strengthen it.

Corner Casting. Usually a CORNER PLATE or PUSH POLE POCKET.

Corner Handle. More commonly a HAND HOLD or GRAB IRON.

Corner Plate. See CORNER BRACE.

Corner Post. The vertical member which forms the corner of the frame of a car body.

Corner Post Grab Iron. See GRAB IRONS.

Corner Post Knee Iron (Passenger Equipment Car End Framing). A metal angle brace used to connect the foot of the corner post to the side sill.

(Vestibule.) An iron angle brace for the outside corner post of a vestibule resting upon the platform end sill.

Corner Post Pocket. The pocket for the corner post. See POST POCKET.

Corner Seat. A seat for the corner of a car, the back of which is not reversible.

Corner Seat End. A seat end bracket secured to the wall of a passenger car for supporting the outer end of a CORNER SEAT.

Cornice. The moldings where the ceiling or headlining joins the sides and ends of the car inside.

Cornice Sub-Fascia or **Panel.** A board or panel directly below a cornice.

Corridor (Sleeping and Compartment Cars). A passage running at one side of a car affording access to the compartments. All sleeping, dining and private cars have corridors to pass the staterooms, smoking compartments, etc.

Corrugated Metal Car Roof (Freight Cars). A roof consisting of iron, steel or zinc plates usually covered with boards, and resting on roof strips on top of the carlines. See ROOFS.

Corticine. A form of floor covering.

Cotter Pin. A split pin placed in a hole through the end of a bolt, axle, or shaft, and the ends of the pin forced apart to prevent it being withdrawn or lost. Its purpose is to prevent the loss of nut, washer, or plate. See SPLIT KEY.

Counterbore. An enlargement, for a certain portion of its length, of a smaller hole bored in any piece of material to receive a bolt or pin. The counterbore is made of sufficient depth to allow the head or the nut to come below the surface of the piece.

Counterbrace. In passenger equipment car framing, the

timber framed into the top of the side sill near the needle beam and supporting the compression beam brace into which it is also framed.

Counterbrace Rod. An inclined rod which acts as a counterbrace.

Counterbrace Rod Plate Washers. Washers that rest upon the plate and receive the end of the counterbrace rod.

Coupler (Car). The term applied to the modern drawbar. The coupler proper is the head of the drawbar, which is so constructed as to automatically connect with or couple to the drawbar head on another car. The drawbar and its head, together with its knuckle and locking devices, is commonly termed coupler. Figs. 1229-1323, 1340-1342; Pages 557-564, 570-573, 575, 579, 580, 583, 591, 599, 955.

(Electric.) A device attached to the end of a car including insulated metallic contacts for the connection of electric circuits between cars, generally used for connection of trail car lighting, heating or signal circuits to the motor car. See CONTROL MULTIPLE UNIT SYSTEM.

The term coupler or coupling is also commonly applied to the connector which is used on air brake and steam heat hose. See also AUTOMATIC CONNECTOR, STEAM HOSE COUPLER.

Coupler, Automatic Car, Uncoupling Arrangements for. See UNCOUPLING ARRANGEMENTS.

Coupler Butt. See COUPLER.

Coupler Carrier. See DRAWBAR CARRY IRON.

Coupler Carry Iron. See DRAWBAR CARRY IRON.

Coupler Centering Device. See DRAWBAR CENTERING DEVICE.

Coupler, Electric. A device attached to the end of a car including insulated metallic contacts for the connection of electric circuits between cars, generally used for connection of trail car lighting, heating or signal circuits to the motor car. See CONTROL SYSTEM.

Coupler, Emergency. See EMERGENCY COUPLING DEVICE.

Coupler Head. See COUPLER.

Coupler Horn. The projecting lug cast on the head of the coupler which bears on the face of the end sill or dead wood when the draft gear is closed solid. Also called striking horn. See COUPLER, BUFFER SAFETY LUG.

Coupler Jumper. Two coupler plugs connected by an insulated flexible cable. See MULTIPLE UNIT CONTROL SYSTEM.

Coupler Latch (Steam Coupler). A catch to lock the steam hose couplers together and prevent accidental parting in rounding sharp curves.

Coupler Knuckle. See KNUCKLE.

Coupler Knuckle Kicker. A knuckle opener.

Coupler Knuckle Lock. The block which drops into position when the knuckle closes and holds it in place, preventing uncoupling.

Coupler Knuckle Opener. The device which throws the knuckle open when the lock is lifted so that a coupling can be made. With couplers not having a knuckle opener it is necessary to go in between the cars and pull the knuckle open by hand after the lock has been lifted. See COUPLER.

Coupler Knuckle Pin. See KNUCKLE PIN.

Coupler Lock Lifter. The part of the mechanism inside the coupler head which is moved by the uncoupling rod and in moving lifts the knuckle lock so that the knuckle can open. Also designated as COUPLER LOCK LIFT. See COUPLER.

Coupler Lock Set. A device by which the knuckle lock when lifted is held in a raised position until the knuckle is opened, when it allows the lock to drop back into position for automatically coupling when the cars are brought together. See COUPLER.

Coupler Locking Pin Trigger. See COUPLER.

Coupler Pocket. A casting having a rectangular pocket, to receive the coupler shank, which is bolted or riveted to the end sill, sometimes having a means of adjustment. See COUPLER.

Coupler Plug. A movable coupler designed to engage and connect to a coupler socket. See CONTROL MULTIPLE UNIT SYSTEM.

Coupler Release Rigging. See UNCOUPLING LEVER.

Coupler Rightener. See DRAWBAR CENTERING DEVICE.

Coupler Socket. A fixed electric coupler. See CONTROL MULTIPLE UNIT SYSTEM.

Coupler Tests. See COUPLER.

Coupler Wall, Area of Bearing Surface of Lock on. See COUPLER.

Couplers, Worn, Gages for. See COUPLER.

Coupler and Yoke, Gages for. See COUPLER.

Coupler Yoke. The yoke or strap that surrounds the draft gear and is riveted or keyed to the end of the coupler shank or drawbar. See COUPLERS. Figs. 1085, 1122-1131, 1186-1125, 1342; Pages 542, 543, 549, 553, 555.

Couplet (of Springs). Two elliptic springs placed side by side, to act as one spring. Three springs united in this way form a triplet, four a quadruplet, five a quintuplet, six a sextuplet.

Coupling Chain. See SAFETY CHAIN.

Coupling Link. A wrought iron link or open bar by which freight cars are coupled together by coupling pins. Chain coupling links are used with draw hooks. In consequence of the danger to trainmen attending the use of coupling links, and legislation forbidding their use, this type of coupling is not in use on standard gage American railroads. See COUPLER.

Coupling Pin. A round bar of iron with which a coupling link is connected to a drawbar. Now almost obsolete because of the use of automatic couplers.

Coupling Pin Chain. A small chain attached to the car by a suitable eye to prevent the coupling pin from being lost.

Cover. See JOURNAL BOX COVER, MANHOLE COVER, etc.

Cover Plate. In metal underframes for cars a plate which is riveted to the flanges of the center sills to give them additional vertical strength as in a box girder. The plate riveted to the top flanges is called a top cover plate and one riveted to the bottom flanges a bottom cover plate. See CENTER SILL BOTTOM COVER PLATE and CENTER SILL TOP COVER PLATE.

Cover Strip (Refrigerator Car). Metal plates covering a gutter in the floor.

A strip of metal, or sometimes wood, to cover a joint in the roof sheets.

Crabs or Tongs (Pile Driver and Wreck Crane). A

pair of loose bent iron bars fastened at the top with a ring and intended to firmly clamp to the under side of the rail head when an upward pull is applied to the ring. They are used to anchor a pile driver car, steam shovel or wreck crane to the rails and prevent them from overturning when a heavy load is being lifted. Also called rail clips or rail clamps. See TONGS.

Crane. See WRECKING CRANE, LOCOMOTIVE CRANE.

Cross Bar (Swing Link Hanger). The iron bar supporting the cross bar casting which carries the spring plank. Also called mandrel pin and lower swing hanger pin.

Cross Beam. A transverse floor member placed upon the sills to support the inclined floor of a coal or ore car.

Cross Bearer. A transverse member of the underframe, placed between the bolsters, acting as a tie between the various sills and helping to distribute the weight of the car. Cross bearers on steel cars are sometimes termed needle beams, but the term cross bearer is preferable. In steel car construction the term cross tie is commonly applied only to those members which tie the center and side sills together, the cross bearer usually having a filler between the center sills and thus extending across the car. See UNDERFRAME.

Cross Bearer or Cross Tie Cover Plate. The member which forms the top or bottom flange, to which the diaphragms are riveted in a built-up cross tie. The bottom cover plate is sometimes called Tie Plate.

Cross Bearer Center Filler. See CROSS BEARER DIAPHRAGM.

Cross Bearer or Cross Tie Diaphragm. The web plate or filling piece, outside the center sills, to which the cover or tie plates are riveted in a built-up cross tie.

Cross Tie. See CROSS BEARER.

Cross Tie Timber. See CROSS BEARER.

Cross Tie Timber Truss Rod. An iron truss rod under the cross tie timber, serving to strengthen it. See NEEDLE BEAM TRUSS ROD.

Cross Tie Timber Truss Rod Bearing. A queen post for the cross tie timber truss rod of a built-up needle beam.

Cross Timber Hopper Ends. In a wooden hopper car, a transverse floor timber framed between the intermediate sills, to which the lower end of the inclined floor is spiked and to which the outer hopper doors are hung. The ends of the draft timbers are bolted to it, and the short center sills about it.

Crosshead (Air Brake Cylinder). A forked casting or forging attached to the end of a piston rod, to which the brake levers are connected.

Cup Holder. A stand orr ack or other receptacle for holding a drinking cup. See TUMBLER HOLDER. Figs. 1034, 1035.

Cup Washer. A SOCKET WASHER.

Cupboard Bolt. See DOOR BOLT.

Cupboard Catch. An indefinite term for a light spring catch nearly or quite flush with the surface to which it is attached. It has a beveled bolt which snaps shut. See FLUSH BOLT.

Cupola. A small cabin built on the roof of a caboose to afford a means of lookout for the train crew and also to facilitate passage from the caboose to the top of the train. Cupolas are also commonly used on dynamometer cars.

Cupola Hand Rail. A rail attached to a cupola to prevent trainmen from falling when entering or leaving through the cupola windows.

Cupola Inside Step. A step attached to the inside of a caboose to enable trainmen to enter and leave the cupola.

Cupola Marker Lamp. See CUPOLA SIGNAL LAMP.

Cupola Signal Lamp. A signal lamp mounted on the cupola of a caboose.

Current Director (Car Heating). A device for controlling the flow of steam or hot water in the pipes, working on the principle of an injector.

Curtain. A piece of cloth or other material hung in front of or around any space or object, as a window or sleeping-car berth, and which may be contracted or spread at will. The term, however, is usually restricted to loosely hung drapery, suspended on a curtain rod by curtain hooks or rings, in distinction from a shade, which is flat and rolls up. Curtains in cars are chiefly used for sleeping-car berths. (Berth Curtains.) Window curtains are used in dining, parlor and private cars. Except in the saloons, blinds have been abandoned, and window shades are in almost universal use on steam railroads. The protecting shield used over vestibule diaphragms is called a curtain. See VESTIBULE CURTAIN, WINDOW SHADE.

Curtain Hook (Sleeping Berths). See BERTH CURTAIN HOOK.

Curtain Rod. A bar to carry a curtain hung upon rings and sliding freely along the rod.

Curtain Rod Bushing. A socket or bushing for the end of a curtain rod where it abuts a wall or partition.

Curtain Rod Folding Bracket (Sleeping Car). A bracket for a curtain rod in a sleeping car which may be folded into the upper berth in such a manner that it is out of sight when the upper berth is shut up. See BERTH CURTAIN ROD BRACKET.

Cushion. Cushions used in passenger car upholstery are of the box type, being built upon and connected with a wooden framework or cushion frame. See CAR SEAT.

Cushion Frame. A wooden frame to which the seat springs and upholstery of a car seat are attached.

Cuspidor. A vessel to receive discharges of spittle, and having a wide rim so that if it is upset its contents will not be spilled.

Cut-Out. A switch or fuse in a branch electric circuit or loop, used to disconnect the branch circuit from the main circuit.

Cut-Out Cock. See BRAKE CUT-OUT COCK.

Cut-Out Valve (Car Heating). Used for controlling admission of steam to radiator pipes.

Cutting Out Brakes. See AIR BRAKES.

Cylinder. A chamber or vessel whose ends are circular, and with straight parallel sides, as the cylinder of a steam engine. See BRAKE CYLINDER.

A name sometimes given to the fire pot of a stove or heater.

A type of lock is called a cylinder lock.

Cylinder Head. A metal cover for the end of a cylinder, held on by cylinder bolts or cylinder studs. The cylinder head through which the piston passes is commonly termed the back cylinder head, and the other the front cylinder head. Brake cylinder heads are called pressure and non-pressure heads.

Cylinder Lever. In passenger brake equipment, two levers which are connected by a rod attached near their centers. One end of one lever is attached to the crosshead of the brake cylinder, and the corresponding end of the other is attached to a bracket on the brake cylinder head at the opposite end of the cylinder. The other ends of the levers are connected with the floating levers by rods.

In freight brake equipment there is no second cylinder lever, the term applying only to the lever which receives the braking force direct from the push rod. Fig. 1870, etc.

Cylinder Lever Bracket. A T-shaped piece of iron bolted to the front cylinder head, to which one of the brake levers is attached.

Cylinder Lever Guide. A guide or support for the cylinder lever.

Cylinder Lever Support. A wrought iron bar bolted to one of the center sills, on which the ends of the cylinder levers rest.

Cylinder Support. A bracket attached to a brake cylinder for holding it in place on a car.

Cylindrical Gages. Gages made for measuring the size of cylinders and cylindrical holes, often called Whitworth gages. They consist of steel cylinders and rings hardened and ground very accurately to standard sizes. These fit into each other. The cylinders are used for measuring the size of holes, and the rings for measuring the outside of cylindrical objects. They are called internal and external cylindrical gages. They are generally used as master gages or standards alone, from which other tools and gages are made of the proper size. See GAGES.

D

Dairy Car. A refrigerator car used for carrying butter, cheese, milk and other dairy products. Fig 306.

Damper. A valve in the stove pipe or in the bottom of a stove for regulating the draft.

Day Coach. See PASSENGER CAR.

Dead Air Space (Insulation of Refrigerator Cars). Air spaces which have no communication with the outside air, so there can be no free circulation or change of air as there is in a free air space.

Dead Block. See DEAD WOOD.

Dead Lever (of Brake Gear). The one of a pair of truck brake levers to which the brake connecting rod is not attached. The upper end of the dead lever is confined within a dead lever guide, or brake lever stop, which is provided with pins to adjust the end of the brake lever, and consequently the slack in the brakes, as the brake shoes wear. The lever to which the power is first applied through the brake connecting rod is termed the live lever. Fig. 1870.

Dead Lever Guide. An iron bar or loop attached to a truck or car frame which holds the upper end of a fixed or dead brake lever. It usually has holes in it in which a fulcrum pin is inserted. By moving the pin from one hole to another the lever is adjusted so as to take up the wear of the brake shoes. Also called BRAKE LEVER STOP. Figs. 1808, 1819, 1820, 1844, 1870, 1871.

Dead Lever Guide Lug. A lug or bracket attached to a truck bolster to support the dead lever guide.

Dead Lock. A lock in which the bolt is thrown each way by the key, and not in one direction by a spring, as with a spring lock or night latch.

Dead Padlock. A padlock in which neither the lock, bolt, nor hasp has a spring, but the former is thrown each way by the key, and the hasp must be opened by the hand.

Dead Wood. A single wooden block or piece of timber attached to the end sill of freight cars to protect persons between the cars from injury, by preventing the cars from coming together in case the drawbar or its attachment should give way. See BUFFER BLOCK.

Deadening or **Deafening.** The filling placed between the floor and the deafening ceiling of a passenger car to serve as a non-conductor of heat and noise. Mineral wool is sometimes used for deadening, but commonly shavings, when anything at all is used. An intermediate floor (between the sills) and deafening ceiling (under the sills) is used in refrigerator cars.

Deafening Ceiling. Boarding on the under side of the sills of a passenger car to exclude or deaden the noise of the car.

Deafening Floor. See DEAFENING CEILING.

Deck. A term applied to the roof of a car which has a clere-story. The deck or upper deck is properly the clere-story, but the entire roof is commonly called the deck and subdivided into lower deck or main roof, and upper deck. See also TURTLE BACK ROOF.

Deck Beam. A beam in the form of an inverted T with a bulb on the upper end, used in some forms of steel car construction.

Deck Bottom Rail. See DECK SILL.

Deck Bridging. Bridging or blocking used in the upper deck or clere-story.

Deck Caboose Lamp. See SIGNAL LAMP.

Deck Carline. See UPPER DECK CARLINE.

Deck Collar (Heaters). A sheet metal ring to line the smoke pipe opening through the roof.

Deck Eaves Molding or **Upper Deck Eaves Molding.** A molding under the outside edge of the upper deck.

Deck End Panel. A narrow panel in the end of the upper deck.

Deck End Plate. A member that fulfills the same office for a clere-story that the body end plate does for the body. See END PLATE.

Deck End Sill. A horizontal timber connecting the ends of the deck sills, and forming the base for the end of the upper deck.

Deck Inside Cornice. A molding which fills the interior angle where the upper deck joins the deck side.

Deck Lamp. A lamp which is fastened to the deck or ceiling of a car.

Deck Plate. A plate used in constructing the roof or deck of a steel passenger equipment car. A longitudinal member of the roof frame at the top of the deck posts and upon which the ends of the upper deck carlines rest. It has the same relation to the deck sill as the side plate has to the side sill.

Deck Post. An upright member which connects the deck plate with the deck sill.

Deck Roof. The roof of the upper deck or clere-story, itself sometimes called the deck or upper deck. See DECK.

Deck Sash. A glazed sash in the sides of the upper deck. See SASH. For details see Figs. 925, 935-946; Page 471.

Deck Sash Catch. See DECK SASH LATCH.

Deck Sash Flush Catch. A deck sash latch mortised into the sash rail flush with the sash.

Deck Sash Latch. A spring bolt attached to a deck sash, which engages with a deck sash latch keeper or strike plate.

Deck Sash Opener. A lever attached to a revolving rod by which a deck sash is opened and held in any desired position.

Deck Sash, Outer. A deck sash which carries the screen, and prevents the admission of dust and cinders.

Deck Sash Pivot. Roughly a metal stud or spindle attached to a suitable flange by which it is fastened to a deck sash, and on which the latter turns. See DECK SASH RATCHET CATCH.

Deck Sash Pivot Plate. A plate attached to the window casing, with a hole or eye in which a deck sash pivot works. Sometimes they are provided with springs to prevent the sash from rattling.

Deck Sash Pull. A ring attached to a deck sash to open and close it.

Deck Sash Quadrant. A curved bar or plate of metal used as a guide or stop to control the movement of a deck sash. See DECK SASH RATCHET CATCH.

Deck Sash Ratchet Catch. Usually combined with a deck sash pivot and stop. A ratchet makes it possible to hold the window open in any one of several positions.

Deck Sash Ratchet Plate. A part usually attached to the side of the car, but sometimes to the sash, carrying a ratchet in which the ratchet catch engages.

Deck Sash Spring Pivot. A deck sash pivot provided with a spring to make the sash removable.

Deck Screen Bottom Rail. A rail running the entire length of the clere-story, and closing the space between the bottom of the screen and the roof.

Deck Screen Post. An upright stick forming the side pieces of a frame to hold a wire screen put on outside of the deck windows to exclude dust and cinders.

Deck Side. The entire part, consisting of a plate, rail, posts and panels, or sashes, which forms the side which occupies the vertical space between the lower and closing the aperture. See Ventilator.

Deck Side Ventilator. This term is used to designate the sash or valves and their attachments for opening and closing the aperture. See VENTILATOR.

Deck Sill. A longitudinal member of the roof frame at the top of the lower deck or main roof carlines and forming the lower sill of the deck or clere-story.

Deck Sill Facing. The facing or finishing material applied to the inner side of the deck sill.

Deck Sill Sub-Facing. A thin board sometimes used below the deck sill facing.

Deck Soffit Board. A board on the under side of the overhanging cornice of an upper deck.

Deck Top Rail. A deck plate.

Deck Ventilator. The deck sash are frequently hung and operated as deck side ventilators. See DECK SIDE VENTILATOR.

Deck Window. A window in the upper deck or clere-story. More commonly a deck sash.

Deck Window Screen. An outside sash with a screen over it to exclude dust and cinders.

Deflector. See DUST DEFLECTOR.

Deflector Springs (of Ventilators). Springs controlling the movement of the deflectors.

Dental Lavatory. A basin with the necessary faucet, tumbler holder, etc., used in connection with cleansing the teeth.

Derrick Car. A strong platform car which carries a derrick crane which is used for removing wrecked cars and engines, erecting bridges, or handling any heavy objects. Also called wrecking car. See LOCOMOTIVE CRANE, WRECKING CRANE.

Detective Wire (for Car Seals). A flat twisted wire or other equivalent device to prevent the seal being stripped from the wire without destroying one or both.

Diagonal Brace. See END SILL DIAGONAL BRACE.

Diagonal Floor Timber. A floor timber which is placed in a position diagonal to the sills.

Diameter Testing Gage (for Car Wheels). A gage for testing the diameter of wheels and axles. See WHEELS.

Diamond Arch Bar Truck. A car truck with iron side frames consisting of two or more Arch Bars, and a pedestal tie bar. The spaces between the arch bars are diamond shaped, hence the name. The journal boxes are rigidly bolted to the side frames. The cross members of the truck, bolster, spring plank, etc., are either of wood or metal, or of both wood and metal combined, but the modern truck is almost always of metal throughout. For many years it was the type almost universally used, but latterly trucks with cast steel side frames have now come into common use for freight service. See TRUCK.

Diaphragm. Usually a thin wall or partition.

(Valves). Some valves are regulated by diaphragms or diaphragm plates, to which are attached springs, nuts, stems, etc., whose names explain themselves. These diaphragms are commonly spring plates, which guide the rod and, assisted by spiral springs, cause the attached valves to seat or unseat at a fixed pressure.

(Of a Vestibule.) A device usually made of some combination of rubber and canvas, arranged in folds and connecting the vestibule face plate with the vestibule to exclude the dust and cinders, and at the same time to allow the face plate free movement to adjust itself to the motion of the cars. Figs. 777-790; Page 441.

Diaphragm Face Plate. See VESTIBULE FACE PLATE.

Dining Car. A car operated in passenger trains and

equipped with kitchen and utensils, dining tables, etc., for serving meals to passengers. Figs. 361-375. See CAR.

Direct Drive Equipment—Electric Car Lighting. Figs. 2281, 2282; page 905-907.

Direct Steam Heating System. A system of car heating in which the steam from the locomotive is carried directly to the radiators or heating pipes. The term is used to distinguish the system from those in which the steam is employed to heat the water which circulates in the radiators or heating pipes. See PASSENGER TRAIN HEATING.

Dirt Collector. See CENTRIFUGAL DIRT COLLECTOR.

Discharge Pipe (Air Compressor). Also called reservoir pipe. A pipe by which the compressed air is conveyed from the air compressor to the main air reservoir.

Discharge Valve (of Car Signal Valve). The valve in the attachment called the car signal valve. The whole device is also sometimes so called.

(Of Air Compressor.) The valve through which the air as compressed passes to the main reservoir.

Distance Block. A short, thick piece of wood placed between two or more objects to keep them apart, or to preserve a space between them, as floor timber distance block, truck bolster distance block, etc.

Distributing Table (Postal Car). A table upon which the mail bags are emptied of their contents, and from which they are distributed to the various boxes or pouches. Fig. 546.

Distributing Table Hinge. A strap hinge for the table on which mail is sorted in postal cars.

Ditcher. A small steam shovel, usually mounted on a flat car, for digging the ditches in railroad cuts.

Dividing Attachment (Vacuum Brake). A device to regulate the application of the brakes to the locomotive or train, or both. See EJECTOR.

Division Arm (Twin Seats). The middle seat arm between the two seats.

Dog. A general term in mechanics for all devices which bite or take hold of or give motion to other parts.

(For Pawl of Winding Shaft.) A disk or button eccentrically pivoted in such a way as to hold the ratchet wheel pawl of a winding shaft in its place. The pawl itself of a ratchet gear is also sometimes termed the dog in other forms of ratchet gear where no dog to hold the pawl is necessary. A brake pawl-dog is similar.

Dome. A spherical roof or covering. A vertical cylinder attached to the top of the tank on tank cars and to the top of steam boilers. See TANK DOME.

Dome Head (Tank Car). The top of a tank dome.

Dome Lamp Shade. A lamp shade of curved or spherical outline.

Door. A frame of boards or plates of metal for inclosing a doorway, as BOX CAR DOOR, DROP DOOR, PLATFORM TRAP DOOR, etc. See DOOR FRAME for names of parts. Figs. 650-724; Pages 393-398, 401, 403, 405, 415, 419, 956, 959.

Door Back Stop. See DOOR STOP.

Door Bolt or Bar. An iron bar, actuated by a handle, which slides into a bracket or eye and locks the door. Used chiefly on the swing doors of refrigerator cars.

A metal bar attached to a slide and fastened to a door so as to hold it shut from the inside. They are either round, or barrel, or square. A square neck door bolt is one with an angle or shoulder in it. Flush door bolts are gained in so as to be flush with the surface. A cupboard catch is a form of door bolt having a beveled latch and actuated by a spring; but bolts so formed are commonly termed latches. See also BARREL DOOR BOLT, FLUSH BOLT, SQUARE DOOR BOLT.

Door Bolt Bracket. An iron eye attached to the body of the car into which the door bolt or bar is forced, to hold the door in a closed position. Used chiefly on freight cars which are equipped with swing side doors.

Door Bolt Keeper. See KEEPER.

Door Bottom Rail. See DOOR FRAME.

Door, Box Car, Seal Records of. Page 398.

Door Brace (Freight Car Doors). A diagonal piece of timber framed into the door frame to stiffen the door.

The report of the committee on car framing, roofs and doors, 1910 M. C. B. Proceedings, page 399, contains recommendations for the bracing of side doors.

Door Bracket. See SIDE DOOR BOTTOM GUIDE.

Door Bumper. A door stop.

Door Butt. A butt hinge.

Door Button. A small piece of wood or metal swiveled by a screw through the middle, and used as a fastening for a door or gate.

Door Cap (Freight Car Doors). A horizontal board across the top of the door.

Door Case. The frame which incloses or surrounds the sides and top of a door. The separate parts are the door jambs or door posts, door sill and door lintel.

Door Case Top Rail. A timber parallel with the door lintel.

Door Center Girth (Freight Car Doors). A horizontal board across the middle of the door. A middle door rail, except that it is not framed into the door, but simply nailed on.

Door Chain Bolt. A device which permits a door to be opened a short distance, yet not far enough to gain admission.

Door Check. A pneumatic or hydraulic dash pot and spring attached with suitable levers to the top of a swinging door and to the door lintel. The spring tends to close the door, and the dash pot checks its motion sufficiently to prevent the door slamming shut.

Door Closer. A door check.

Door Control. A push button switch for the control of magnetic air valves for pneumatic door operators.

Door and Step Controller. A pneumatically operated device, included in the Safety Car Control Equipment, which directly controls the opening and the closing of the car doors (as well as the raising and the lowering of the steps, if desired). Its operation is linked up with the brake valve in such a way that the door opening and closing follows in the natural order of operation.

Door Fixtures, Box Car. Figs. 650-655; page 405.

Door Fixtures, End. Fig. 656.

Door Frame. The structure in which the panels of a door are fitted. It is composed, as is also a window

sash, of the stiles, or upright pieces at the sides; the mullions, or central upright pieces; the bottom rail; the lock or central rail, and the top rail. The Door Case surrounds it.

Door Friction Roller. See Sliding Door Friction Roller.

Door Guards (Baggage and Freight Car Sliding Doors). Strips of wood which inclose the space occupied by the door when open to keep the freight from interfering with its movement. See Car Doors.

Door Guide. See Side Door Bottom Guide.

Door Handle. A handle, commonly of a D-shape, attached to a door as a means of opening and closing it.

Door Hanger. A device by which a sliding door is suspended at its top, and which slides on a track. Most modern freight car door hangers are fitted with rollers which run on a door track.

Door Hanger, Sliding. A device provided with rollers and traveling over a track to operate the sliding side or end door.

Door Hanger Sheave. See Sheave.

Door Hanger Roller. See Door Hanger.

Door Hasp. A metal clasp attached to a door, by which it is fastened to a staple on the body of the car. A pin or a car seal is passed through the staple after the hasp is placed over it. Used chiefly on freight car doors. Generally made of malleable iron and with the pin attached so that it cannot be lost. Padlocks are rarely used on freight cars.

Door Hasp Holder. A metal strap, usually malleable iron, bolted to a freight car side door, and having a hook or eye to which the hasp is attached.

Door Hasp Staple. A ring or U-shaped staple over which the slotted part of the door hasp fits and through which the door pin is passed.

Door Head. A steel plate or combination of steel plates placed across the top of a door opening.

Door Hinge. See Hinge.

Door Holder. A device for holding a door open or shut. Also called door stop, as it is also intended to check the momentum of the door when swung open violently.

Door Holder Catch or **Door Holder Stop.** A metal bracket attached to the floor (floor stop) or side (partition stop) of a car, with which a door holder engages, to hold a door open.

Door Hook. A hook for holding a door open or shut.

Door Jamb. The side piece or post of a door case. Also called door post. Not to be confused with the stiles of the door itself. See Door Post.

Door, Door Jamb and All Other Inside Exposed Corners of Stock Cars, Rounding Corners of, Fig. 657; Page 398.

Door Knob. A ball attached to the end of the spindle of a door latch to take hold of in moving the latch or opening the door. Made in various peculiar forms.

Door Latch. An attachment to hold the door shut. A door latch is often made in combination with a lock, having a separate bolt and key to secure or fasten the door from the outside. See Vestibule Door Latch, Latch, Lock.

Door Latch Bolt. See Latch.

Door Latch Keeper. See Keeper.

Door Latch Rose or **Escutcheon.** A plate fastened to a door as a guard or bearing for the latch spindle. A door latch rose is frequently called a rosette. See Escutcheon.

Door Latch Spindle. A small metal shaft to which the door handle or knob is attached, and by which the latch is turned.

Door Latch Spring. A spring which acts on the latch hook or bolt and causes it to engage with its keeper; usually made of a flat piece of steel.

Door Lintel. The horizontal part of a door casing above the door. See Door Frame.

Door Lock. See Lock.

Door Lock Bolt. See Lock.

Door Lock Keeper or **Nosing.** See Keeper.

Door Mullion. A vertical bar of wood between the panels of a door. See Door Frame, Door Window Mullion.

Door Name Plate. A metal plate on the inside of a passenger car door with the name of the builder inscribed on it. The name is now more commonly painted on.

Door Notice Plate. See Notice Plate.

Door Operating Gear. The mechanism used to open and close the type of doors commonly known as drop doors, which are used on hopper, gondola and other types of drop-bottom cars. Figs. 694-708; Pages 121, 144, 145, 149, 166, 167, 415, 962.

A power arrangement for controlling the opening and closing of sliding doors on suburban or street railway cars. Figs. 709, 710.

Door Panel. A piece of board whose edges are inserted into the groove of a thicker surrounding frame of a door. They are distinguished as lower, middle and upper. Any panel, but especially the lower, is sometimes cut up into two twin panels by a door mullion.

Door Pin (Freight Car Doors). A pin used to fasten a hasp to a staple.

Door Pin Chain. A metal chain by which a door pin is attached to a car.

Door Plate. A notice plate. See Door Name Plate.

Door Post or Door Jamb. A vertical post which forms the side of a doorway.

Door Post Plate. A metal plate laid over the door post to protect it from damage.

Door Post Pocket. The pocket for the door post. See Post Pocket.

Door Protection Plate. A plate placed at the side of a doorway to act as a reinforcing member in case of shocks, as when trunks, etc., are thrown against the frame.

Door Pull. See Door Handle.

Door Rail. A horizontal member or bar of the framing of a door. The upper one is called the top rail; the lower one, the bottom rail; and the middle, lock rail.

Door Rail Bracket (Car Doors). A bracket to carry a top door rail, serving as a guide for the door. See Door Track Bracket.

Door Roller. Also called door sheave. The term door roller is applied to a flat tread wheel pivoted in a

bracket and attached to the bottom of a door to roll upon a flat surface rather than a narrow track.

Door Sash. A wooden frame containing one or more panes of glass, placed in a door. In some cases one of these sashes is made to slide, so that it can be opened for ventilation. They are distinguished as lower and upper door sash.

Door Sash Bolt. A metal pin attached to a sliding door sash to hold it in any desired position.

Door Sheave or **Sliding Door Sheave.** A small wheel on which a sliding door rolls. It is usually placed at the top of the door, and sometimes at the bottom also. It is carried in a door sheave holder. A grooved casting called a door shoe or door slide is sometimes used as a substitute on freight car doors, especially when the load does not rest upon the lower door track. See Door Roller.

Door Shoe. See Door Sheave.

Door Sill. A cross piece attached to the floor on the under side of a door opening.

Door Slide. See Door Sheave.

Door, Sliding. See Sliding Door.

Door Spindle. The bar passing through the door which carries the door knobs.

Door Specifications for Outside Hung Side Doors for New Box Cars. Page 393-398.

Door Spring. An attachment to make doors self-closing.

Door Stile. One of the two upright pieces on the outer edges of a Door Frame.

Door Starter. A device for helping to start a door to open. Used chiefly on box cars.

Door Stiffener. See Stiffener.

Door Stop. A peg or block against which a passenger car door strikes when opened, often provided with a rubber cushion, especially for swinging doors. Door holders, which both stop the door and retain it, are often called door stops.

(Freight Car Sliding Doors.) A block of wood or an iron casting placed on the side of the car to limit the distance that the door can be moved. A combined stop and lock is a door stop with an attachment for locking the door.

Door Threshold Plate. A plate on the threshold of the door.

Door Track. A guide which supports a sliding door, and upon which it moves, or by which it is held in its place. They are either top door tracks or bottom door tracks. The former usually carry the weight of freight car doors, which are hung thereon by door hangers. The lower track serves only as a guide for the door shoes. See Car Doors.

Door Track Bracket. A bracket for securing a side-door track to the car. See also Door Rail Bracket.

Door Track Support. See Door Track Bracket.

Door Window Mullion. A middle upright bar in the door window frame. See Door Frame.

Doorway. The passage or opening formed by a door casing, which is closed by a door.

Double Board Roof. The upper layer of grooved boards is sometimes laid with the grooves under, so as to form a kind of tube between the two layers. See Roof.

Double Capacity Brake. See Empty and Loaded Equipment.

Double Body Bolster. See Body Bolster.

Double Chair. A twin car seat.

Double Coil Draft Spring. See Draft Spring.

Double Coil Jet System (Car Heating). A system of car heating which combines the drum or jacket features with the jet commingler system of injecting steam into the hot water circulation. The steam is first sent through the inner or steam coil of the double coil in the heater, and then through an annulus, into the circulating pipe. The jet is so directed as to aid the circulation in the pipes. Page 864.

Double Coil Nest Spring. A spiral spring with another within it.

Double Deck (Stock Car). A second floor—often made removable—in a stock car half way between the ordinary floor and the roof, to increase the carrying capacity of the car for small live stock, such as pigs, etc. A similar arrangement is sometimes fitted in an automobile car. See Upper Floor, and Car. Figs. 185-187.

Double Door. A door made in two parts. These are sometimes fastened together by hinges, so as to fold back on each other; sometimes each part is hinged to one of the door posts. Sliding doors are also sometimes made in two parts.

Doors in pairs, one inside the other, as in refrigerator cars, etc., are also called double doors.

Double Lip Retaining Ring (Steel Tired Wheels). One of the common methods of attaching a steel tire to the body of the wheel.

Double Pipe Clip. An iron band made with two bends for holding two pipes (as heater pipes) in their place. See Clip.

Double Pressure Retaining Valve. See Pressure Retaining Valve.

Double Track Snow Plow. A snow plow for use on railroads having two or more tracks, and so constructed that it throws the snow to one side only. See Snow Plow.

Double Transom Truck. A four-wheel passenger truck with two bolsters, designed to give the same easy-riding qualities as the six-wheel truck.

Double Washer. A washer that serves two bolts.

Double Web Bolster. A single bolster consisting of two beams. The term should not be confused with Double Body Bolster.

Dovetail. A flaring tenon adapted to fit into a mortise having receding sides so as to prevent the withdrawal of the tenon in the directions to which it will be exposed to strain.

Draft Arm. Figs. 1174-1175; pages 541, 542, 543. See Draft Sill.

Draft Beam. A substitute for draft timbers and stops, being cast in one piece and bolted on the inside of the center sills.

Draft Casting. One of a set of castings riveted or bolted to the draft sills and transmitting to them the stresses received from the draft gear. The latter lies between the draft sills and the ends of its follower plates bear against shoulders on the castings. Also called cheek casting. See Front and Back Stop.

Draft Door (Baker Heater). A door in the smoke flue base, automatically opened and closed by the fire regulator.

Draft Gear. A term used to designate the apparatus which connects the coupler or drawbar with the car sills. It receives and dissipates the shocks received by the coupler, thus tending to prevent their damaging the car. See FRICTION DRAFT GEAR, TANDEM SPRING DRAFT GEAR, TWIN SPRING DRAFT GEAR. Figs. 1098-1225; Pages 497, 498, 509, 511, 513, 517, 519, 521, 523, 525, 527, 533, 535, 537 955.

(Passenger Equipment Car.) See THREE-STEM EQUIPMENT.

Draft Gear Carry Iron. A plate which extends underneath the draft sills and supports the draft gear. See DRAWBAR CARRY IRON. Figs. 1327-1334.

Draft Gear Cheek Casting. See DRAFT CASTING.

Draft Gear Followers. See FOLLOWERS.

Draft Gear Tie Rod. A rod which connects an end sill or platform end sill with a body bolster or other cross timber to tie them together. The term is sometimes applied to the draft rods of continuous draft gear.

Draft Key. A key used with some forms of draft gear. It passes through key slots in the draft sills, the coupler shank or butt, the cheek plates and side links, and secures the draft gear to the sills. Figs. 1204-1207; Page 549.

Draft Link. A long flat rectangular bar of metal perforated with one or more key slots and used to connect or "link" together the various parts of certain types of draft rigging.

Draft Lug Angle. An angle riveted to the bottom of the center sill at the draft gear, to which the lower part of the draft casting is fastened.

Draft Plate. See DRAFT CASTING.

Draft Regulator. See FIRE REGULATOR.

Draft Rod (Continuous Draft Gear). A rod which unites two drawbars at opposite ends of a car, and relieves the draft timber attachments from tensile stress. See AMERICAN CONTINUOUS DRAFT AND BUFFING APPARATUS.

Draft Sill. In wooden cars commonly designated as draft timber. The center sills which transmit the draft stresses from end to end of the car are sometimes termed the draft sills. When metal draft members are used the term draft sill is almost universally applied. Fig. 270; Page 363.

Draft Sill Tie Plate. A plate riveted to the draft sills to aid in holding them rigid.

Draft Spring. A spring attached to a coupler or drawbar to give elasticity. They are usually so arranged by means of follower plates at each end as to resist either tension or compression.

Draft Spring Pocket. A drawbar spring pocket.

Draft Spring Stop. A metal sleeve or thimble in the center of a spiral draft spring to resist excessive compression. Not to be confused with a drawbar stop.

Draft Spring Thimble. A projection riveted to the follower plates and fitting inside the draft spring to hold it in place.

Draft Timber. A pair of timbers, carrying the drawbar attachments, placed below the center sills, and usually extending from the platform end timber of passenger equipment cars, or the end sill of freight cars, to the body bolster.

Draft Timber Bolt. A bolt used to secure a draft sill to a center sill.

Draft Timber Pocket. A casting attached to the body bolster or center sills of a car to receive the end of a draft timber.

Draft Timber Tie Bar. A transverse iron bar attached to the under sides of a pair of draft timbers to tie them together.

Drain Cock. See RESERVOIR DRAIN COCK.

Drain Cup or **Drip Cup** (Air Brake). A globular receptacle under a triple valve to collect the water of condensation.

(Refrigerators and Ice Cars.) A metal cup through which the drippings from the ice pass, but which is so arranged as to prevent the entrance of air to the car.

Draining. See AIR BRAKES.

Drain Valve (Car Heating). A valve for draining off the water condensed in the steam pipes where an automatic trap is not used.

Draw Head. The head of an M. C. B. automatic coupler, exclusive of the knuckle, knuckle pin and lock.

Draw Spring. See DRAFT SPRING.

Draw Timbers. See DRAFT TIMBERS.

Drawbar. Used synonymously with Coupler. It has been used indiscriminately to designate both the old link and pin drawbar and the modern automatic car coupler. There has been in the past an effort to confine the name drawbar to the old link and pin type, but in the proceedings of the M. C. B. Association, in speaking of the height of drawbars, the term is applied to the standard automatic coupler. See COUPLER.

Drawbar Carry Iron. U-Shaped strap fastened to the under side of the end sill and supporting the outer end of the drawbar. Often contracted to carry iron or carrier iron. Also called stirrup. Page 955.

Drawbar Centering Device. A device for maintaining the drawbar normally in the center line of draft, but allowing it to move to either side when the car is rounding a curve while coupled to another car. Figs. 1324-1328.

Drawbar Safety Lug. See COUPLER HORN.

Drawbar Stirrup. See DRAWBAR CARRY IRON.

Drawbar Stop. See DRAFT CASTING.

Drawer Pull. A wooden or metal attachment on a drawer to take hold of in pulling it out.

Drawing Room. A small room or compartment in a drawing-room car. See STATEROOM.

Drawing Room Car. A term at one time applied to parlor cars, but now usually restricted to certain types of sleeping cars which have one or more separate compartments or drawing rooms containing a double-berth section and a sofa or lounge, in addition to which they are usually supplied with a private toilet. Such a car is termed a Drawing Room Sleeping Car. See PARLOR CAR.

Draw-Off Cock (Baker Heater). A cock for emptying the pipes.

Dressing Room. Another name for a saloon, particularly one provided with wash bowl and toilet facilities.

Drinking Cup Vendor. Figs. 1034, 1035.

Drier, Japan, Specifications for. Page 1063.

Drinking Fountain. See Water Cooler.

Drip Coupling or Basin Coupling (Wash Basin). The connection of the waste pipe or drip pipe with the basin.

Drip Cup (Air Brake). A receptacle inserted in the brake pipe to receive water condensing therein. A drain cup.

Drip Pan (Refrigerator Car). A dish or pan at one corner or end of the car for receiving the water from the melting ice, usually permitting it to escape to the roadbed through a trap.

Drip Tray. An enameled piece of iron placed directly under the seat of a closet, and over the bowl.

Drip Valve, Automatic. Used in connection with an automatic connector and in Car Heating Systems, Fig. 2166. See Reservoir Drain Cock.

Drive, Motors. Page 1174.

Drop Bottom. See Drop Door.

Drop Bottom Car. A car with a level floor or bottom, equipped with a number of drop doors, for discharging the load. See also Car and Hopper Bottom Gondola Car. Figs. 60, 61, 68-69; Pages 144, 145, 149; Pages 276, 277, 966.

Drop Brake Shaft. A brake shaft which is normally in a vertical position, but can be dropped to a horizontal position and still remain operative should conditions of lading required this to be done. Figs 2057-2064; Page 962.

Drop Door. A door at the bottom of a drop bottom or hopper bottom car for unloading it quickly by allowing the load to fall through the opening. Drop doors are usually in pairs, and are supported by a chain wound upon a winding shaft; or by a lever arrangement. Frequently a drop door beam extends across the car above the winding shaft to assist in supporting it and to stiffen the car. Figs. 31-36, 78-81, 119-122, 694-708; Pages 121, 144, 145, 166, 167, 415, 962.

Drop Door Chain. A chain attached to a drop door, and usually connecting it with a winding shaft, for the purpose of controlling the door. Also sometimes termed hopper chain.

Drop Door Chain Ring. An iron ring to which are fastened the single chain passing around the door winding shaft and the two chains which are attached to eye bolts in each of the double drop doors.

Drop Door Eye Bolt. An iron bolt with an eye in the upper end which is fastened to a drop door near the edge away from the hinge and to which is secured the drop door chain.

Drop Door Gear. See Door Operating Apparatus.

Drop Door Hinge. A hinge on which a drop door swings; usually made of flat bar iron, bent to form an eye, through which a hinge pin passes.

Drop End Door. Used on gondola cars. The entire end is arranged to swing down at right angles to its normal position, for loading long material. Figs. 677.

Drop End Gondola Car. A gondola car with the ends in the form of doors, which can be dropped when the car is used for shipping long material which extends over more than one car. See also Car.

Drop Forging. One made by a die under a power hammer.

Drop Suspension (Electric Lighting). A drop or bent frame attached to the truck frame. The belt or chain is adjusted by sliding the generator along on the frame and this arrangement is called the sliding-type suspension. See Suspension.

Drop Table. A table hinged to the wall so as to drop against it out of the way when desired.

Drop Test Machine. Figs. 1240-1245, 1584.

Dropper Bar. A special rolled steel bar.

Drum. A cylinder over which a belt or band passes.

A chamber of a cylindrical form used in heaters, stoves and flues. It is hollow and thin, and generally forms a mere casing, but in some cases, as steam drums, is adapted to stand considerable pressure.

(Hoisting Gear.) The main cylinder upon which the hoisting rope is coiled. The spur wheel is carried on the same shaft.

Drum Shaft (of a Derrick or Crane). The shaft on which the winding drum is carried.

Drum System of Car Heating. See Passenger Train Heating.

Dry Closet. A closet, so called in distinction from a water closet, which is not flushed with water.

Duck. A cotton fabric, lighter and finer than canvas, used in car upholstery.

Dummy End (Passenger Equipment). A term applied to the end construction commonly used on baggage, express and postal cars, which have no external platform or vestibule.

Dummy Hose Coupling. A casting of the same shape as a hose coupling, into which the coupling may be hooked. It is used to prevent dirt and debris getting in the brake pipe, as well as to prevent the coupling from hanging down when not in use and being damaged.

Dump Car. A car from which the load is discharged either through doors or by tipping the car body. See also Car, Center Dump Car and Side Dump Car. Figs. 156-173, 2980-3022; Pages 188, 189, 191, 193.

Dumping Apparatus. Figs. 694-708; pages 415, 962.

Dumping Machine, Car. A machine usually built in a coal pier by means of which loaded cars are raised and turned partly over, thus discharging the coal into a conveyor car or directly into a chute by which it is placed in the vessel. Figs. 2677, 2678; Pages 975, 997.

Dumping Tray (Postal Car). A tray used in a postal car for handling mail. Fig. 456.

Duplex Air Gage (Air Brake). A gage which registers simultaneously on the same dial the main reservoir pressure and brake pipe pressure. For this purpose a red hand for the reservoir and black hand for brake pipe pressures are provided.

Dust Arrester (of Pintsch Gas Pressure Regulator). A cavity closed at each end by a perforated plate to prevent dust entering to clog the regulating valve.

Dust Collector. Fig. 1872.

Dust Deflector (Windows). A device for deflecting dust and cinders and preventing them from entering the car, particularly through the windows.

Dust Guard. A thin piece of wood, leather, felt, asbes-

tos or other material inserted in the dust guard chamber at the back of a journal box, and fitting closely around the dust guard bearing of the axle. Its purpose is to exclude dust and to prevent the escape of oil and waste. Sometimes called axle packing or box packing. See also DUST DEFLECTOR. Fig. 1521.

Dynamo (Electric Lighting). A generator of electric current. See GENERATOR.

Dynamometer. See DYNAMOMETER CAR.

Dynamometer Car. A car equipped with apparatus for measuring and recording drawbar pull, horse power, train line pressure, and other data connected with locomotive performance and train haul conditions.

(Weighing Head.) An apparatus attached by means of interlocking yokes to the car coupler, thus transmitting the draw bar pull and buffing stress to the measuring and recording mechanism.

(Recording Table.) A table on which is mounted the various recording devices which are connected to the weighing head, the steam and air lines, the integrator, and to other parts in the locomotive cab.

(Integrator.) A horizontally mounted rotating disc consisting of a compound carriage or multiplying device which computes and records. Figs. 2720-2733.

E

Ear Bail (Lanterns). An attachment formed of wire connected with the wire guard, to which the bail is attached, instead of to the body of the lantern.

Eaves Molding (Freight Cars). A plain strip sometimes used outside the fascia.

(Passenger Equipment Cars.) An ornamental finish to the lower edge of the lower deck or main roof outside of and above the fascia. A similar deck eaves molding is used for the upper deck.

Eccentric Pivot Plate (for Seat Arms). A seat arm pivot plate, made eccentric to get room for screw holes.

Egg-Shaped Stove. A stove resembling an egg in form. It is commonly known simply as a cast iron stove, and is very largely used in cabooses, etc., where appearance is not important.

Ejector. An appliance for operating a vacuum brake by exhausting or "ejecting" air. It consists essentially of a pipe placed in the center of a surrounding shell or casing, with an annular opening between the pipe and the casing. When the current of steam is admitted at the lower end and escapes at the upper end, the air in the casing is drawn out through the annular opening by the current of the escaping steam. The space is connected by a pipe with the appliances on the cars for operating the brakes. Suitable valves are also used in connection with the ejector to shut off and admit steam and air. A muffler is used to render noiseless the escaping steam. It consists simply of a box of small round balls, like shot, through which the steam must pass to escape. In a later type a combination ejector is used having two ejector pipes, one a small one, which is kept in action continuously to maintain the vacuum in the brake pipe, and a large one for use in quickly releasing the brakes after a stop.

Elbow. A short L-shaped tube for uniting the ends of two pipes, generally at right angles to each other.

Electric Car. An ELECTRIC MOTOR CAR. Figs. 475-541.

Electric Cell Filler. A device for supplying storage battery cells with water.

Electric Compressor Governor. See AIR COMPRESSOR GOVERNOR.

Electric Fan. A rotary fan operated by a small electric motor. Used in railway passenger cars for ventilating purposes. Fig. 2260.

Electric Heater. Heaters used on electrically operated cars, where electric current is available for their operation. Usually placed under the seats. Heat is developed by passing current through resistance coils and is controlled by regulating switches. Figs. 2217-2236.

Electric Lamps. Figs. 2279, 2280, 2359-2453; Pages 935, 954, 956.

Electric Lighting. See Figs. 2265-2491; Pages 889-907, 909, 911, 912, 913, 917, 923, 955.

Electric Wiring. A system or arrangement of insulated copper wires forming a circuit between the generator and the lighting devices. On locomotives and other places where it is necessary to protect the wires from injuries they are enclosed in conduits or otherwise protected. Figs. 2485-2491; Pages 893-895, 943.

Electric Motor. See MOTOR, ELECTRIC.

Electric Motor Car. A car which is propelled by electric motors. SEE MOTOR CAR and CAR.

Electric Motor Car Equipment. The motors, current collectors, switches, controllers, etc., used on electric motor cars. Figs. 487-537.

Electric Shovel. A power shovel operated by electric power.

Electric Train Line Coupler (Electric Lighting). A device somewhat like a steam or air brake hose coupler which is used to connect the electric light circuits on adjoining cars.

Electric Wiring. The arrangement of wires by which the electric current is conducted to the various outlets for lamps, dynamos, or other devices operated by electricity. Where it is necessary to protect the wires from injuries they are enclosed in conduits or otherwise protected. Figs. 2485-2491; Page 943.

Electro-Pneumatic Brake. Used on long high speed electric trains, such as used in subway service. In addition to the functions performed by a quick action automatic air brake means are provided for applying and releasing the brakes on each car through the action of electro-pneumatic valves energized by current taken from contacts on the motorman's brake valve and continuous train wires. Brakes on long trains can be applied instantaneously and simultaneously with this device, eliminating any tendency to surging. See AIR BRAKE. Figs. 1948-1950; Pages 812, 813, 818.

Electro-Pneumatic Car Discharge Valve. A valve used with the train-signal equipment on cars employed interchangeably in electric road and steam road service and requiring electro-pneumatic operation in electric road service and pneumatic operation in steam road service.

Electro-Pneumatic Compressor Switch. A device used in conjunction with the electric compressor governor in the governor synchronizing system for insuring uniform compressor labor. Its operation is controlled by the governor and its function is to automatically open or close the circuit to the motor-driven air com-

pressor when the pressure in the main reservoir line falls below a predetermined minimum or rises to a predetermined maximum, respectively, which pressures are determined by the setting of the governor. See AIR COMPRESSOR.

Electro-Pneumatic Signal System. An electrically operated train air-signal system, adapted to either single cars or trains which may or may not carry trailers, and providing means for signalling to the motorman from any part of the train and in as rapid succession as desired, the signals being sharp, distinct and coincident with the pulling of the signal cord. The system is so designed that, if desired, the whistle on each end of every car in the train may be sounded from a signal given from any part of the train. The equipment includes a conductor's signal switch, combined magnet and bracket, signal whistle, jumper and receptacle, cut-out cocks, fuses, snap switches, etc. For cars which operate in both steam road and electric road service, an electro-pneumatic car discharge valve is used, electric operation being used in electric road service and pneumatic operation in steam road service. Figs. 2001-2005.

Electrode. A term sometimes used to designate the individual elements or plates of a storage battery.

Electrolier. A chandelier of electric lights.

Elevated Car. An electric motor car for use on elevated railways in large cities.

Ell. A short term for elbow.

Elliptic Spring. A spring of elliptical form made of two sets of parallel steel plates of constantly decreasing length. Such springs are generally used for bolster springs for passenger cars.

The set of elliptic springs is the total amount of bend or compression of which the spring is capable. Elliptic springs in service are termed double or duplicate, triplets or triplicate, quadruple, quintuple, sextuple, etc., according to the number of springs used side by side and connected by a single eye bolt, so as to constitute practically one spring. Pages 713, 714, 715, 716, 717, 718.

Emergency Application. See AIR BRAKES.

Emergency Coupler Knuckle. A knuckle which is designed for use in case of damage to the knuckle of automatic couplers.

Emergency Coupling Device. A short shank coupler which can be chained in place if the standard coupler is pulled out or broken.

Emergency Head Back-Up Connection. A device for application to an automatic connector in order that a back-up cock, brake or signal hose may be coupled to it.

Emergency Valve (Air Brake). A valve used for making emergency applications of the brakes with the straight air system. See TRIPLE VALVE. Figs. 1958, 1959, 1969; Page 812.

Emigrant Sleeping Car. A plainly finished sleeping car for the use of emigrants. See SLEEPING CAR.

Empire Deck. A form of roof used in passenger car construction in which both the lower deck and upper deck are curved. Double deck sash, usually half elliptic, are used and the upper deck is vaulted over each deck window. See VAULTED DECK WINDOW.

Empty and Load Brake Equipment (Freight). An equipment which not only operates to materially increase the total braking power controlling train units on grades, but gives a practically uniform braking power on car units—whether empty or loaded—in any service.

See AIR BRAKE. Figs. 1888-1890; Pages 768, 781, 783, 785.

End Axle Guard. The axle guard at the end of a six-wheel truck, to support the outer axle in case of breakage. See AXLE GUARD.

End Belt Rail. See BELT RAIL.

End Brace. See BRACE.

End Brace Pocket. See POST POCKET.

End Brace Rod. See BRACE ROD.

End Carline. A carline at the end of a car body. See CARLINE.

End Chute Plank. The planking of an inclined floor of a car which discharges its load longitudinally from the end toward the middle of a car.

End Compression Beam (Passenger Equipment Car Framing). A timber directly above the sills over the body bolster against which the compression beam brace and the end counterbrace abut. The compression beam proper is situated at the middle of the car, directly under the window sills. The end compression beam is sometimes omitted.

End Counterbrace (Passenger Equipment Car Framing). More commonly counterbrace. A brace in the side of a car body, between its ends and the body bolster. See COUNTERBRACE.

End Door. A door in the end of a car.

In box cars this door, when used, is small and generally about half way up to the roof. It is used for loading and unloading long material, which cannot be handled through the side doors. Figs. 656, 675-677.

On some classes of automobile cars one end of the car is arranged in the form of a double swing door.

The term is used in connection with passenger cars to differentiate from the vestibule side door.

End Fascia. A plain board on the end of a car covering the upper ends of the sheathing boards and extending to the roof line.

End Frame. The frame which forms the end of a car body. It includes the posts, braces, belt rail and end plate. Figs. 617-621, 626-634. Pages 377, 386, 387. See BODY FRAMING and FRAME.

End Girth. See BELT RAIL.

End Girth Tie Rod. An end belt rail tie rod.

End Grab Iron. See GRAB IRON.

End Hook (Signal Cord). A hook sometimes used on the ends of passenger equipment cars, high up under the platform roof, for fastening the end of the signal cord.

End Panel. A panel at the end and on the outside of a passenger equipment car below the window.

End Piece (Truck Frame). A transverse timber or bar by which the ends of the two-wheel pieces of a truck frame are tied together. A crooked end piece is one cut away on top to clear the draft gear. The inside end piece is the one nearest the center of the car, in distinction from the outside end piece. They are frequently designated as the front and back end pieces.

End Piece Corner Plate (Passenger Equipment Trucks). A plate or casting used to connect the wheel and end pieces and stiffen the truck frame.

End Piece Plate. A plate used to stiffen the end piece of a wooden passenger equipment truck.

End Plank (Gondola Car). The planks in the end of the car body. They often form a door, which is hinged to the car floor so as to drop down upon it. Then called a drop end or drop end door.

End Plate. A member across the end and connecting the tops of the end posts of a car body and fastened at the ends to the two side plates. It is usually made of the proper form to serve as an end carline.

End Play (Axle). The movement, or the space left for movement, endwise.

(Truck Bolster.) Usually called lateral motion. See Swing Bolster.

End Post. The vertical members in the end body framing between the corner posts.

(Hopper Car.) A vertical support for the overhang of the hopper floor, resting on the end sill. Ladder rounds are usually secured to the two end posts in the center.

End Post Pocket. A pocket for the end posts. See Post Pocket.

End Rafter. A term sometimes erroneously applied to an end carline.

End Rail. See Wainscot Rail.

End Reinforcements. Figs. 626-636; pages 385, 387.

End Sheet. A plate used in closing the end of a steel car.

End Sill. The transverse member of the underframe of a car framed across the ends of all the longitudinal sills. In wooden underframe cars a heavy timber, approximately square in cross-section and in steel underframe cars a rolled or cast section, or a pressed plate. In passenger cars the end sill comes directly under the end door, the platform, with its various parts, usually being a separate construction. Fig. 617.

End Sill Angle. A commercial angle used on an end sill which is built up of several members.

End Sill Brackets (Steel Frame Cars). Angle plates used to connect the longitudinal sills and the end sill. In bridge building such plates are termed brackets. When of triangular section they are termed gussets.

End Sill Diagonal Brace. A horizontal brace extending from the end sill diagonally back to or beyond the bolster.

End Sill Flitch Plates. The iron or steel plates sandwiched between the wood members of a composite end sill.

End Sill Plate. A plate extending the full length and width of a built-up end sill, and riveted to the other members.

An iron or steel plate bolted on the face of the end sill of some passenger cars to give added strength.

End Sill and Plate Tie Rod. A tie rod joining the end sill with the end plate.

End Sill Stiffening Angle (Anti-Telescoping Device). An angle riveted or bolted to the end sill stiffening plate and to the end sill on the inside. The inner body truss rods pass through it, the end sill and the truss rod washer plate.

End Sill Tie Rod. An iron rod passing through the end sill and the bolster to tie the two together.

End Slope. The sloping floor from the end of a hopper car to the hopper door. See Hopper Slope Sheet.

End Stiffener. A reinforcing member extending across the end of a freight car to prevent it from bulging or breaking out due to shifting of the load or end shocks. An end tie band is a member of this kind, but with the ends bent and fastened to the side of the car, thus tying the end of the car securely.

End Stud. See Stud.

End Tie Band. See End Stiffener.

End Timber. See Buffer Beam, End Sill, Platform End Sill.

End Train-Pipe Valve (Steam Heating). A valve in the train steam pipe at the end of the car by which the entire car may be cut out. Usually operated by an extension handle extending up to the platform or out to the side of the car. Figs. 2152, 2154, 2162, 2169, 2171-2175, 2189.

End Truss Plank. See Truss Plank.

End Ventilator. An aperture for the admission or escape of air at the end of a car. See Ventilator.

End Window Panel. A panel at the end and on the outside of a passenger car alongside the window, in distinction from the end panel proper, which is below the window. See Panel.

Equalizer. A short term for Equalizing Bar.

(Vestibule.) A bar in the hood of a platform which equalizes the pressure of the two upper face plate springs and keeps the opposing face plates in contact, so as to maintain frictional contact and exclude dust and smoke.

Equalizer Connecting Chain (Vestibule). Three links of a chain connecting the upper ends of the vertical equalizing levers with the end of the horizontal equalizing lever.

Equalizer Spring. A spring which rests on an equalizing bar and carries part of the weight of a car. Single or double coil spiral or helical springs are generally used for this purpose.

Equalizer Spring-Block (Passenger Equipment Trucks). A casting bolted to the wheel piece and resting on the equalizer spring cap.

Equalizer Spring Cap. A casting which fits over the top of the equalizer spring and transmits to it the weight received from the wheel piece.

Equalizer Spring Seat. A casting which rests on an equalizing bar and supports the spring.

Equalizing Bar (Passenger Equipment Trucks). Commonly abbreviated into equalizer. A wrought iron bar which bears on top of the journal boxes and extends longitudinally from one to the other. Equalizer springs rest on it between the two boxes. It is used to transfer part of the weight on one axle to the other, and thus equalize it on both; hence its name.

Equalizing Bar Pedestal (Four-Wheel Caboose Cars). A casting serving to give a fulcrum to the center of a lever, called an equalizing lever, which distributes the weight of the car evenly on the two axles.

Equalizing Bar Seat. The surface in top of a journal box on which an equalizer rests. See Equalizing Bar.

Equalizing Brake Lever. A floating brake lever is also called an equalizing lever. See Brake Lever.

Equalizing Lever Set. An arrangement of cylinder levers and connections for double-truck cars, so designed as to insure proper equalization of braking force on both trucks with either the hand or air brake.

Erecting Crane. Similar to a locomotive crane but usually having no means of propulsion and used for handling material within the radius of its boom.

Escutcheon. A plate or guard for a keyhole of a lock.

Examination of Car Inspectors, Rules for. Page 1163.

Expander Ring (Air Brake Cylinder).

Exhaust Muffler (Traction Air Brake). A device for subduing the sound of air discharging to the atmosphere during operation of the brakes.

Expanded Metal. A perforated metal sheet which is made by slotting a sheet of iron or steel and then drawing it out so that the slots form diamond-shaped holes in the plate. It is largely used in composite concrete construction as a binder; for lockers and window guards; and in certain types of iron castings.

Express Car. A car operated in passenger trains for carrying express freight. See CAR. Figs. 420-430.

Extensible Trap Door. A trap door with an extension device to prevent passengers stepping between a car and the station platform.

Extension Bracket. See RUNNING BOARD BRACKET.

Extension Reach (Logging Cars). The reach is a long bar connecting the two trucks. The extension reach is adjustable. See LOGGING TRUCK.

Extension Reach End (Logging Cars). A strap for the end of the extension reach.

External Cylinder Gage. See CYLINDRICAL GAGES.

External Screw Gage. A steel ring with a very accurate screw thread in the inside for testing screw threads. See INTERNAL SCREW GAGE.

Extra Transom (Passenger Equipment Trucks). An extra or auxiliary member placed alongside the transom to further strengthen the truck frame.

Eye. A small hole or aperture. See EYE BOLT.

Eye Bolt. A bolt having an eye or loop at one end for the reception of a ring, hook or rope, as may be required.

Eye Bolt Link Hanger. A special form of swing hanger having a very short link attached to an eye bolt passing through the transoms. See SWING HANGER.

Eyelet. A short metallic tube, the ends of which are flanged over against the object through which it passes. Used as a bushing or reinforcement for holes in carpet and other fabrics. In metallic eyelets of the usual form the two halves which when compressed together form the eyelet are known as grommets.

(Window Shade.) A slot in the window shade leather to fit over the sash lift to hold the shade fast.

Eyelet Nail. A wire nail with turned knob for use with carpet eyelets.

F

Fabrikoid. An artificial leather made by coating a cloth fabric with a compound which gives it the texture and appearance of leather. Used for car seat upholstery. See also LEATHEROID, MERITAS, PANTASOTE, and TEXODERM.

Face (Rim of Car Wheel). The vertical surface of the outside of the rim.

Face Plate (Steel Tired Wheel). The plates connecting the tire and hub. They are distinguished as front and back face plates. See also VESTIBULE FACE PLATE.

Face Plate Buffer. A buffer plate to which a vestibule face plate is attached. See VESTIBULE FACE PLATE.

Face Plate Buffing Stem (Vestibule). See FACE PLATE PISTON.

Face Plate Piston (Vestibule). A face plate buffing stem corresponding to the side buffer stem, beneath the platform floor. The end is contained in a face plate piston guide.

Fall (Hoisting Tackle). That part of the rope to which power is applied.

Fall and Tackle. Another name for block and tackle.

Fan. A device rotated by electric power or other means, used in passenger train cars for the purpose of ventilation. Figs. 2260, 2435.

Fascia. A plain board running the length or width of the car, directly under the roof. Designated as side fascia and end fascia, depending on location. In passenger equipment cars the eaves molding is placed on the upper edge of the fascia.

Faucet. A synonymous term with cock. For fuller definition see BIBB COCK, PUSH BUTTON FAUCET, TELEGRAPH COCK. Figs. 1050-1058.

Faucet Alcove. A water alcove.

Feed Tube (Oil Lamp). The tube connecting the reservoir with the burner. The standard by which the entire lamp is supported passes through it.

Feed Valve. Also called slide valve feed valve.

(Traction Air Brake.) A valve which automatically maintains the pressure of air supplied through the brake valve to the automatic brake system. It may be attached either to the brake valve or placed in the piping between the main reservoir and the brake valve

(Train Air Signal.) See REDUCING VALVE.

Felt Edge (Car Seats). A device for building up the edges of car seat cushions. It is simply a roll of felt stitched in such a manner as to fit over a cleat: and when tacked down it forms an even elastic face to the cushion.

Female Center Plate. The body and truck center plates are sometimes called male and female plates, respectively. See CENTER PLATE.

Female Gage. An external gage. See CYLINDRICAL GAGES.

Fender Board. A board at the end of passenger car steps to prevent mud and dirt from being thrown on them by the wheels. More commonly, string board. The splash board, if used, goes on the back side of the steps.

Feralun. A metal cast with one or more incorporated wear, heat and acid-resistant strata, exposed as one or several faces, or embodied at a desired depth. A stratum may be so exposed as to give a gritty surface of extreme durability and any desired degree of roughness for an anti-slip surface. See SAFETY TREAD.

Ferry Push Car. A very long platform car used for pushing or pulling other cars on or off a ferry boat when the latter is approached by an incline too steep for locomotives, so that the latter can push or pull the cars without running on the incline. See LORRY and PUSH CAR, INDUSTRIAL CARS.

Field Coils. Coils of insulated copper wire or ribbon surrounding the iron poles of a motor field-magnet. Current passing through these coils produces the magnetic flux in which the armature rotates.

Filler Block. A block fitted into the space between the tank head and the end sill of a tank car to prevent the tanks moving on the frame. See TANK HEAD BLOCK.

Filler Cover. The cover for the opening to the water tank supply on cars.

Fillet. A small light molding, more generally termed a bead. A rounded corner left on the inside of the angle where two surfaces join.

Filling Cock (Car Heating). A cock used for supplying water to the hot water circulation heating system. In some cases has a funnel attachment.

Filling Device (Car Heating). Used in connection with hot water heating systems.

Filling Piece. Any piece of timber or metal used to close a gap.

Filling Spider. See BODY BOLSTER FILLER.

Filling Valve (Pintsch System). A soft metallic seated valve of peculiar construction operated with a key. One is placed on each side of a car, bolted to an iron bracket. The pipe connection is made to a connection piece which is slipped through the bracket from the outside and screwed to the pipe. The filling valve is then bolted back against this flange connection piece, a lead and rubber gasket forming a tight joint. Page 944.

Filter. A vessel so constructed that water or other liquids must pass through a filtering device, usually containing charcoal, sand, small gravel, etc., thus removing the impurities. Fig. 1032.

Finger Guard (Brake Beams). A projecting rod or finger which prevents the brake beam from being excessively displaced laterally by bearing on the inside of the wheel. A wheel guard.

Finishing Varnish (Painting). An elastic (oily) varnish applied in two coats. See PAINTING. Pages 1058-1064.

Fire Extinguisher. Usually a small receptacle carried in a passenger car, and containing some chemical which will extinguish fire.

Fire Regulator and Pressure Indicator (Baker Heater). This device is attached to the hot water circulating pipes at a point a little above the coils, and is somewhat like the ball and lever safety valve, the ball or weight in this case being the draft door. The fire regulator bowl consists of two concave plates bolted together, with a corrugated steel diaphragm and two copper duplicates, top and bottom, between (for preservation). On this set of diaphragms rests a piston connected with a lever, on one end of which hangs the counter draft damper in the base of the smoke flue. On the front end of this lever is the spiral adjusting spring, and the figures denoting the pressure within the heater. The "adjusting spring" is to be hooked into the hole at the figures denoting the pressure and consequent temperature desired.

First Class Car. The ordinary American day coach used by the great bulk of short trip passengers. So called to distinguish it, on the one hand, from those of an inferior grade, as emigrant and (rarely) second-class cars, and on the other hand from sleeping and parlor cars, in which an extra charge, in addition to the ordinary fare, is made. Second-class cars are used in Canada. See also SECOND CLASS CAR and PASSENGER CARS.

Fish Car. A car equipped with water tanks for the transportation of live fish and also providing quarters for the operators in charge of the car and special equipment. The construction is similar to passenger train cars and it usually is operated in passenger trains. Figs. 426, 427.

Fixed Brake Lever. More commonly, Dead Lever.

Flag Holder (for Corner Post of Passenger Car). A cast or malleable iron receptacle for a signal flag staff.

Flange. A projecting rim for attaching a part to any surface by screws or bolts.

(Car Wheel.) A projecting edge or rim on the periphery for keeping it on the rail. See WHEELS.

Flange for Steel and Steel-Tired Wheels. See WHEEL TREAD AND FLANGE FOR STEEL AND STEEL-TIRED WHEELS.

Flange Thickness Gages. See WHEEL FLANGE THICKNESS GAGES.

Flange and Wheel Tread, Form of. See WHEEL TREAD AND FLANGE, FORM OF.

Flanges, Wheel, Distance Between the Backs of. See WHEEL FLANGES, DISTANCE BETWEEN BACKS OF.

Flange Fittings. Special fittings made with flanges held together by screws. The joints are made tight by the use of washers or gaskets of rubber, asbestos, lead or other soft materials.

Flanged Brake Shoes. Brake Shoes so constructed that they bear on both the tread and flange of a wheel.

Flanger. A form of plow, sometimes placed under a special car, called a flanger car, but usually under a snow plow, for clearing ice and snow from the inside of the rails to provide a clear passage for the wheel flanges. Flangers are also frequently attached to locomotives, either on or just behind the pilot. Also called snow scraper. Figs. 2691-2693.

Flashing (Plumbing). A lap joint used in sheet metal roofing, where the edges of the sheets meet on a projecting ridge. A strip of lead leading the drip of a wall into a gutter. Hence, extended to mean any strip of sheet metal of an L section used to make a watertight joint.

Flat Car. A freight car having a floor laid over the sills, and without any housing or body above. See CAR and WELL CAR. Figs. 38-129, 2887-2890, 2941-2942, 2952; Pages 1124, 1129.

Flexible Car Roof. A roof designed to accommodate itself to the weaving or distortion of the car frame when passing around curves. See CAR ROOF.

Flexible Joint. See FLEXIBLE METALLIC JOINT.

Flexible Metallic Joint. A metallic joint so designed as to provide for flexibility. A swing joint. Figs. 2105-2128; Pages 859, 861.

Flexible Truck. A truck with a more or less flexible connection between the bolster and side frame.

Flitch Plate. An iron or steel plate sandwiched between pieces of wood and bolted together to give the member which they comprise greater strength. Also called sandwich plates.

Floating Connecting Rod (Foundation Brake Gear). A rod which connects a cylinder lever with a floating lever.

Floating Lever. A lever, one end of which is fastened to the fulcrum bracket, the other end connected to the

live truck lever, and the middle to the cylinder lever, to which latter is connected the push rod.

Floating Lever Bracket. A bracket bolted to the underframe of a car to carry the floating lever of the brake gear.

Floating Lever Hanger. A square bracket or hanger supporting the floating lever.

Floor. The boards, plates, or other material which cover the sills of a car. In passenger cars the floor consists of two, and sometimes three, courses of boards, called respectively the flooring, intermediate floor and deafening ceiling, the latter being on the under side of the sills. With the introduction of steel passenger cars has come the use of floors of concrete and other mixtures. Figs. 576, 854-858; Pages 457, 959.

An intermediate or upper floor, more commonly called the double deck, is used in stock cars for carrying sheep and hogs. See Floor Nailing Strip, Floor Support.

Floor Beam. A beam for supporting the nailing strips or floor stringers in a steel car, and also acting to a certain extent as a tie between the side and center sills.

Floor Chute. See Hopper Tube.

Floor Mat. A thin flat structure of hemp, cocoa, fiber, rattan, india rubber, wood or other material, laid on the floor of a car for passengers to clean their shoes on.

Floor Nailing Strip. A strip of wood placed between the sills, to which the floor boards are nailed. See Nailing Strip.

Floor Nailing Strip Stiffener. A metal reinforcing strip on a floor railing strip.

Floor Pipe. See Hopper Tube.

Floor Plate. See Center Pin Floor Plate.

Floor, Refrigerator Cars, Height of. See Refrigerator Cars, Floors and Ice Tanks.

Floor Stop (Door Holder). A catch for a door holder attached to the floor, in distinction from a partition stop attached to the wall or partition. See Door Holder.

Floor Stringer. See Stringer.

Floor Strip. The strips that make the grated floor of a street car.

Floor Support. See Floor Beam.

Flooring. See Floor.

Flow Meter. A device similar to a pressure gage which indicates, and in some types, also records, the flow of steam, water, air or gas.

Flush Bolt. A bolt attached to a slide which is let into a door, sash, or window, flush with its surface. A spring flush bolt is commonly called a cupboard catch.

Flush Bolt Keeper. A plate which is attached to a door, sash or window frame, and has a suitable hole, in which a flush bolt engages.

Flush Door (Box Cars). A door which is flush with the side of the car when closed. Figs. 653-655, 678, 679.

Flush Handle. A handle for a lock or latch which is placed in a recess, as of a door, sash or berth, and which does not project beyond the surface of the object to which it is attached.

Flush Sash Lift. A metal sash lift with a recess which is let into a sash flush with its surface.

Folding Door. A door made in two or more sections hinged together to permit folding.

Folding Lavatory. A wash stand for the staterooms of sleeping, private and business cars, which can be folded out of the way and out of sight. See Lavatory.

Folding Platform Tail Gate. See Tail Gate.

Folding Table Leg. See Table.

Folding Wash Stand. See Folding Lavatory.

Followers. Rectangular or circular plates or blocks of metal placed inside of the coupler yoke and bearing against each end of the draft gear. Their function is to protect the draft gear from the battering due to the movement of the drawbar and to transmit the stresses of compression or tension to the draft springs and the draft timbers. They literally "follow" the gear—hence the name. Designated Front and Back Follower. Also called Follower Plates. Figs. 1204-1207.

Follower Block. A special form of draft gear follower plate.

Follower Bolt. A piston follower bolt. See Piston.

Follower Lug. See Draft Casting.

Follower Plate. See Followers.

Follower Plate Support. A support or guide placed across the center or draft sills for the draft gear followers.

Follower Stop. See Draft Casting.

Foot Board (Freight Cars). See Brake Step.

Foot Plate (Three Stem Equipment). A cast iron wearing plate on the upper side of the passenger platform end sill. In platforms with vestibules a sliding foot plate is attached to the buffer plate and works or slides back and forth in a foot plate housing.

Foot Plate Housing. See Foot Plate.

Foot Rail. A horizontal wooden bar underneath a car seat for the passengers who occupy the next seat to rest their feet on. See Foot Rest.

Foot Rest. A support for the feet of passengers, commonly two horizontal wooden bars underneath a car seat. They may be pivoted in the center so that they can be adjusted to a comfortable position for the passengers occupying the next seat, or moved out of the way if desired. Another style is an adjustable foot rest sliding in a grooved channel. A portable stuffed carpet foot rest is usually termed an ottoman or hassock.

Foreign Car. Any car not belonging to the particular railway on which it is running. A term also used in America to designate a car used in a foreign country.

Forgings. Figs. 2955-2972; Pages 1070, 1130, 1131.

Foundation Brake Gear. The levers, rods, brake beams, etc., by which the piston rod of the brake cylinder is connected to the brake shoes in such a manner that when air pressure forces the piston out the brake shoes are forced against the wheels. Figs. 1870, 1877-1879.

Four-Point Support. See Brake Beam Support.

Frame. A structure composed of a number of members designed and arranged to withstand the stresses set up in the particular part of a car for

which it is intended. See UNDERFRAME, etc. Figs. 575, 581-625; Pages 373, 376, 377, 955.

Free Air Space (Refrigerator Car Insulation). An air space which has free communication with the outside air so that the air can circulate through it.

Freight Car. A general term used to designate all kinds of cars which carry goods, merchandise, produce, mineral, etc., to distinguish them from those which carry passengers. See also CAR, BOX CAR, GONDOLA, etc.

Freight Car Repairs. See REPAIRS.

Freight Car Lock. A lock for fastening the doors of freight cars.

Freight Equipment Cars, Marking on. See MARKING ON FREIGHT EQUIPMENT CARS.

Fresnel Lens. A lens formed of concentric rings of glass or other transparent substance, one or both sides of which are bounded by spherical surfaces.

Freight Truck. A freight car truck.

Friction Block. A casting attached to the truck bolster as a guide and to prevent wear between the bolster and transom.

Friction Buffer. A buffer in which shocks are absorbed by friction. See BUFFER.

Friction Draft Gear. Any form of draft gear which makes use of friction for absorbing and dissipating the energy of buffing and tension shocks transmitted through the couplers. See DRAFT GEAR.

Friction Draft Spring. A special spring, the design of which is such as to increase its capacity by friction between the coils. See SPRING DAMPENER.

Friction Plate. A plate to prevent wear, as a plate screwed to the wall to protect the wood work from being chafed by the seat back arms when the seat back is tilted. See BOLSTER CHAFING PLATE.

Friction Roller. A wheel or pulley interposed between a sliding object and the surface on which it slides to diminish the friction.

Frieze. A kind of plush or cloth used in upholstering. Commonly used for covering car seats.

Fruit Car. A box car equipped with some means of ventilation, for carrying produce which does not require refrigeration. Commonly used for fruit. See VENTILATED BOX CAR.

Frog Wing Gage. See GUARD RAIL and FROG WING GAGE.

Front and Back Stop. See DRAFT CASTING.

Fuel Instruction Car. A car equipped for instructing railway employees in the use of fuel.

Fulcrum. In mechanics, that by which a lever is sustained, or the point about which it moves. See BRAKE LEVER FULCRUM.

Fulcrum Hanger Bar. A support for the brake lever fulcrum of a six-wheel truck.

Funnel. An open vessel used for conveying fluids into closed vessels; a kind of inverted hollow cone with a pipe; a tunnel.

Furniture Car. A large box car, particularly designed for carrying furniture or other light freight which is bulky. See CAR.

Furring. Strips of wood placed in a wall or between sills to which to nail sheathing or flooring. The term is also applied to angle blocks glued or nailed in the inside angles of wood work, where strength and stiffness are required. See BLOCKING and NAILING STRIP.

Furring Brace Blocks. Blocks of triangular cross section glued in the angles between the sheathing and furring to give it greater stiffness.

Fuse. A wire strip or bar of fusible metal or alloy placed in series with an electric circuit and designed to melt and open the circuit when the current exceeds a predetermined value. It performs a function similar to that of a circuit breaker.

Fuse Box. A support for fuses, containing contacts for readily attaching the same, and usually provided with magnetic blow-out.

Fusee. The cone or conical part of a watch or clock, round which is wound the chain or cord. It is a very ancient mechanical contrivance, and is made of a cone form in order to equalize the power of the spring, the leverage of the cord increasing as the resistance of the spring increases and vice versa. Also used in sleeping car berths.

Also a term applied to a signaling device used, after being lighted, to drop from the rear of trains to warn following trains and prevent rear end collisions.

G

Gage. A tool or instrument used as a standard of measurement of pressure or size. See CYLINDRICAL GAGE, DUPLEX AIR GAGE, MICROMETER GAGE, PRESSURE GAGE, STEAM GAGE, etc.

(Back-Up Air Brake.) An air gage to guide the brakeman in setting the brakes with the back-up brake apparatus. See AIR GAGE.

(Wheels, Track, etc.) The distance in the clear between the heads of the rails of a railway; 4 ft. 8½ in. is the standard gage; if greater than this by more than ½ in., a broad gage; if smaller, a narrow gage. Wide gage usually means a minor and irregular or exceptional enlargement of a given fixed gage, in distinction from tight gage, a corresponding contraction.

Gage, Guard-Rail and Frog Wing. See GUARD-RAIL and FROG WING GAGE. Fig. 1607.

Gages, Journal Bearing and Wedge. See JOURNAL BEARING and WEDGE GAGES.

Gages, Limit, for Inspecting Second-Hand Wheels. See WHEELS, LIMIT GAGES FOR INSPECTION.

Gage for Measuring Thickness of Rim of Steel Wheels. See WHEELS, STEEL, GAGE FOR MEASURING THICKNESS OF RIM.

Gage, Plane, for Solid Steel Wheels. See WHEELS, SOLID STEEL, PLANE GAGE FOR.

Gages for Round Iron. See LIMIT GAGES FOR ROUND IRON.

Gage, Rotundity. See WHEELS. SOLID STEEL, ROTUNDITY GAGE FOR.

Gage, Wheel-Check. See WHEEL-CHECK GAGE.

Gage, Wheel Defect. See WHEEL DEFECT GAGE.

Gages, Wheel Flange Thickness. See WHEEL FLANGE.

Gain. In architecture, a beveling shoulder, a lapping

of timbers, or the cut that is made for receiving a timber. In car work the term generally means a notching of one piece of timber into another.

Galvanized Iron. Sheet iron covered with sal ammoniac, after first being cleaned in a bath of acid, and then coated with zinc by immersing it in a bath of the molten metal. An amalgam of 11.5 zinc and 1.0 mercury is sometimes used. See KALAMINED IRON. Page 1071.

Gas Broiler. A small cook stove heated by gas for use on parlor and sleeping cars in preparing light meals. See UTENSIL. Figs. 377-379.

Gas Burners. The jet piece of a gas lighting apparatus, at which the gas issues and combustion takes place.

Gas Holder. See HOLDER.

Gas Lamps. Figs. 2496-2517, 2519-2522, 2525, 2527-2529.

Gasket. A thin sheet of rubber, cloth, sheet metal or other material put in a joint between two pieces of metal to prevent leakage.

Gasolene Motor Car and Gas-Electric Motor Car. See MOTOR CAR.

Gate (Of a Casting Mold). The opening through which the molten metal is poured. See also PLATFORM GATE.

Gauze. See WIRE GAUZE.

Gear. In mechanics the term is used to designate a combination of appliances for effecting some result, as valve gear. See BRAKE GEAR, DRAFT GEAR, etc.

Wheels are said to be in gear when they have cogs interlocking or intermeshed. See GEAR WHEEL.

Geared Brake. A hand brake operated by means of gear wheels. Figs. 2041, 2042; Page 845.

Gear Case (Electric Motor). A case enclosing the gear and pinion of a railway motor to exclude dirt and water.

Gear Wheel. A cogged or toothed wheel. A spur wheel.

General Service Car. A car suitable for carrying a variety of classes of freight. See CAR and CONVERTIBLE CAR.

Generator (Electric Lighting). A machine for generating an electric current; driven by a belt, chain or gear from an axle; or by an engine or steam turbine mounted in a baggage car or on a locomotive. See ELECTRIC LIGHTING, AXLE GENERATOR.

Generator Apartment. An apartment in a passenger equipment car in which the electric lighting generator is located.

Generator Coils. Wrought iron pipe coiled into a spiral shape and put into the fire pot of a heater, to heat the water they contain and create a circulation through the hot water pipes of the car. Among the different types is the expanding generator coil in which the diameter of the pipe increases as the heated water ascends in it.

Generator Regulator. Fig. 2329; Page 890.

Gib and Key. A fastening to connect a bar and strap together by a slot common to both, in which a gib with a beveled back is first inserted and then driven fast by a taper key.

Gib Nut. See NUT LOCK.

Gimlet Pointed Screw. A common wood screw, which has its screw cut to a point like a gimlet, so that it can force its own way into wood.

Girder. The term girder is restricted to beams subject to transverse strain, and exerting a vertical pressure merely on their points of support. The term is almost synonymous with truss. Thus engineers speak of a "Howe truss," a "Pratt truss," a "Warren girder" and a "lattice girder." The distinction is that a truss consists of separate parts held together by pins, or even simply by pressure, which may be taken down and re-erected; whereas a girder is a single solid structure, either all one solid piece (rolled girder), or of plates riveted together (plate girder), or of combined plates and riveted lattice work (lattice girder).

Girth. See BELT RAIL.

Girth Tie Rod. A belt rail tie rod.

Gland. A stuffing box, as of a piston rod, valve rod, etc.

Glassware—For Car Lighting. Figs. 2454-2484.

Glass Water Gage. A gage consisting essentially of a vertical glass tube connected at the top and bottom with a boiler so as to indicate the height of water therein.

Glideover Seat. See WALKOVER SEAT.

Globe. A globe of hemispherical form, admitting air only from the top when used for oil or gas lamps; closed when used for electric lamps. Figs. 2364-2367, 2373-2379, 2467-2484, etc.

Globe Holder. A device for holding a globe on a lamp. Usually it consists of a metal ring at the base of the globe, in which the latter rests, and to which it is fastened with springs, screws, or by the pressure of the globe chimney on top, when the latter is adjustable. Figs. 2565, 2573; Pages 935, 954, 956.

Gondola Car. A car with sides and ends, but without a top covering. Used for the transportation of freight in bulk. Gondola cars are sometimes distinguished as high side, low side, drop bottom and hopper bottom. The floor or bottom is level. See also CAR, HOPPER BOTTOM GONDOLA CAR and DROP BOTTOM CAR. Figs. 56-99, 2945, 2953, 2954; Pages 137, 144, 145, 149, 276, 277, 965, 966, 967, 1126, 1129.

Governor (Air Brake). See AIR COMPRESSOR GOVERNOR.

Grab Handle. See GRAB IRON.

Grab Iron. A rod or bar of iron attached to freight cars for the use of trainmen in boarding the cars. Also termed hand hold and grab handle. Often more definitely specified as roof, side or end grab irons.

They are attached to both sides of the side doors at the ends of passenger equipment cars, both for the use of trainmen and for passengers while boarding a train. See HAND RAILS.

Graduated Spring. A form of compound spring in which only a certain number of the individual spirals come into action with a light load, and the others only under a heavy load. Another method of accomplishing the same end, graduating the resistance of the spring to the load placed upon it, is the use of the keg-shaped or spool-shaped spring. Under a load the part of larger diameter closes first and that of smaller diameter is much stiffer. Graduated springs have been constructed by combining rubber

and spiral springs, but they are now out of use. Graduated springs have largely been superseded by single and double nest coil springs of equal length. See Springs.

Graduating Nut (Triple Valve).

Graduating Sleeve (Triple Valve). GRADUATING SPRING.

Graduating Valve Spring (Triple Valve).

Graduating Spring (Triple Valve). A spiral spring which acts against a collar on the graduating stem to restrain the triple valve piston from moving beyond service position when a gradual brake pipe reduction is made, but which is compressed by the piston when a sudden brake pipe reduction is made. See TRIPLE VALVE.

Graduating Valve (Triple Valve). A device attached to the piston stem by a pin and whose movements are controlled by the piston. Its office is to open and close the service port in the slide valve, feeding air from the auxiliary reservoir to the brake cylinder when a service application of the brakes is made. See TRIPLE VALVE.

(Car Heating.) Used for regulating the steam supply.

Grain Door. A close fitting movable door on the inside of a box car by which the lower part of the door opening is closed when the car is loaded with grain, to prevent the latter from leaking out. Such doors are usually made so that they can be thrown over on one side of the doorway or be suspended from the roof, and thus be out of the way when they are not used. Very few cars, however, are fitted with such doors, and ordinarily a temporary arrangement is used which is nailed in place. A burlap covering is sometimes used to insure against the grain leaking out at the joints. Figs. 21, 22, 30-34; Page 121.

Grain Door Rod. An iron rod attached to the door posts on the inside of a box car, to which a grain door is fastened or hinged. The door and rod are generally arranged so that the former can be moved to one side and out of the way when the car is not loaded with grain.

Grain Shoe. A strip of wood or other material used to prevent leakage of grain from freight cars.

Grated Door. A door consisting of a wooden frame with iron or wooden bars, used on cars for carrying fruit, live stock, etc.

Grating. A perforated or slatted covering for an opening. A slat frame on the floor of refrigerator cars, to raise lading above the floor and prevent its coming in contact with water, etc.

Gravel Car. A car for carrying gravel; usually either a dump car or a flat car, the latter being most used. See BALLAST CAR, CONTRACTOR'S CAR, INDUSTRIAL CARS.

Gravity Relief Trap (Steam Coupler). An auxiliary trap, automatic in its action, which is closed by the escape of steam and held closed by the steam pressure. When the pressure is removed the weight of the valve stem tips the valve and allows the escape of the water of condensation. The pressure under which it closes is dependent on the weight of the valve stem.

Gravity Side Bearing. A side bearing which, after a movement in either direction, returns to its normal position by gravity. See SIDE BEARINGS.

Grease Box. A JOURNAL BOX.

Grille (Interior Decoration). Fret work for decoration. Used instead of panels, over doorways and in bulkheads; sometimes employed as brackets.

Grommet. The separate parts of any metallic eyelet are known as grommets. The two grommets, when compressed together (with a setting die), form the eyelet.

Ground Glass. Glass having the surface roughened by a mechanical or chemical process to destroy its transparency.

Group Spring. A spiral car spring formed of a number of separate springs, single, or nested and united by a common pair of spring plates. See SPRINGS.

Guard (For Lanterns). The exterior wire cover surrounding the globe and protecting it from accident. See also DUST GUARD.

Guard Lining Strips. Horizontal bars or strips placed in a car to keep freight from a door, ice box, ventilator, etc.

Guard Posts (Fruit Car). A row of posts standing inside of the ventilators and serving as a fender for the load packed within so as to prevent obstruction to the ventilators.

Gudgeon. The bearing portion of a shaft, particularly an upright wooden shaft. The crosshead or wrist pin of a steam engine is sometimes called a gudgeon pin.

Guide. See DEAD LEVER GUIDE, etc.

Guide Bar. See BOLSTER GUIDE BAR or COLUMN.

Guide Casting. A strip or plate of metal screwed to the wall or arm rest of a seat for the striker arms to rub against to save the wood. Also called FRICTION PLATE.

Guide Rail. A door track.

Gusset Plate. A flat plate used to fasten two parts of a metal frame together by riveting through each member and the plate, or to stiffen a joint between two pieces which are fastened together by angle plates, in which case the gusset plate is riveted to the flanges of the adjoining pieces.

Guy. A rope, chain, or rod used as a stay to steady a mast or other piece with one end in an elevated position.

H

Hair Felt (Refrigerator Car Insulation). A heavy nonconductor of heat made of hair, placed between the inner and outer linings to prevent absorption of heat. See INSULATION.

Half Elliptic Spring. See ELLIPTIC SPRING.

Hammer (Pile Driver). The heavy weight by which piles are driven. It falls between the leaders and is provided with a hammer eye or clevis, to which the shears of the hoisting rope or hammer rope are attached. Also called a TUP. Fig. 2665; Page 991.

Hammock (Sleeping Car Berth). A light hammock of twine hung lengthwise across a sleeping car berth to hold day wearing apparel.

Hand Brake. The name applied to the brake apparatus

with which all cars are equipped, which permits of the brakes being applied by hand. When cars are being switched in yards they are frequently in motion when no locomotive is coupled to them and a hand brake is necessary so that the trainmen may control them. See BRAKE SHAFT, BRAKE SHAFT CHAIN, etc., and SAFETY APPLIANCES. Figs. 2034-2079; Pages 769, 843, 845, 849, 957, 970.

Hand Brake Chain. One of the hand brake connections. See BRAKE SHAFT CHAIN.

Hand Brake Chain Carrier. A guide for the hand brake chain, riveted to the underframe.

Hand Brake Connections. The rods and chains connecting the hand brake shaft with the brake levers.

Hand Brake Guide. See BRAKE ROD GUIDE.

Hand Brake Pawl. See BRAKE PAWL.

Hand Brake Rod Guide. See LOWER BRAKE SHAFT BEARING.

Hand Brake Shaft. See BRAKE SHAFT.

Hand Brake Wheel. A wheel attached to the upper end of the brake shaft, by which the latter is turned to apply the brakes by hand. See HAND BRAKES.

Hand Car. A small and light car arranged with cranks or levers and gearing so that it can be propelled by hand by persons riding on the car. They are commonly used by section or track repair gangs. Fig. 2710.

Hand Hold. See GRAB IRON and SAFETY APPLIANCES.

Handhole. A small opening in a tank or other vessel provided with air and water tight seal which may be removed and the hand inserted for making repairs or other purposes.

Hand Rail. A bar or rail to be grasped with the hand as a help in boarding and alighting from cars, and also to prevent trainmen from being thrown from cars, due to their motion or sudden shocks.

Hand Rail Post (Tank Car). A support for the Hand Rail.

Handle Latch Spring (Motorman's Air Brake Valve). A spring carrying a latch or dog to hold the handle in any desired position.

Hanger. That by which a thing is suspended. A means for supporting shafting of machinery. See BERTH CURTAIN ROD BRACKET, BRAKE BEAM ADJUSTING HANGER, etc.

Hanger Link. A Swing Hanger.

Hanging Boards or Meat Timbers (Refrigerator Car). Transverse bars, usually resting on bogus plates, to which the load of meat is suspended from hooks.

Hard Hair. A quality of curled hair which is very stiff or rigid.

Hasp. A bar which fits over a staple and is fastened thereon by passing the shackle of a padlock through the staple, or by a pin. The other end of the hasp is attached by a pin or another staple to the door. See DOOR HASP.

Hat Hook. A metal hook on which to hang hats.

Hatch. The opening and also its cover through which ice is placed in refrigerator cars. See REFRIGERATOR CARS.

Head Block (of a Derrick or Crane). The casting carried at the top of the mast to which the boom rods, tension rods, guy rings, etc., are attached. It usually revolves upon a head block pin. See also TANK HEAD BLOCK.

Head Board. A light partition which separates one berth in a sleeping car from that next to it. It is stowed away by day in the pocket between the upper berth, when closed up, and the roof. It is secured in place at the back and front by head board bolts entering at the back into a bushing, fixed to the stop of the stationary seat back; and along the upper inside edge by a head board coupling, entering into a head board coupling keeper. The head board bolt for the front corner of the head board is of peculiar construction, designed to avoid all interruption of a flush surface by day, while still giving a secure attachment when the berth is arranged for occupancy. Fig. 390.

Head Board Bolt. See HEAD BOARD.

Head Board Bolt Bushing. See HEAD BOARD.

Head Board Coupling. A metal hasp and keeper by which a head board is fastened to the side of the car.

Head Board Plates. Reinforcing plates for a wooden head board.

Head Board Pocket. A pocket formed at the bottom of the head board by pulling out the head rest of a sleeping car seat. It is used for holding wearing apparel while the lower berth is in use.

Head-End System. A system of electrically lighting a complete railway train from a single generating plant, located either on the locomotive, on the tender, or on one of the cars of the train. Head-end generators may be steam or axle-driven. If located on the locomotive, they are driven by steam. If located on the tender or on one of the cars, they may be axle-driven or steam-driven. The head-end generator is connected to the train line system of the train by a suitable set of connections, and current is supplied to each car through the taps to the train lines. In this system it is not essential to equip each car with a storage battery, although it is generally advisable, for when so equipped the train can be broken up and separated into its units without destroying the continuity of the light on any car. See ELECTRIC LIGHTING. Page 889.

Head Lining. Any material with which the ceilings of passenger cars are covered. See AGASOTE, and LIGNOMUR.

Head Lining Nail. A nail with a large button-shaped head especially made for fastening head linings to the ceilings of wooden passenger cars.

Head Rest. The padded upper part of a seat back, against which the passenger's head rests. Also called Head Roll.

Head Roll. See HEAD REST.

Heat Guard. A sheet metal covering for the woodwork of a passenger car, to protect it from the heat of a stove.

Heater. Any apparatus for warming a car, room, or building by convection; that is, by conveying hot water, steam, or warmed air into or through the apartments. The term generally refers to any arrangements for warming apartments other than stoves, which heat by direct radiation. See CAR HEATER, HEATING APPARATUS.

Heaters of various types are often applied to refrigerator cars during cold weather, when it is desired to transport perishable products. See HEATER CAR.

(For Lamps or Lanterns.) A metallic attachment

passing around and above the flame or otherwise immediately adjacent to it, by which heat is conveyed to the oil in the reservoir below, to prevent freezing, or, in some cases to assist combustion by heating or volatilizing the oil.

Heater Box. A box applied to refrigerator cars and containing the burners for heating during cold weather while transporting perishable products.

Heater Car. A car, equipped with heating apparatus, for carrying fruits, vegetables, and other perishable products during cold weather. Refrigerator cars are frequently converted to heater cars by adding heating apparatus. Figs. 228-232, 241, 242, 266, 267.

Heater Coil. See GENERATOR COIL.

Heater Pipe Casing. A wooden or iron shelf over a heater pipe in a passenger car to prevent the feet of passengers from coming in contact with the hot pipes. The casing also forms a foot rest.

Heating Apparatus (Passenger Train Cars). See DIRECT STEAM HEATING SYSTEM; DRUM SYSTEM OF CAR HEATING; PRESSURE AND VAPOR HEATING SYSTEM; HOT WATER CIRCULATION HEATING SYSTEM; PASSENGER TRAIN HEATING.

Heater Room. A small closet, cased with sheet metal interior heat guards, to contain the heater and prevent all direct radiation.

Heater Switch. See ELECTRIC HEATER.

Helical Spring. A spring made of bar steel bent in the form of a helix. A coil or spiral spring. Figs. 1650-1654; Pages 713, 714, 715, 716, 717, 718.

High Back Seat. A type of car seat with an extra high back and frequently a head roll or head rest. See SEAT.

High Side Gondola Car. A gondola car with extra high sides and ends, for carrying coal or minerals.

High Speed Brake. An air brake designed so that a greater pressure is applied to the wheels when traveling at a high speed than at a low speed. See AIR BRAKES.

High Speed Foundation Brake Gear. See FOUNDATION BRAKE GEAR.

The principles involved in the high speed brake were demonstrated by a series of experiments known as the Westinghouse-Galton tests. These showed that a greater pressure not only could be safely applied to the wheels by the brake shoes at high speeds, but also that such considerably greater brake shoe pressure must be applied to the wheels at high speeds in order to then resist the motion of the train as effectively as it is resisted with a more moderate brake shoe pressure at low speeds.

High Window. A term sometimes applied to the small windows, located high in the side of a car, commonly used in saloons and dining car kitchens.

Hinge. A hook or joint on which a door, gate, etc., turns. It is provided with a tube-like knuckle through which the hinge pin passes.

The common door hinge is usually a butt or butt hinge, the varieties of which are the acorn butt, a large ornamental hinge, the Blake butt and the hopper butt, so called from its pointed form. The parliament hinge is a sort of T-shaped butt hinge to afford more room for screws. It is little used except for ornamental purposes. Butt hinges are either fast joint, loose joint or loose pin. The strap hinge is a common form of rough hinge for heavy doors, but it is sometimes made very elaborate and ornamental. A T-hinge is a combination of the butt and strap hinge, one-half being of each form. A double acting hinge is one which permits the door to swing either way. See BUTT HINGE, DROP DOOR HINGE, SOFA HINGE, etc. Figs. 953, 954.

Hinge Pin. The pin passing through the knuckle of a hinge and holding the two parts together.

Hog Chain (Shipbuilding). A chain in the nature of a tension rod passing from the stern of a vessel, and over posts nearer amidships; designed to prevent the vessel from dropping at the ends.

The term is applied to a certain form of trusses in car construction. A hog chain is an inverted truss rod, and usually so called when applied in connection with and in similar form to a body truss rod, the object of a truss rod being to prevent a beam from sinking in the middle, and of a hog chain to prevent sinking at the ends when supported at the middle. Also called an overhang truss or brace rod. See OVERHANG BRACE ROD, HOG CHAIN ROD.

Hog Chain Queen Post. A strut over which a hog chain passes.

Hog Chain Rod (Passenger Equipment Car). More properly a continuous counterbrace rod or an overhang truss rod.

Hoisting Block. The main block at the lower end of hoisting tackle carrying the sheave hook, or hoisting hook, to which the load is attached.

Hoisting Block Clevis. A clevis carried at the top of a hoisting block to which the fixed end of the hoisting chain is attached. In some cases it is attached to a clevis at the upper end of the boom. See CLEVIS.

Hoisting Chain (Derrick, Steam Shovel, or Crane). The chain attached to the hoisting drum at one end and to the hoisting block or boom clevis at the other, by which the loads are raised.

Hoisting Chain Sheave. A pulley sometimes placed at the foot of the mast, when the hoisting gear is at some distance from it. The term is equally applicable to the mast sheave and boom sheave at the top of those parts of a derrick, but the latter are generally otherwise distinguished.

Hoisting Drum. The barrel about which is wound the chain cable attached to the dipper block.

Hoisting Engine. The engine geared to the hoisting drum.

Hoisting Gear. The gear wheel on the hoisting drum.

Hoisting Hook. See HOISTING BLOCK.

Holder (Pintsch Gas). A tank or cylindrical container hung below a passenger equipment car, to hold a supply of gas for lighting. Also called Receiver. See also STORAGE GAS TANK.

Holder Valve (Pintsch System). A valve which controls the supply of gas from the holders to the pipes. Page 944.

Hollow Piston Rod (Freight Brakes). A brake cylinder piston rod which is made hollow to receive the push rod.

Hood (Heater). More properly a ventilator or wind scoop. A horizontal tube or covering on the outside of a car, and on top of the cold air pipe, so as to give the latter a T-shape. The air is admitted to the pipe through the ends of the hood, which are covered

with wire netting to exclude cinders. It has a valve which is moved by the current of air so as to admit it whichever way the car runs. See Platform Hood, Ventilator Hood.

Hook Bolt. A bolt having a hook at one end.

Hopper (Passenger Cars). A closet hopper; water or soil hopper. See Closet.

(Freight Cars.) See Hopper Car.

Hopper Bottom Gondola Car. A gondola car having a level floor or bottom and one or more hoppers equipped with drop doors for discharging the load. See also Drop Bottom Car, and Gondola Car.

Hopper Car. A car with the floor sloping from the ends and sides to one or more hoppers, which will discharge its entire load by gravity through the hopper doors. See Car and Tandem Hopper Car. Figs. 100-155, 2899-2905; Pages 166, 167, 183, 277.

Hopper Carry Iron. See Hopper Supporting Strap.

Hopper Chain. See Drop Chain.

Hopper Deflector. See Hopper Ventilator.

Hopper Door. A door at the bottom of the slope or hopper of a hopper car which when opened permits the load to discharge. See also Drop Door. Figs. 119-122, 694-699; Pages 166, 167, 415, 962.

Hopper Door Locking Pawl. In a hopper door gear, the catch which, when thrown into engagement with the toggle arms, prevents the arms from moving from the closed position and opening the hopper doors.

Hopper Door Operating Shaft, End for. Fig. 658; Page 398.

Hopper Door Toggle Arm (Hopper Car). A link in the drop door mechanism which is fastened to the door and force it shut when the toggle link is forced down.

Hopper Door Toggle Link (Hopper Car). The arm in the drop door mechanism which forces down the toggle arms when the winding shaft is revolved and closes the doors.

Hopper Ore Car. See Ore Car.

Hopper Plates. The metal sheets constituting the bottom of a hopper car. Also termed inclined floor or hopper slope. The term hopper plate is generally confined to the metal lining plate used in wooden hopper cars. See Hopper Slope Sheet.

Hopper Siding. The planking that forms the side of a box hopper.

Hopper Slope Sheet. A metal sheet used in the sloped floor of a hopper car.

Hopper Stay Rod. Inclined rod passing through the center sill of a wooden car and to the hopper supporting strap at the hinged end of the doors to prevent the hopper from sagging in the middle.

Hopper Support (Hopper Car). An angle riveted to the ridge of the hopper at the center and the top of the side sheet, forming a support for the hopper. It serves the same purpose as the hopper supporting strap in a wooden car.

Hopper Supporting Strap. A heavy U-shaped iron strap bent to the shape of the hopper of a wooden gondola car, and with the ends bolted to the side sills. It is usually applied at the end of the inclined floor, and in the middle of the hopper at which point the doors are hinged. Also called hopper carry iron.

Hopper Tube. The tube or chute leading from the hopper of a closet.

Hopper Ventilator. A device for exhausting air from the closet hopper to the outside of the car. Also called hopper deflector. Fig. 442.

Horizontal Brake Shaft. See Brake Shaft.

Horse Car. A car, usually of the passenger equipment type, fitted with stalls, and water and feed facilities, for carrying horses. See Car.

Horse Car Door. Specially designed to suit the conditions, and larger than standard side doors.

Hose. Flexible tubing made of woven fabrics, rubber, or metal, for conveying air, steam, water, or other fluids. See Air Brake Hose, Steam Heat Hose.

Hose Bracket. See Brake Hose Bracket.

Hose Chain. A light chain to hold up the steam hose when uncoupled and prevent its dropping to the track.

Hose Clamp. A clamp to bind the hose to the hose nipple and coupling. Sometimes called a hose band. Figs. 2020, 2021.

Hose Coupling. See Air Brake Hose Coupling.

Hose Nipple. See Air Brake Hose Nipple.

Hose Protector. A device to protect the air brake, signal or steam heat hose from injury. See also Armored Brake Hose.

Hospital Car. A car fitted with hospital appliances for use in treating injuries caused by railroad accidents. Such cars are usually run to the scene of accidents with the wreck train. Figs. 403-407.

Hot Water Circulation Heating System. A system by which the car is heated by the circulation of hot water, the water being heated either by fire in a heater carried in the car, or by steam from the locomotive, or by a combination of both. Figs. 2200-2215; Page 864.

Hot Water Heater. See Baker Heater.

Hot Water Pipes. Pipes running along the side of a car under the seats, and containing hot water by which the car is heated. Between the seats the pipes on the side of the car have a hot water pipe guard rail running over and above them.

House Car. An enclosed freight car.

Housing. A term frequently applied to any part which encases some or all of the working parts of a machine.

Hub (Car Wheel). The central portion into which the axle is fitted.

Hub Bolts (Steel-Tired Wheels). Bolts fastening the face plates to the hub.

Hydraulic Jack. A jack in which the power is exerted by means of the pressure of some liquid acting against a piston or plunger. See Jack.

I

I-Beam. A rolled steel commercial bar whose cross section has the form of the letter I.

I-Beam Type Bolster. A bolster whose cross section has the shape of the letter I.

I-Section Bolster. See I-Beam Type Bolster.

Ice Bunker (Refrigerator Car). The receptacle or compartment in which the ice is placed in a refrigerator car. Figs. 202, 211, 219, 237-241, 243-254.

Ice Car. A car for transporting ice, usually constructed with insulation similar to a refrigerator car, but without ice tanks or ventilators. See also REFRIGERATOR CAR.

Ice Pan (Refrigerator Cars). A receptacle for carrying ice in cars which do not have end ice bunkers.

Ice Tanks, Refrigerator Car. See REFRIGERATOR CAR.

Icing Door. A door in the roof of a refrigerator car through which ice and salt are placed in the ice tanks.

Impact Tests. An individual paper on the impact between freight cars in switching service, by Professor Louis E. Endsley, will be found in the 1915 M. C. B. Proceedings. It includes a description of the testing and recording apparatus and the results of a series of tests. See DRAFT GEAR.

Imperial Gallon. An Imperial (British) gallon contains 277.274 cubic inches. An Imperial gallon of water weighs 10 lbs.

Independent Brake. See AIR BRAKES. Page 769.

Inclined Floor Timbers (Hopper Car). The wooden sills to which the sloped floor of a hopper car is nailed.

Indicator (Car Heating). Used in connection with the regulation of the hot water circulation heating system. See PASSENGER TRAIN HEATING.

Indirect Lighting. A system of lighting in which the light is not thrown directly on an object but thrown upward and reflected.

Industrial Cars. Railway cars of various types such as dump, hopper, flat, etc., used in industrial plants, mines, construction work, etc. Figs. 2891-3046; Pages 1089, 1090, 1121, 1122-1124, 1125, 1126, 1127, 1128, 1129, 1132, 1142, 1143, 1144.

Inlet Valve (Steam Heating). The valve controlling the inflow of steam to the heater pipes.

Injector (Car Heating). Used in connection with the regulation of the hot water circulation heating system. See PASSENGER TRAIN HEATING.

Inside Casing (Baker Heater). Sheet iron or steel plate bent and riveted into the shape of a frustum of a cone, which forms the top of the fire pot.

Inside Ceiling (Refrigerator Car). The inside layer of light boards in the roof of the car. More properly, CEILING.

Inside Corner Brace. See CORNER BRACE.

Inside Cornice (Passenger Car Interiors). A molding fitted in the angle where the roof joins the side of the car.

Inside Cornice Fascia. A projecting board which forms a molding or ornament under the inside cornice.

Inside End Piece (Passenger Truck Frame). The end piece which is nearest to the center of the car. It is usually straight, while the outer one is cut away on top to make room for the draft rigging.

Inside Hung Brakes. Brake attachments for trucks in which the brake shoes and beams are between the wheels. When attached on the outside they are termed outside hung brakes.

Inside Lining Stud. A vertical strip or post extending from the side sill to the belt rail to serve as a nailing strip for the inside lining.

Inside Roof. A light board roof or ceiling under the main roof and separated from it by the purlins.

Inside Window Panel. A panel inside of a passenger car between the windows.

Inside Window Sill. A horizontal piece of wood or metal under the window on the inside.

Inside Window Stop. A wooden or metal strip attached to a window post on the inside of a window blind or an inner sash of a double window. It forms a groove in which the blind or window sash slides. Also called window casing. Sometimes the window mording forms a stop on the inside. See WINDOWS.

Inspection Car. A car used for inspecting track and right-of-way. See HAND CAR, VELOCIPEDE CAR. Figs. 2697-2712.

Instruction Car. A car used for the instruction of railway employees in matters pertaining to their work. See AIR BRAKE, FUEL AND LIGHT INSTRUCTION CAR. Figs. 2713-2719.

Insulating Paper (Refrigerator Cars). A heavy paper or other material, specially prepared to make it a non-conductor of heat, placed between the linings as part of the insulation of the car. Figs. 199-202; Pages 206-209.

Insulation (Refrigerator and Heater Cars). A system of walls, and dead air-space used in the construction of the sides, ends, roof and floor to make them poor conductors of heat, thus facilitating the keeping of the contents of the car cool or warm, as may be desired. See REFRIGERATOR CARS. See also Figs. 846-848, 862, 863; Pages 457, 458.

Insulation Methods and Apparatus for Testing. See REFRIGERATOR CARS.

Insulation Paper for Refrigerator Cars. See REFRIGERATOR CARS.

Interior Finish or Inside Finish (Passenger Cars). A term used to designate the fine wood, metal, or composition paneling and sheathing used on the inside walls, to distinguish it from the outside sheathing. Figs. 846-860; Page 455.

Intermediate Cross Tie. A timber sometimes framed across the longitudinal sills of a wooden car about half way between the cross tie timbers and the body bolster.

Intermediate Floor (Passenger Cars). A floor consisting of boards placed between the sills and between the deafening ceiling, or under floor, and the upper or main floor. Its purpose is to exclude noise and cold.

Intermediate Lining (Refrigerator Car). See BLIND LINING.

Intermediate Sill. The main longitudinal members of an underframe between the side sills and the center sills. Seldom used in steel construction.

Internal Cylindrical Gage. See CYLINDRICAL GAGES.

Internal Screw Gage. A solid steel cylinder with a screw thread on it, for testing the diameter of female screws.

Inverted Arch Bar. A bottom arch bar.

Inverted Body Queen Post. A post in the side of a car body which supports the inverted body truss rod or overhang truss rod. See QUEEN POST.

Inverted Body Truss Rod. A truss rod used as a hog chain.

Iron Paste, Specifications for Oxide of. Pages 1063, 1064.

J

Jack. A machine for raising heavy weights, as a car. It commonly consists of one or more screws, turned

by a lever and working in a case, which rests upon the floor or ground. Jacks take various names from their forms, sizes and shapes, and are designated as bell base, broad base, claw, low, ball-bearing, etc., and also from the uses for which they are designed, as journal box jack, traversing jacks, track jacks, etc. See Screw Jack, Ratchet Jack. See also Hydraulic Jack. Figs. 3087-3089; Page 1173.

Jack Arms. Heavy beams with jack screws at the ends which are put out on each side of a steam shovel or a locomotive crane at the forward bolster and supported on blocking. They prevent the car body from overturning due to the reaction of the load on the boom. Also called outriggers.

Jack Screw. A jack screw working on a jack screw pin or jack arms attached to the body, for relieving the springs of the cars from action and making the platform a rigid body. Tongs or clamps attached to the track are used to prevent the car body from rising when on the jack screws. Another device used for this same purpose is a bolster jack screw.

Jacking Block. A Jacking Plate.

Jacking Plate. A plate commonly applied to a steel side sill to protect it from damage when the car is being raised on jacks.

A topical discussion on the application of lugs to steel and steel underframe cars for jacking up car bodies will be found in the 1909 M. C. B. Proceedings, page 98.

Jamb (Door). The door post on each side of the door proper.

Jaw Bolt. A bolt with a forked end.

Jib (Derrick or Crane). More properly called Boom.

Joint Bolt. A bolt used for fastening two timbers when the end of one joins the side of another. The lug bolt is another form used for the same purpose.

Journal. The part of an axle or shaft on which the journal bearing rests.

Journal Bearing. A block of metal, usually some kind of brass or bronze, in contact with a journal, on which the load rests. In car construction the term when unqualified means a car axle journal bearing. A standard shape has been adopted by the American Railway Association, and a Recommended Practice for its composition specified.

A lead-lined journal bearing is one coated on the inside with a thin sheet of lead to make it self-fitting on the journal. Babbitt metal in some of its many forms is used for car journal bearings occasionally, and almost universally for the bearings of machinery.

In order that the journal bearing may be more easily removable, and to distribute the load more equally, a journal bearing key, or wedge, is used to hold the bearing in place. Roller and ball bearings have also been used to some extent in car construction.

Journal Bearing Key. See Journal Box Wedge.

Journal Bearings for Passenger and Freight Equipment Cars, Specifications for. Figs. 1529-1537; Page 663.

Journal Bearing and Wedge Gages. Figs. 1531-1533.

Journal Boxes and Details. Figs. 1521-1583; Pages 657-665, 669, 671, 673, 675, 955.

Journal Box. A metal box or case which incloses the journal of a car axle, the journal bearing and key, and which holds the oil and packing for lubricating the journal. Also called an axle box, car box, grease box, housing box, oil box, and pedestal box. British, usually axle box. Figs. 1522-1583; Pages 657-655, 669, 671, 673, 675, 955.

Journal Box Bolts. The bolts on either side of the journal box which secure it between the arch bars and the pedestal tie bar, or to some forms of cast steel truck side frames.

Journal Box Cover. See Journal Box Lid.

Journal Box Cover Bolt. A bolt used to fasten covers which have no hinge, to the box.

Journal Box Guide. See Pedestal.

Journal Box Jack. See Journal Jack.

Journal Box Lid. A door or lid covering an opening in the end of the journal box, by means of which oil and packing are supplied and journal bearings are inserted or removed. Such covers usually are made of cast iron, malleable iron or pressed steel—sometimes of wood. They usually are held closed by a spring.

Journal Box Lid Spring. A spring to hold the lid in place.

Journal Box Wedge. A device used to hold the journal bearing in place; to distribute the load evenly over the bearing; and to allow it to be removed easily. Also called a journal box key. Figs. 1522-1532, 1557, 1558.

Journal Brass. A Journal Bearing.

Journal Jack. A small jack used for relieving the weight from car journals for the purpose of changing bearings or brasses. See Jack.

Journal Packing. Threads of wool or cotton or mixtures of these into which is incorporated mechanically curled vegetable fiber, often cocoanut fiber, to impart to the product an elasticity not possessed by wool or cotton threads. The material is saturated with lubricating oil and placed in a journal box so that it comes in contact with the lower half of the journal. Sometimes called packing or dope. Various special compositions have been developed, sometimes with springs inserted in the mass to impart greater resiliency.

Journal Packing Guard. A device to keep journal packing in place.

Journal Packing, Method of. See Page 1536.

Journal Spring. A spring supporting part of the weight of a car which is placed directly over the journal, and which usually rests on the journal box under the truck frame.

Jumper. A short conductor cable used to connect two electric circuits.

Jute. A coarse vegetable fiber raised chiefly in India and used for making bags, matting, ropes, etc. It is sometimes used in railroad cars in the form of matting or as burlap in upholstering car seats.

K

Kalamined Iron. Sheet iron, coated with an alloy of zinc, lead, tin and nickel. The alloy melts at a lower temperature than common zinc, and is claimed to give a more durable compound as well as a thinner and more adhesive coating. Galvanized iron is sheet iron coated with zinc. See Galvanized Iron.

Keeper. A ring, strap, pocket, or like device for detaining an object.

The box on a door jamb into which the bolt of a lock protrudes when shut. When the keeper is for

a beveled latch bolt, which is moved by contact with it, it is more commonly called a strike plate. They are also further designated by the name of the lock or latch which they accompany.

The latch of a hook, which prevents its accidental disengagement.

Key. In general sense, a fastener; that which fastens; as a piece of wood in a frame of a building. Hence a pin inserted in a hole in a bolt, and used to secure the bolt or its nut. A split key is a special form.

An instrument for opening or shutting a lock by pushing the bolt one way or the other.

A block over the top of a journal bearing, called in full Journal Bearing Key. This part is also commonly called a wedge.

A beveled bar used with a gib to form a gib and key.

Key Bolt. A bolt slotted near the end to receive a key, which takes the place of a nut.

Key Pin (Lock). The pivot on which the key turns when inserted in the lock.

Key Ring (Tire Fastening). A mode of securing the tire to the wheel, composed of two rings, one of U-section and the other nearly rectangular. The former ring holds the tire and wheel together, and the latter ring holds the former in place, filling up the groove in the tire. When both rings are in place the outer lip of the groove in the tire is slightly hammered over, thus gripping the second or key ring, and retaining it in place.

Key Slot (Coupler). The slot or slots in the coupler butt and draft sills through which the draft key are inserted.

Kicker. See Coupler Knuckle Kicker.

Kicking Coil. A coil of wire consisting of about ten turns wound on a wooden core; it is located in the feed circuit between the lightning arrester and controller, and acts as an inductive resistance to the passage of lightning discharge through the apparatus. See Lightning Arrester.

Kilowatt. One thousand watts.

King Bolt or **King Pin.** See Center Pin.

King Post (Truss). A single post or distance piece between a truss rod and the chord of a truss or beam. If two such posts are used they are called queen posts.

Kitchen (Dining Car). A large compartment at one end of the car provided with all the facilities of a well-organized kitchen. See Dining Car

Kitchen Car. A combined day coach and dining car for use on trains where a regular dining car could not be profitably run. More commonly called Cafe Car or Cafe Coach. Figs. 371-373.

Knee Iron. An L-shaped or angle iron casting or forging which is fastened to the corner where two timbers are joined to strengthen the joint.

Knuckle (Couplers). The rotating coupling hook by means of which coupling is effected when the knuckle is locked by the catch or lock. It must conform to certain contour lines adopted by the American Railway Association. Figs. 1231-1323; Pages 560, 561, 567, 571, 579, 580, 583, 955, 961.

. (Of a Hinge.) The central tubular projections which carry the hinge pin. In mechanics the term is of wide and general application to many similar parts.

Knuckle, Car Coupler. See Coupler.

Knuckle, Contour Line and Limit Gages. See Coupler.

Knuckle, Emergency. See Emergency Coupler Knuckle.

Knuckle Joint. A joint in which a projection on each leg or leaf of a device is inserted between corresponding recesses in the other, the two being connected by a pin or pivot on which they mutually turn. The legs of dividers and the leaves of door hinges are examples of true knuckle joints. The term, however, has been somewhat commonly restricted to compound or universal joints designed to act in any direction. See Coupler.

Knuckle Kicker. See Coupler Knuckle Kicker.

Knuckle Lock. See Coupler Knuckle Lock.

Knuckle Opener. See Coupler Knuckle Opener.

Knuckle Pin (Coupler). The pin holding the knuckle in the jaws of the coupler. Sometimes called pivot pin.

Knuckle Pin Plate. A plate used in connection with three-stem equipment.

Knuckle Throw. A device which throws the knuckle of a car coupler open when the uncoupling rigging is operated.

Knuckle Pivot Pins, Specifications for Heat-Treated, for Passenger and Freight Equipment Cars. See Page 563.

L

Label. See Air Brake Hose Label.

Label Box (Postal Car). A small box in which the labels for letter pouches are carried. See Postal Cars, Fig. 462.

Ladder. Bars of wood or iron attached to the side or end of a freight car or caboose so as to form steps by which persons may climb to and from the top of the car. The individual bars, whether of wood or iron, and whether round or square, are termed ladder rounds. They are sometimes fastened at their ends to ladder side rails. The handles alongside of the ladder are termed grab irons, or hand holds, or sometimes corner handles; the one placed on the roof near the ladder is called the roof grab iron or ladder hand rail. See Upper Berth Ladder, and Safety Appliances. Figs. 636-644; Pages 389, 390.

Ladder Bolt. A bolt designed especially for securing the ladder rounds at the corner post when two rounds are directly in line on the side and end of the car.

Ladder Round. A cross bar or step of a ladder. See Safety Appliances.

Ladder Side Rails. The vertical side pieces to which the ladder rounds are attached.

Lag Screw. An iron bolt with a square or hexagonal head, and with a wood screw thread cut on it; intended to screw into wood.

Lamp. See Alcove Lamp, Argand Lamp, Berth Lamp, Caboose Deck Lamp, Deck Lamp, Side Deck Lamp, Tail Lamp. Figs. 2279, 2280, 2359-2453, 2495-2529, 2533-2562, 2565; Pages 954, 956.

Lamp Alcove. A metal casing or lining for a recess in the side of a car to contain an alcove lamp.

Lamp Arms. Rods by which a lamp is attached to the ceiling of a car. Some lamp arms have bracket angles to support the shade, and are then called bracket arms.

Lamp Bottom. The lower portion of a lamp which is removable. Contains the wick, burner and oil.

Lamp Burner. That portion of a lamp by which the opening on the top of the reservoir is closed, which holds the wick, and by which the latter is adjusted. In gas lighting, the burner is the tip where the gas escapes and is ignited. See BURNER.

Lamp Canopy. See SMOKE BELL.

Lamp Chimney. A glass tube which incloses the flame of a lamp, conducts away the smoke and gases and produces the necessary draft.

Lamp Chimney Bracket. A projecting metal arm attached to the side of a car and carrying a chimney holder, by which a lamp chimney is held in place.

Lamp Chimney Reflector. Usually a reflector with a hole in the center in which the chimney is inserted.

Lamp Fount. The receptacle for the oil burned in a lamp. Also called lamp reservoir.

Lamp Globe. A glass or porcelain case or vessel inclosing or surrounding the flame of a lamp or candle, and intended to protect the latter from wind. Lamp globes are approximately globular in form, in distinction from a lamp shade, which flares at the bottom, but are often made of different shapes, as round, pear-shaped, etc. Figs. 2454-2484.

Lamp Globe Chimney. A metal tube attached to the top of a lamp globe for conducting away the smoke. A shade cap is an equivalent device for a lamp shade.

Lamp Hoop. A ring with an interior screw thread for attaching to cheap oil lamps to receive the burner.

Lamp Jack. A cap or covering over a lamp vent on the outside of a car to exclude rain and prevent downward currents of air.

Lamp Key (Gas). A substitute for the ordinary cock of gas fixtures, used to prevent unauthorized tampering with the burners. Fig. 2247; Page 885.

Lamp Panel. A small switchboard, generally placed in a locker of an electrically lighted car, upon which are mounted switches for controlling the lamps and ventilating fans. Fig. 2286; Page 909.

Lamp Regulator. Figs. 2310-2312, 2326-2329, 2331; Pages 890, 917.

Lamp Regulator Relay (Electric Lighting). An automatic and very sensitive electrical device for controlling the action of the lamp regulator. Such a device must be very sensitive in operation yet robust enough in construction to withstand railway service. It is genrally enclosed for protection against dust and accident, but when once adjusted should not require attention for long periods.

Lamp Reservoir. See LAMP FOUNT.

Lamp Shade. A conical shaped reflector placed over a lamp to reflect the light downward. Figs. 2454-2484.

Lamp Socket. A socket which holds an electric lamp. A bracket for supporting a tail lamp or a signal lamp. See also MARKER BRACKET.

Lamp Switch (Electric Lighting). A switch for controlling the lamp circuit of the car and which, by opening or closing, turns off or throws on all of the lights. This switch is generally mounted on or near the lamp panel.

Lamp Vent. An opening in the roof through which the gases from a lamp escape.

Lantern. A portable lamp the flame in which is protected from wind and rain by glass, usually in the form of a globe surrounded by wires, called guards. According to the number of these wires the lantern is called single, double or triple guard. The conductor's lantern is one with a bail or handle large enough to be carried on the arm, leaving both hands free. Figs. 2541-2560.

Lantern and Flag Holder. A device for displaying signals on rear of trains. See MARKER BRACKET.

Latch. The primary sense of this word is—to catch, to close, stop, or make fast; hence, an attachment to a door, window, etc., to hold it open or shut, is called a latch. The ordinary distinction between a latch and a lock is that a lock is closed and opened with a separate key, and usually has a square bolt; whereas, a latch has no separate key, and usually has a beveled bolt which snaps shut automatically by contact with the keeper or strike plate. The most exact distinction between a latch and lock seems to be the form of the bolt, and not the use or disuse of a key. See SASH LOCK. Latches named from the use which they subserve are the following: BERTH LATCH, DECK SASH LATCH, SAFETY BERTH LATCH, SPRING DOOR LATCH, etc.

A sliding door latch, or lift latch, has a beveled hook instead of a beveled bolt, but operates upon substantially the same principle. Nearly all forms of latches are spring latches. A night latch is a large and carefully made form of an ordinary latch, which can be opened from the outside by a key. A cupboard latch is any form of small latch. A rim latch, like a rim lock, is one attached simply to the inside of the door, in distinction from a mortise or rabbeted latch (both rarely used), which is boxed into the door. Figs. 958-970.

Lateral Motion (Truck). A movement sidewise. Rollers between the journal box and spring seat provide for this on certain types of pedestal trucks.

Lateral Motion Spring. A spring sometimes used to check excessive lateral motion in car trucks. See also SWING BOLSTER.

Lavatory. A room provided with washbowl, towels, combs, brushes, etc., in which passengers may make their toilet. Parlor and sleeping cars are provided with separate lavatories for men and women, which are separated from the saloons. The best and most modern coaches have a lavatory. A saloon is sometimes termed a lavatory. The term is also used in a more restricted sense to designate the wash basins and their equipment or the basin for dental purposes, which is termed a Dental Lavatory. See WATER SUPPLY and FOLDING LAVATORY. Figs. 1041-1071.

Lead. See RED LEAD, WHITE LEAD.

Lead-Lined Journal Bearing. A journal bearing which has its inner surface covered with a thin layer of lead, so that it may fit itself to the journal as soon as subjected to wear. See LINED JOURNAL BEARING, Page 663.

Leader (Pile Driver). The long vertical timbers serving to guide the hammer in its fall.

Leader Cap (Pile Driver). A cross piece connecting

the two leaders at the top and carrying the main sheave and pile hoisting sheave of the hoisting gear.

Leader Stay. An oblique diagonal brace, attached at the upper end to top stringers, serving to stiffen the leaders.

Leakage Groove (Air Brake Cylinder). A small passage past the brake piston to prevent application of the brakes by trifling leakages of air.

Leatheroid. A substance somewhat resembling leather, and somewhat similar to vulcanized fiber in its general character and appearance. It is made by treating paper with sulphate of zinc. See also FABRIKOID, PANTASOTE, MERITAS, and TEXODERM.

Leg Rest (Reclining Seats). A bracketed and adjustable shelf, which may be used on a chair seat to support the limbs when the seat or chair is in a reclining position. It is adjusted by a leg rest ratchet and leg rest pivot casting, or by a leg rest slide fitting in a leg rest socket casting.

Lens. An optical instrument for conveying rays of light upon a fixed path or fixed point.

Letter Board (Passenger Equipment Car Exteriors). A horizontal board under the cornice, extending the whole length, on which the name of the company to which the car belongs is usually painted. The letter board occupies the frieze of the car, and is sometimes so called.

Lettering Cars. See MARKING ON FREIGHT CAR EQUIPMENT.

Letter Case (Postal Car). An open-front case or rack divided into small compartments or "pigeon holes" and used for the distributing of letters. See POSTAL CAR.

Letter Drop (Postal Car). An aperture through the side of the car provided with a plate with a spring flap for receiving letters for the post. A letter box lid. Fig. 452.

Letter Drop Chute (Postal Car). The chute extending from the letter drop on the outside of a postal car to the floor inside of the car. Fig. 452.

Lever. In mechanics, a bar of metal, wood or other substance, turning on a support called a fulcrum. See BRAKE LEVER, UNCOUPLING LEVER, etc.

Lever Connection. See BRAKE LEVER CONNECTION.

Lever Faucet. A self-closing faucet, shut by a spring and opened by the movement of a handle or lever. Also called telegraph faucet. They are called vertical or horizontal according to the direction of the pipe or opening into which they are fastened. Fig. 1058.

Lever Frame (Hand Car). A wooden frame shaped somewhat like a letter A, on top of a hand car, which supports the lever shaft and lever.

Lever Frame Cap (Hand Car). A short horizontal piece of timber, to which the lever journal bearings are fastened.

Lever Frame Tie Rod (Hand Car). A vertical rod by which the lever frame cap is bolted to the floor frame.

Lever Guard. A guide on a platform rail for a platform uncoupling lever.

Lever Guide. See LEVER GUARD and DEAD LEVER GUIDE.

Lever Shaft (Hand Car). A short iron shaft to which the propelling levers are attached.

Levers, Marking of. See FOUNDATION BRAKE GEAR.

Library Car. Generally a parlor or observation car equipped with a small library containing books and periodicals for the use of passengers. See CAR.

Lift. A finger hold attached to windows and window blinds to grasp in raising or lowering them. See SASH LIFT.

Lift Latch or Sliding Door Latch. A lock, the latch of which is lifted by turning a knob, instead of drawing it backward. See LATCH.

Light Instruction Car. See INSTRUCTION CAR. Fig. 2714.

Light Weight of Car, Stenciling of. See FOUNDATION, BRAKE GEAR.

Lighting. See ACETYLENE GAS, ELECTRIC LIGHTING, PINTSCH GAS, VAPOR SYSTEM, TRAIN LIGHTING.

Lightning Arrester. A device for protecting the electrical apparatus from damage by lightning.

Lignomur. A decorative head lining made from strawboard or paper, with figures stamped or embossed upon it. The figures are usually light colored, while the background is darker. It is glued to a thin narrow matched ceiling or may be applied directly to an old veneered ceiling. See also AGASOTE.

Limit Gage. A term applied to many forms of gages which are used for determining whether pieces do not exceed or fall below a certain specified range of dimensions. See GAGE.

Limit Gages for Round Iron. Fig. 2779; Page 1076.

Limit Gages for Inspecting Second-Hand Wheels. See WHEELS, LIMIT GAGES FOR INSPECTING.

Limiting Valve. See PRESSURE VALVE.

Line Car. A short term to designate cars belonging to the various fast freight lines which run over several roads between the leading shipping points east and west.

Line Switch. A combination of one or two unit-switches, assembled in a case, for handling main power currents.

Lining. The lining which is nailed to the insides of the posts of freight, baggage and other cars. In box cars it extends half way up only, to the girth. Inside lining becomes inside sheathing when it is carried up to the roof, and in some types of car construction is the only sheathing for the car, the frame being left exposed on the outside.

Lining for Outside-Framed Cars. Fig. 574; Page 367.

Lining Strips. Wooden or metal strips put on the inside of freight or baggage cars to protect the inside of the car from being injured by freight or baggage.

Lining Stud. Vertical studs placed between the posts and over or under the braces, and to which the lining is nailed. See NAILING STRIP.

Link. A short connecting piece, of circular or other equivalent shape; as one of the oval rings for divisions of a chain. See also DRAFT LINK.

Link Hanger. A swing hanger in the form of a link.

Link Hanger Eye Bolt. A bolt passing through the truck transoms, from which a short swing hanger is suspended.

Link Pin. A coupling pin.

Link and Pin Coupler. An old type of drawbar by which cars were connected by a link and a pin.

Link Suspension (Electric Lighting). A system in which the axle generator is suspended on a pair of parallel links supported on the truck frame, the adjusting of

the driving belt or chain being accomplished by a device which swings the links slightly. See SUSPENSION.

Linoleum. A form of floor covering manufactured from linseed oil, prepared by a special process, mixed with ground cork and backed with canvas. Another floor covering of substantially the same nature as linoleum is known as Corticine.

Lintel. The horizontal part of a door or window frame above the sash.

Lip Lamp Chimney. One with an indented ring near the bottom, for use with screw lamp burners.

Liquid Soap Fixture. A container for holding liquid soap. Usually placed above the wash basin in a car. lavatory. Figs. 1066, 1068, 1071.

Live Lever. The one of a pair of truck brake levers to which the brake power is applied from the cylinder.

Lock. Generally, a fastening of any kind operated by a key. Specifically, one having a dead bolt as distinguished from one having a spring latch bolt, the latter being technically termed a latch. A rim lock is one applied to the surface of a door. A mortise lock is one designed to be mortised into the edge of a door. A rabbeted lock is one with an offset front to conform in shape to a rabbeted door. A dead lock is one in which a bolt is moved by a key and not a spring. A latch is a lock with a spring bolt. A night latch is a lock with a spring bolt operated from the outside only by a key and from the inside usually by a knob. A padlock is a detached lock provided with a shackle adapted for engagement with a hasp or staple. According to their uses locks are divided into berth locks, door locks, freight car locks, grain door locks, seat locks, sliding door locks, etc. See also SASH LOCK. Figs. 955-970; Pages 957, 958.

(Car Coupler.) The catch which drops in front of the knuckle horn and holds it shut, thus locking the couplers together.

Lock Case. The outside or covering part of a lock, more particularly a padlock.

Lock Chain. A chain by which a padlock is fastened to prevent its being lost.

Lock Keeper. See KEEPER.

Lock Lifter. See COUPLER LOCK LIFTER.

Lock Nut. The outer one of a pair of nuts on one bolt, which, by screwing up separately to a tight bearing locks the inner one. A large number of special forms of lock nuts and nut locks, which serve the same purpose, are in use which are not strictly included under the above definition. See NUT LOCK. Figs. 2784-2824; Pages 1084, 1085, 1086, 1087, 1088.

Lock Seal. A piece of glass, lead or paper, which forms a seal for a lock, so that the latter cannot be opened without the seal being broken and the act being known.

Lock Set. See COUPLER LOCK SET.

Lock Washer. A washer for locking the nut in place while it is being tightened or drawn up.

Locker. A small compartment or closet for storage.

Locomotive Crane. A self-propelling car with a crane mounted upon it. See also WRECKING CRANE. Figs. 2628, 2647-2674; pages 972, 973, 985, 987, 989, 991, 993, 995.

Locomotive Valve (Steam Heating). The valve on the locomotive which admits live steam to the train steam line.

Lodging Car. A passenger or box car fitted up with sleeping accommodations for men at work on the line of a road. More commonly called boarding car.

Log Bunk. See BUNK, and LOGGING TRUCK.

Logging Car. A special type of car for hauling or carrying logs, usually consisting of two trucks and a skeleton frame, but sometimes provided with machinery and power for hauling by means of a cable. See CAR. Figs. 2891-2894, 2898, 2946; Pages 1126, 1144.

Logging Truck. A truck used in logging cars. The member corresponding to the body bolster in other types of trucks is called a bunk and is so arranged that timber or logs may be chained in place on it. Fig. 2897.

Lookout (Caboose). See CUPOLA.

Loose Berth Hinge. A berth hinge, the two parts of which are detachable.

Lorry. A small push car used in railroad construction work for moving rails, ties, etc. See PUSH CAR.

Lounging Car. A term applied by some railways to a special type of parlor car arranged in two or more compartments, such as reception room, smoking room, etc., and generally having movable instead of fixed seats. Also called Club Car.

Lower Berth (Sleeping Cars). The bed nearest the floor made up by pulling out the seats and dropping down the seat backs. The mattress for it is carried by day in the pocket formed by the upper berth. See BERTH.

Lower Brake Shaft Bearing. An eye or guide for a vertical brake shaft, near the lower end. The support at the lower end is preferably called the brake shaft step.

Lower Chord (Truss). The lower outside member. In the side trussing of a freight or passenger car the side sill is the lower chord.

Lower Deck. The main roof of a passenger equipment car on each side of the clere-story or upper deck.

Lower Deck Carline. A short carline extending under the lower deck or main roof only.

Lower Deck Headlining. The inside finish of the lower deck. It forms the top finish for the upper berth in sleeping cars. See HEADLINING.

Lower Deck Roof Support. See LOWER DECK CARLINE.

Lower Wainscot Rail (Passenger Car Interiors). A longitudinal rail immediately above the truss plank. The upper wainscot rail comes directly below the window.

Lubricator. An instrument used for applying a lubricant to a journal or other moving part. Also called oiler.

Lug. A projecting stud or ear to afford a bearing or point of attachment.

Lug Bolt. A strap bolt with a lug turned up at one end to enter a mortise in the timber and in part to relieve the attaching bolts from strain.

Lumber. Figs. 2764-2772; Pages 1042-1055, 1056, 1057.

Lumber Door. A door placed in the end of a box car for removal of lumber. Figs. 257-263; Page 237.

Lumber Specifications. Pages 1047-1055.

Lunch Counter Car. A passenger equipment car fitted up with a lunch counter for serving light meals.

M

Magnets, Application and Release. Used in connection with electro-pneumatic brakes. See ELECTRO-PNEUMATIC BRAKE.

Mail Apartment. Similar to an alley apartment, but extending the full width of the car. See ALLEY APARTMENT.

Mail Bag Hook (Postal Car). A hook for securing the mail bags to the mail bag rack. See POUCH RACK.

Mail Bag Rack (Postal Car). A rack for mail bags, constructed of metal rods and provided with hooks to hold the mail bag in an open position to receive mail as it is sorted on the distributing tray or table. See POUCH RACK.

Mail Car. See POSTAL CAR.

Mail Car Lamp. A lamp used for lighting mail or postal cars.

Mail Catcher. A device, attached to the outside of a postal car, provided with a movable arm to take a mail pouch from a post at the side of the track while the train is in motion. Also called pouch catcher. Fig. 450.

Mail Catcher Bracket. The brackets or sockets on either side of the postal door which hold the mail catcher.

Main Cock (Pintsch Gas Lighting). A cock usually placed in the saloon for the control of the low pressure supply. It regulates all the burners at once, in addition to which there are separate cocks on each lamp fixture.

Main Cock Cover (Pintsch System). A cast-iron cover with hinged lid to fit over the key shaft of the main cock. It is screwed to the side of a car or to a bulkhead.

Main Floor (Refrigerator Car). The top layer of boards in the floor of the car.

Main Reservoir (Air Brake). A cylindrical tank, carried on the locomotive, or motor car, to hold a supply of compressed air. So called in distinction from the auxiliary reservoirs under each car.

Main Roof (Refrigerator Cars). The outside roof. See CAR ROOF. On cars with clere-stories, the lower deck, or that part of the roof over the sides of the car and on either side of the deck or clere-story.

Making Up Trains. See AIR BRAKES.

Male Center Plate. The body center plate is sometimes called a male center plate. See CENTER PLATE.

Malleable Iron. Cast iron which has been annealed and the brittleness greatly decreased by packing the castings in iron pots containing forge scale, hematite ore or some other oxide of iron and subjecting them to a continued red heat for a period of several days. They are then allowed to cool slowly. The change which takes place is internal, and while little or no carbon is removed its physical condition is changed from graphitic to amorphous or cement carbon and the iron is rendered less brittle. Malleable castings can be bent within moderate limits, but are not truly malleable like wrought iron.

Malleable Iron Castings for Passenger and Freight Equipment Cars, Specifications for. Pages 1065, 1066.

Manhole. An opening in a boiler or tank to enable a man to enter and make inspection or repairs.

Manhole Cover. A plate or lid to close a manhole.

Manhole Cover Chain. A chain with which a manhole cover is fastened to a tank to prevent it from falling when the manhole is open.

Manhole Hinge. A hinge by which a manhole cover is attached to the manhole ring.

Manhole Ladder (Tank Car). An iron ladder extending down into the tank under the manhole to allow workmen to descend for purposes of cleaning, inspection or repairs.

Manhole Ladder Brace (Tank Car). A wrought iron piece attached to the inside of the tank and to the manhole ladder to keep the latter in a vertical position.

Manhole Ring. A metal ring riveted around a manhole, and forming a seat for the cover.

Manifold. See THREE-PIPE MANIFOLD.

Mansell Retaining Ring. A mode of connecting steel tires to the wheel centers by a ring of an approximate L or U cross-section, which secures the tire to the wheel, so that every part of the tire is securely held, into however many pieces it may be ruptured. This ring is almost universally used in English passenger service. See WHEEL and CAR WHEEL. Figs. 1624, 1625, 1627.

Mantle. A device used as a burner in mantle gas lamps, so constructed that when the gas is ignited the mantle becomes incandescent. See PINTSCH MANTLE LAMP.

Mantle Lamp. See PINTSCH MANTLE LAMP, and VAPOR SYSTEM.

Marker. A lamp or flag used to indicate the rear end of a train. See TAIL LAMP.

Marker Bracket. A term used to indicate both the bracket or socket on a car which supports marker or tail lamps as well as flags; and the bracket or arm which fits into the socket and supports the tail lamp.

Marking on Freight Equipment Cars. Figs. 577-580; Pages 369-371.

Master Controller. See CONTROL SYSTEM.

Meat Timbers (Refrigerator Car). The vertical and horizontal timbers inside the refrigerating chamber on which the meat is suspended.

Mercury Vapor Lamp. A lamp consisting of a tube containing mercury through which the electric current is passed, vaporizing the mercury and giving out a greenish light.

Meritas. A composition substance on a cotton fabric base. Used for car upholstery. See also FABRIKOID, LEATHEROID, PANTASOTE. Page 969.

Metal Hose. See HOSE.

Metal Screw Thread. A form of screw thread used when both the male and female screws are made of metal. Metal threads are made of the same size as the spaces between them, whereas the spaces between wood screw threads are made wider than the projections. See also SELLERS SYSTEM OF SCREW THREADS.

Meter. See AMPERE HOUR-METER, CONDENSATION METER, FLOW METER.

Mica Chimney (Pintsch Lamp). A chimney for use on all center lamps, being placed immediately above the

ring reflector, allowing a portion of the light to be directed toward the roof of the car.

Micrometer Gage. A form of gage for microscopic or very minute and exact measurements. See GAGE.

Middle Door Rail. A horizontal bar in a door frame intermediate between the top and bottom rails. See DOOR FRAME.

Middle Transom (Six-Wheel Trucks). The term applied to the two transoms nearest the center of the truck, in distinction from the two outside transoms.

Milk Car. A car similar to a refrigerator car, but generally built for operation in passenger trains for carrying fresh milk in cans. Fig. 306.

Miller Coupler. A form of automatic coupler for passenger cars largely in use before the general adoption of the M. C. B. type of vertical plane coupler. It consisted of a shank and a head with a fixed projection or hook which engaged with a corresponding hook when cars were brought together, by side displacement of the drawbars. To uncouple, one or both of the drawbars were pulled to one side by an uncoupling lever and chain operated from the platform. A strong spring kept the drawbars normally in the center line of draft.

Mine Car. A small car for carrying minerals in mines, usually having four wheels, and provided with a dumping device by which the load may be quickly and completely discharged. Figs. 2932, 3006-3017, 3031-3035; Pages 1121, 1142, 1143.

Mineral Wool. A substance having much the appearance which its name implies, manufactured from the slag of iron furnaces by throwing against it while in the molten state a strong blast of air. It is used for deadening in passenger cars and also largely as a non-conductor for coating steam pipes and boilers.

Molding. A mode of ornamentation by grooved or swelling bands or forms, following the line of the object. Small moldings are often termed beads and also fillets. A cove molding is one of concave section. There are a great variety of other special technical terms for different forms of moldings. Moldings are either straight or waved. See also DECK EAVES MOLDING, EAVES MOLDING, WINDOW COVE MOLDING, WINDOW MOLDING, WINDOW SILL MOLDING.

(For Car Seats.) Also called seat back bands or seat molding. A metal band to finish the edge of the seat back. Flush or leather covered strips are also used.

Molding Joint Cover. A piece of wood or metal in some ornamental form for covering the joints of two pieces of molding.

Monitor Top. A clere-story. See DECK.

Mortise Lock. A lock adapted to be inserted into a mortise in the edge of a door, so as only to expose the selvage or edge plate. See LOCK.

Motor (Electric). A machine for converting electrical energy into mechanical energy of rotation. May be operated by either alternating or direct current. Figs. 488-493, 516-521.

(Gasolene). An internal combustion engine, using gasolene as the means of power.

Motor Cut-Out. A switch in the bottom of a controller which, when opened, cuts out one motor of a two-motor equipment or two motors of a four-motor equipment.

Motor Car. A car driven by some form of motor which is carried by the car itself. The common types of motor cars are electric, which receive current from a third rail, trolley wire or storage batteries; gasolene, which are propelled by internal combustion engines; gasolene-electric or gas-electric, which obtain power from an electric generator driven by an internal combustion engine carried in the car; and steam, which obtain power from a steam boiler and engine located in the car. See CAR and SELF-PROPELLED CAR. Figs. 475-569; Pages 338, 339, 355, 359. Fig. 2977-2996.

Motor Controller. See CONTROLLER.

Motor-Driven Air Compressor (Air Brake). An air compressor driven by a motor for use on electric cars. See AIR COMPRESSOR.

Motor Inspection Car. A small four-wheel car with seats, propelled by a gasoline engine. See INSPECTION CAR. Figs. 2697-2712.

Motorman's Air Brake Valve. See BRAKE VALVE.

Muck Bar. Bar iron which has passed once through the rolls. It is usually cut into lengths, piled, and rerolled as desired. Certain grades of iron axles are made directly from muck bars and contain no scrap.

Muffler (Vacuum Brake). A device to render noiseless the emission of steam at the ejector when brakes are applied. It is simply a collection of beads or shot, through the interstices of which the steam must force its way to escape.

Muffler Exhaust. See EXHAUST MUFFLER.

Muley Axle. An axle without collars.

Mullion. A bar between panes of glass or panel work. See DOOR MULLION.

Multiplier (Electric Lighting). A device used in connection with a lamp regulator to prevent variations, in the current supply to the lamps.

Multiple Unit Control System. A system developed with special reference to the operation of a train consisting of several motor cars coupled together, all motors being controlled simultaneously by a single operator. See MOTOR CARS, ELECTRIC MOTOR CARS, etc. Figs. 475-537; Pages 338, 339.

N

Nail. A small pointed piece of metal, usually with a head to be driven into a board or other piece of timber, and serving to fasten it to the other timber.

The common nails of commerce are divided into cut nails, clinch nails, and wire nails. They are distinguished in size by the number of pennies, as 10d., 20d., etc.

Nailing Sill. See NAILING STRIP and FLOOR NAILING STRIP.

Nailing Strip. A strip of wood laid over a metal frame and bolted to it, to which the boards are nailed in a combined wood and steel car. In refrigerator cars, where there is generally more than one floor course, nailing strips are also used. They are also used in some cases for fastening insulation. See also SIDE NAILING STRIP, FURRING, and STRINGER.

Nailing Strip Bracket. A bracket secured to the sills to hold in place the NAILING STRIP.

Nailing Strip Cross Ties. Light members of a metal underframe extending across the sills for the purpose of supporting the nailing strips.

Nailing Strip Silencer. Serves a purpose similar to that of a NAILING SILL BRACKET.

Name Plate. See DOOR NAME PLATE and NOTICE PLATES.

Narrow Gage. The distance in the clear between the heads of the rails of a railroad when less than 4 ft. 8½ in. See GAGE.

Narrow Vestibule. See WIDE VESTIBULE.

Needle Beam. The transverse members of the underframe of a car between the body bolsters which support the truss rod queen posts. Also act as crossties for the longitudinal sills. The term needle beam is sometimes applied to what is more properly a cross bearer or cross tie.

Needle Beam Bottom Tie Plate. A plate which extends across the bottom of a needle beam of the built-up type and ties the various members together.

Needle Beam Center Filler. A casting between the center sills, forming a part of a needle beam of the built-up type.

Needle Beam Truss Rod. A truss rod used in a built-up form of needle beam. Such a needle beam consists of the gross tie timber, queen post, and truss rod. See also CROSS TIE TIMBER TRUSS ROD.

Negative. An arbitrary term used in electrical engineering to distinguish the pole or connection toward which current is considered to flow, from the positive pole or connection away from which current flows. Thus direct current always flows from the positive pole or brush of a battery or dynamo through the external circuit and back to the negative pole or brush. Positive poles are distinguished on drawings by a plus (+) sign, and negative poles by a minus (—) sign. In a ground return system the ground connection is always negative.

Nest Spring. A spiral spring with one or more coils of springs inside of it. See HELICAL SPRING.

Night Latch. A spring door lock which requires a key to be opened from the outside, but which can be opened from the inside without one. See LATCH and LOCK.

Nipple (Pipe Fittings). A short pipe with a screw thread cut on each end, used for connecting couplings, tees, etc., together or with some other objects, as a tank or heater. See AIR BRAKE HOSE NIPPLE.

Non-Pressure Head (Brake Cylinder). The cover for the end of the brake cylinder opposite to that having air pressure against it. It has an opening in the center for the piston rod.

Non-Vestibuled Car (Passenger Equipment). A car having either open platforms, with hoods, or having dummy ends.

Nosing (of a Lock). A keeper.

(Of Steps.) The part of a tread board which projects beyond the riser, hence the metallic moldings use to protect that part of the tread board.

Notice Plate. Varieties are the platform notice plate, saloon notice plate, etc. See DOOR NAME PLATE.

Nozzle. See TANK NOZZLE.

Nut. A small block of metal or wood containing a concave or female screw. Nuts take their name from the bolts, rods or other parts to which they are attached. They are usually either square or hexagonal. See SCREW THREADS. Figs. 2784-2824; Pages 1084, 1085, 1086, 1087, 1088.

Nut Fastener. See NUT LOCK and LOCK NUT.

Nut Lock. A device for locking the nut in place on the bolt after it has been drawn up. Also called nut fasteners. See also LOCK NUT. Figs. 2784-2824; Pages 1084, 1085, 1086, 1087, 1088.

Nuts. See SCREW THREADS, BOLT HEADS and NUTS. Figs. 2782-2824; Pages 1080, 1081, 1084, 1085, 1086, 1087, 1088.

O

Oakette. An artificial leather used for curtains and upholstering. It is made by coating a cloth fabric with a compound which gives it the appearance of leather. See FABRIKOID, LEATHEROID, PANTASOTE, MERITAS, and TEXODERM.

Observation-Buffet Car. See BUFFET CAR and OBSERVATION CAR.

Observation Car. A car equipped with an observation end.

A special type of observation car is in limited use in mountainous regions having open sides and the seats arranged in tiers. Figs. 354, 357, 358, 360. See CAR and OBSERVATION END.

Observation End or **Observation Room.** That end of a car which is fitted with an extended platform and large windows for the purpose of affording passengers an unobstructed view. Commonly applied to parlor, sleeping and business cars, which are run as the last car in a train, from which passengers may get a view of the country, and the track and structures.

Observation Parlor Car. A parlor car with an observation end. See OBSERVATION END, OBSERVATION CAR.

Observation Platform Railing. A metal railing enclosing the observation platform. See PLATFORM RAILING.

Observation Sleeping Car. A sleeping car with an observation end. See OBSERVATION END, OBSERVATION CAR.

Officers' Car. See BUSINESS CAR and PRIVATE CAR.

Oil, Boiled Linseed, Specifications for. Page 1061.

Oil Box. See JOURNAL BOX.

Oil Car. A car made especially for the transportation of mineral oil. Some oil cars are built for carrying barrels of refined oil. Crude oil and refined oil are usually carried in tank cars. See TANK CAR.

Oil-Electric Car. See MOTOR CAR.

Oil Lamp. A lamp for burning oil. See also TAIL LAMP. Figs. 2533-2562.

Oil, Raw Linseed, Specifications for. Pages 1061, 1062.

Open Door Stop. A block of iron or wood fastened to the side of a freight car to prevent a sliding door from sliding too far when opened.

Open Platform. A platform covered by a hood or canopy but not enclosed by a vestibule.

Ore Car. A hopper car made especially for carrying ores. Because of the great weight of ore relative to its bulk, ore cars are generally shorter and consequently of less cubic capacity than other forms of hopper cars. See also CAR and HOPPER CAR.

Ottoman. A carpet-covered movable cushion serving as a foot rest. Used in parlor cars.

Outer Intermediate Sill. A term applied to the two intermediate sills next to the side-sills, to distinguish

them from the two intermediate sills adjacent to the center sills, which are the inner intermediate sills.

Outlet Valve (Tank Car). The valve by means of which oil or other liquids are removed from the tank. Figs. 269, 291; Page 267.

Outside Body Truss Rod. When two or more truss rods are used under each side of a car body those farthest from the center are called outside body truss rods, in distinction from the inside truss rods.

Outside End Piece (Truck Frame). The end piece nearest the end of the cars, in distinction from the inside end piece. See END PIECE.

Outside End Sill. A type of box car framing in which the end sill projects outside the sheathing, forming a narrow platform at the ends of the car.

Outside Hung Brake. Brake gear hung so that the shoes bear on the outer side of the wheels, or the side of the wheels away from the bolster.

Outside Sills. The side sills of a car frame.

Outside Transom (Six-Wheel Truck). The term applied to the two transoms farthest from the center of the truck, in distinction from the middle transoms.

Outside Wheel Piece Plate. An iron plate fastened to the outside of a wheel piece to strengthen it.

Outside Window Sill. A horizontal piece of wood or iron under a window on the outside of a car on which the sash rests.

Outside Window Stop. A wooden or metal strip attached to a window post on the outside of a sash to hold the latter in its place.

Overhang (Roof). The projection beyond the walls.

(Car Body.) That part of a car body between the body bolster and end.

Overhang Brace Rod (Passenger Equipment Car Framing). A truss rod extending over the side sills and between the sheathing and wainscoting. Its office is to sustain and stiffen that part of the underframe which overhangs at the ends and outside the bolsters.

Overhead Equalizer Spring (Vestibule). A face plate buffer spring is a more appropriate term, as it corresponds to the side stem buffer spring of a platform equipment.

Overhead Lining (Refrigerator Cars). See CEILING.

Overhung Door. A sliding door which is hung from or supported on a rail above the door.

P

P. C. Brake Equipment. A type of air brake designed for use on passenger train cars. See AIR BRAKES. Figs. 1911-1914; Pages 791, 793.

Package Rack. See BASKET RACK.

Packing. Any substance used to fill a gland to make a tight joint around valve stem or spindle. Leather, rubber, or metal rings are used. Also the oiled waste for lubricating journals. See JOURNAL PACKING and WASTE.

Packing Blocks. Rectangular blocks gained into the center sills and draft timbers, and serving the purpose of connecting them firmly together longitudinally. The term is borrowed from bridgework, in which the use of packing blocks is very common. They are also called key blocks.

Packing Expander (Air Brake). A spring wire ring for spreading out the leather packing of the brake piston so as to make it fit air-tight.

Packing Leather (Journal Box). A dust guard is sometimes called packing leather.

(Air Brake.) A ring of leather used in connection with brake cylinder pistons to make an air-tight fit. When so used it is always accompanied with a packing leather expander. A packing leather for a piston rod is called a cup leather, and is compressed by a piston spring. See PISTON PACKING LEATHER. Fig. 2010.

Packing Ring (Triple Valve). A circular metallic ring of variable rectangular cross-section which is placed in grooves in the edge of the piston to make it fit air-tight in the cylinder. The rings are turned slightly larger than the cylinder and cut apart diagonally at one point so that when compressed they will tend to spring open.

(Hose Coupling.) A rubber ring in a coupling case which makes a tight joint between the two parts of the coupling.

Padlock. A loose lock having a semi-circular shackle jointed at one end so that it can be opened, the other end of the link being locked when desired by the entrance of the sliding bolt into it. Such locks are used to secure a hasp or the like on a staple or similar device by passing the link through the staple. A spring padlock is one which snaps shut and locks by pressure only. A dead padlock has no springs. See LOCKS.

Paint, Black, Specifications for. Page 1059.

Painting (of Passenger Equipment Cars). Page 1058.

Painting (Steel Cars). Page 1058.

Panel. A board inserted in the space left between the stiles and rails of a frame or between moldings. Sometimes metal plates are used for this purpose. Door panels in passenger cars are usually only the middle and lower or twin door panels. The upper door panel is usually of glass. Window panels come between the windows, and are distinguished as outside and inside. Wainscot panels come below the windows, between the upper and lower wainscot rails. Other interior panels are deck side panels and end panels, the latter sometimes called ventilator panel, and the end roof panel over the door.

(Truss.) The space between two vertical posts or braces and the two chords of a truss.

(Electric Lighting.) A board or support for electric switches and other apparatus.

Panel Back Seats. A car seat made with a loose panel in the back, pivoted and supported by springs set in the seat back frame. The panel pushes back and accommodates itself to the occupant's back.

Panel Ceiling. Any form of ceiling divided into panels. This term is commonly used synonymously with wood or Agasote ceiling.

Panel Furring. Nailing strips or blocks for panels.

Panel Lamp. An alcove lamp.

Pantagraph Trolley (Electric Motor Car). A device for collecting current from an overhead conductor and consisting of a diamond shaped jointed frame operated by springs or compressed air, and having a suitable collector at the top. Fig. 507.

Pantasote. A substitute for leather used extensively

for upholstering and decorating cars and steamships. The Pantasote material ingredients are secret. It is made by sheeting two or more pieces of cloth or canvas together, with the warp running in different directions, to give strength. The sheet making the leather side is passed between heavy rollers many times, and each time it receives a very thin coat of pantasote material, and this is kept up until the cloth or canvas is thoroughly saturated and coated. The color is added to the Pantasote material and is incorporated into the fabric. It is very like leather, and is not readily distinguished from it. See also FABRIKOID, LEATHEROID, AND MERITAS. Page 963.

Paper Box (Postal Car). A box used for the distribution of papers handled in railway mail service. Fig. 461.

Parallel. A method of connecting two or more pieces of electrical apparatus of a common circuit so that the positive poles of each are connected to a common positive conductor and the negative poles are connected to a common negative conductor. See SERIES.

Parallel Brake Hanger. See BRAKE BEAM ADJUSTING HANGER.

Parlor Car. A car for day travel but of a more luxurious character than a day coach, having revolving seats, smoking compartment and other conveniences, and on which an extra fare is charged. Operated on many roads by the Pullman Company and often referred to as Pullman cars. The term chair car is also sometimes used, but incorrectly, as a chair car is properly a day coach with reclining seats, on which no extra fare is charged. See CAR. Figs. 349-351.

Parlor Car Chair. The most common type of chair for parlor cars is a simple arm chair revolving on a pivot which enters a fixed pedestal. In observation cars, etc., ordinary chairs are commonly used.

Parlor-Café Car. See CAFÉ-PARLOR CAR, CAFÉ CAR and PARLOR CAR.

Parting Bead or **Parting Strip.** A strip which acts as a distance piece between two objects, as a window and a window blind.

Parting Rail (Door Frame). A vertical rail between the bottom and middle or middle and top rails of a door or partition, dividing a panel into twin panels.

Partition Stop (Door Holder). So called in distinction from a floor stop.

Passenger Car. A car used for carrying passengers. This term is, however, generally confined to that class of passenger cars commonly known as day coaches, which are equipped with seats or reclining chairs for day travel. See CAR, COACHES, PARLOR CAR, and SLEEPING CAR. Figs. 323-569, 2825-2843; Pages 283-285, 314, 338, 339, 355, 359, 960, 964, 966, 967, 1089.

Passenger Cars, Cleaning. A topical discussion on good methods for terminal cleaning of passenger cars and as to whether it is advisable to have oil in the cleaning mixture will be found in the Master Car Builders' Proceedings, 1900, page 199. A topical discussion on up-to-date cleaning of passenger equipment will be found in the 1907 M. C. B. Proceedings, Page 263.

Passenger Train Car or **Passenger Equipment Car.** A car usually operated in passenger trains. See CAR. Figs. 323-569; Figs. 2825-2842; Pages 283-285, 314, 338, 339, 355, 359, 960, 964, 966, 967, 1089.

Passenger Train Heating. Figs. 2137-2236; Pages 863-866, 869, 877.

Passenger Train Lighting. Figs. 2265-2539; Pages 889-907, 909, 911, 912, 913, 917, 925, 935.

Passenger Car Journal Box. See JOURNAL BOX.

Passenger Car Pedestal. Fig. 1538.

Passenger Equipment Cars, Steam and Air Connections for, See STEAM AND AIR CONNECTIONS FOR PASSENGER EQUIPMENT CARS.

Paste. See IRON PASTE, OXIDE OF.

Patents. An individual paper by Paul Synnestvedt on the value of patents will be found in the M. C. B. Proceedings, 1915, page 411.

Pawl (Brake Ratchet Wheel). A pivoted bar adapted to fall into the notches or teeth of a wheel as it rotates in one direction, and to restrain it from back motion. See RATCHET WHEEL.

Pedestal (Postal Car). Standards which are used to carry the two longitudinal rods near the center of the car which support one side of the distributing tray, dumping tray or bridge. The pedestal fits into a socket in a base plate and is usually secured in place by bolts with wing nuts, so that it can be easily removed. Also called a center stand or standard.

(Truck.) A casting of somewhat the form of an inverted letter U, bolted to the wheel piece of a truck frame to hold the journal box in its place horizontally, but permitting a vertical movement. The two projections of a pedestal are called pedestal legs, and the space between them a jaw, which is closed at the bottom by a pedestal tie bar. In Great Britain pedestals are called axle guards on cars and horn plates on locomotives.

(Revolving Chairs.) The stand by which the chair is supported; consists of three portions—base, column and seat frame.

Pedestal Jaw. The vertical side member of a truck pedestal. See PEDESTAL.

Pedestal Spring. A spring which rests on a journal box between the jaws of a pedestal.

Pedestal Stay Rod. A transverse rod connecting the pedestal tie bars on each side of a truck to prevent them from spreading.

Also a rod connecting the pedestal tie bars on four-wheel caboose cars.

Pedestal Strap. See PEDESTAL TIE BAR.

Pedestal Tie Bar. A bar extending across the mouth of a pedestal jaw underneath a journal box and bolted to the jaws of the pedestal. Also a bar sometimes called pedestal strap, connecting two or more pedestals on the same side of a truck or car.

Pedestal Timber (Four-Wheel Caboose). A longitudinal member sometimes used on four-wheeled cars, which is placed under the floor or alongside the sill and to which the pedestals are bolted.

A term sometimes used to designate the wheel piece of a truck.

Pedestal Truck. A truck which has its journal boxes held in and guided by pedestals which are either a part of or rigidly attached to the side frames. The axle and boxes can thus move vertically in the pedestals and shocks due to the uneveness of the track are not transmitted to the truck frames to the same ex-

tent as in a truck which has the side frames and journal boxes rigidly connected.

Pendant. A small suspended lamp.

Phosphor Bronze. A term applied to an alloy of bronze or brass, or to a triple alloy of copper, tin and zinc, which has been given special purity and excellence by skillful fluxing with phosphorus. It is supposed that the presence of phosphorus gives the tin a crystalline character which enables it to alloy more completely and strongly with the copper. Whether for this reason or not, the phosphor bronzes, when skillfully made, are greatly superior to unphosphorated alloys.

Pick-Up Car. A car provided with a tool house and shelter for the use of yard men in performance of their duties.

Pilaster. A square pier, like a flat column built against a wall, and having a cap and base.

Pilaster, Cap Bracket and Base. A decorative feature of a car interior, placed between the windows and covering the window post.

Pile Driver. A car used for driving piles in construction or maintenance-of-way repair work. Pile drivers are equipped with long bars, called leaders, which are held erect and act as a guide for a hammer or tup. In driving piles a pile is held between the leaders and driven by the hammer dropping on it after being hoisted by a cable and hoisting engine which are located on the car. For moving from place to place in trains the leaders fold back and the forward end is carried on a flat car. Pile drivers usually are self-propelling at low speeds. See CAR. Figs. 2664-2666; Pages 973, 974, 985, 991, 995.

Pillar Crane. A style of crane having the mast supported from below, either by a mass pocket or by a base plate.

Pillow Box (Sleeping Car). The space under the seat in which pillows are stored when the berth is not made up.

Pinion. The smaller cog wheel of two wheels in gear.

Pintsch Gas Burner. Used on all Pintsch lamps other than the bracket lamps. It consists of a small lava tip of the "fish-tail" type, held in a special brass pillar. See PINTSCH GAS LIGHTING.

Pintsch Gas Lamp. A lamp for burning gas, the essential features of which are the closed globe at the bottom, the white porcelain reflector above the flames near the top of the globe, and the peculiar method of supplying air. See PINTSCH GAS LIGHTING.

Pintsch Mantle Lamp. An improvement on the standard Pintsch gas lamp whereby the same quality of gas is burned with an incandescent mantle enclosed in a bulb. The candle power of the lamps is greatly increased with the same consumption of gas. No change is necessary in the piping of the car, but the regulator is adjusted to give a higher pressure in the car piping. The form of lamp used is very similar to the standard Pintsch gas lamp. See PINTSCH SYSTEM OF GAS LIGHTING.

Pintsch Pillar. Used on bracket lamps below the burner. Where no globe holder is used a mill check is placed immediately below the pillar.

Pintsch System of Gas Lighting. A system of car lighting which burns gas taken from a storage tank, where it is carried under a pressure of 150 lbs., or less, per square inch. Figs. 2492-2517; Page 890.

Pipe. A tube for conveyance of water, air, or other fluids. See BRAKE PIPE, etc.

Pipe Bracket. See PIPE CLAMP.

Pipe Bushing. See BUSHING.

Pipe Clamp. A clamp for holding the air brake, signal, or steam pipes in place under the car.

Pipe Clip or **Strap.** An iron band for fastening a pipe against or to some other object. They are usually single, but sometimes double, for two or more pipes. See CLIP.

Pipe Coupling. A short tube with a thread cut on the inside of each end, which is screwed on the ends of two pipes and used for uniting them together, or uniting one pipe with another object, as a cock or valve. In some couplings the thread at one end is right hand and the other left hand, but generally they are both right hand threads.

Pipe Fittings. The connections for systems of wrought iron, gas, water, and steam pipes. The more usual pipe fittings are bushings, elbows, tees, return bends (close or open), reducers, couplings, nipples, plugs, etc. Figs. 2105-2135.

Pipe Hanger. A hanger for supporting a pipe.

Pipe Reducer. See BUSHING.

Pipe Screw Threads. Page 1078.

Pipe Unions. Fig. 2781.

Pipe, Welded, Specifications for. Pages 1078, 1079.

Piston. A metal disk with packing, etc., made to fit in a cylinder, and transmit the power caused by the pressure of a working fluid to the external rod and working parts of some form of engine. In a brake cylinder the piston transfers the pressure of the air to the foundation brake gear. A piston consists of a piston head, attached to a piston rod. The piston follower or follower plate lies at the back of the piston head, inclosing between them the piston packing rings, or (in air brake cylinders) the piston packing leather, which latter is provided with a packing leather expander. The follower plate is secured to the piston with follower bolts. See AIR BRAKES.

Piston Packing Expander (Air Brake). A spring wire ring for spreading out the leather packing of the piston so as to make it fit air-tight against the cylinder walls.

Piston Packing Leather (Air Brake). A circular ring of leather used as a substitute for piston packing rings, pressed into the cylinder so as to have an L-section. It is attached to and surrounds the piston and bears against the inside surface of the cylinder, being pressed against it by a piston packing expander. See AIR BRAKES.

Piston Packing Ring. See PACKING RING.

Piston Rod (Brake Cylinder). A rod attached to the piston of a passenger brake cylinder, by which the pressure against the piston is transmitted to the brake levers and shoes.

A tube attached to the piston of a freight brake cylinder to act as a guide to the piston as it is forced outward by the air pressure. In this case a push rod is attached to the levers and is inclosed by the tube. The push rod transmits the pressure on the piston to the levers and brake shoes, while it allows an application of the brakes by hand without pulling out the piston.

Piston Travel (Air Brake). The amount of movement of the piston when forced outward as the brakes are applied. Running piston travel is the piston travel obtained when the car is in motion and is always greater than the travel obtained when the car is at rest, due to the fact that the slack or lost motion in trucks and brake gear as well as the elasticity of the car body is more easily taken up by the brake shoe pressure when the car is in motion. False travel is that due to some unevenness of the track or to some cause which occasions a momentary change.

Pitch (Screw). The advance made by the thread in one complete revolution, usually expressed by the number of threads in a given space, as (in U. S. and Great Britain) an inch.

(Roof.) The ratio of the rise of a roof to the horizontal distance covered.

Pitching Roof. A roof formed of one or more inclined plan surfaces. When the pitch becomes steep, the term is used to distinguish a roof formed of plane surfaces from one formed of arched surfaces.

Pivot. A pin or short shaft on which anything turns.

Pivot Pin (Coupler). Another name for the Knuckle Pin. It is so called from the fact that the knuckle when opening swings about the pin as a pivot. See COUPLER.

Placard Boards for House Cars. (A. R. A. Recommended Practice.) Page 369.

Plane Gage for Solid Steel Wheels. See WHEELS, SOLID STEEL, PLANE GAGE FOR.

Plain Triple Valve (Air Brake). A triple valve which has no provision for making emergency applications. See TRIPLE VALVE.

Plank. A piece of sawed timber, differing from a board only in being thicker.

Plastic Car Roof. A roofing material the body of which is composed of a very heavy layer of woolen felt, thoroughly saturated with a compound which is used to preserve the roofing itself and also the upper and lower boarding with which it comes in contact. See CAR ROOF.

Plate (Architecture). A piece of timber which supports the ends of the rafters.

(Car.) A horizontal member on top of the posts of a car body supporting the roof carlines or rafters. Also called side plate, in distinction from an end plate, which is a similar member across the end of the car. A deck plate is used to cap the deck posts of an upper deck.

(Cast Car Wheel.) The central portion connecting the hub and tread, sometimes single plate, sometimes double plate. The plate is stiffened by brackets.

Plate Facing. An inside cornice fascia.

Plate Rod (Freight Cars). A horizontal metal rod passing across the car through the two side plates to tie them together.

Plate Washer. Usually a wrought iron cut washer, in distinction from a cast washer, but also used to designate many forms of large washers or plates serving as double or triple washers. See WASHER.

Plate Wheel. A car wheel of which the center portion is formed of a disc or plate instead of spokes. See WHEEL.

Platform (Passenger and Caboose Cars). A floor at the end of a car, supported by projecting timbers below the car body, to facilitate ingress and egress. A narrow platform is sometimes added to freight cars for convenience of trainmen, but a platform proper is used only on passenger equipment cars and cabooses. The term platform is commonly applied to the frame which supports the platform proper in passenger equipment cars, together with its buffing devices. The term is also commonly used for buffing devices and their framing for non-vestibule cars, which have no platform proper. Figs. 615, 616, 621.

Platform Car. A flat car. See INDUSTRIAL CARS.

Platform Chain. A chain connecting the inner platform railings, posts and rails, closing the passageway between the platforms of two cars coupled together. It is used only on the rear end of the last car, and the front end of the first car when the first car is a passenger car.

Platform Cover Plate. A steel cover plate over the platform sills.

Platform End Bracket. An ornamental casting attached under the platform roof on each side of the vestibule face plate on narrow vestibule cars.

Platform End Sill. The transverse end piece of the platform framing. Also called end timber, and buffer beam on passenger equipment cars.

Platform End Timber. A cross timber at the outer end of a car platform. A platform end sill.

Platform Floor. The layer of boards over the platform sills.

Platform Gate. A gate used to close the side entrance to a platform, in general use only for private cars. See PLATFORM TAIL GATE.

Platform Hood. A cover or canopy formed by extending a car roof over the platform. Sometimes called canopy. It is made of wood, sheet iron or agasote.

Platform Hood Bow. A bent member which forms the outer edge of a platform hood and to which the platform hood carlines are fastened.

Platform Hood Bracket. A bracket or knee iron to connect the hood to the corner post.

Platform Hood Carlines. Transverse members which support the roof of a platform hood.

Platform Hood Post. An upright iron bar or rod sometimes attached to the platform or platform railing, to support a platform hood.

Platform Hood Side Piece. The side piece to which the ceiling is attached.

Platform Lever. A lever for uncoupling cars from the platform.

Platform Lever Pin. The pin on which the platform lever pivots.

Platform Plate or **Buffer.** A steel angle plate bolted to the buffer stems and overlapping the platform end sill. When in contact with the like plate of another car, it makes a continuous floor between them. Being pivoted at the platform end sill, it adjusts itself to all curves of the road. The platform plate also acts as a buffer, and is sometimes so called. See VESTIBULE.

Platform Railing. An inclosure consisting of iron or brass posts and rails on the end of an open platform to prevent persons from falling off and also to act as a hand hold. Used chiefly on private cars and on observation platforms. Figs. 842-844.

Platform Roof. That portion of a car roof which projects over the platform. See PLATFORM HOOD.

Platform Roof Carline. A carline supporting the platform roof. See CARLINE.

Platform Roof End Carline. The carline at the extreme end of the platform roof. See CARLINE.

Platform Short Sills. Short longitudinal pieces of timber, not extending under the car proper, which are framed into and bolted to the end sills and platform end timbers of a passenger car to sustain the floor of the platform. The longer timbers which extend under the body of the car proper are called platform sills.

Platform Sill. A sill extending beyond the end of a car proper to support the end platform.

Platform Steps. The stairs at each corner of a passenger equipment or caboose car which afford the means of ingress and egress. Forms of steps have been introduced, but are not in general use, which are folding or extensible, being dropped down into position when the car is stationary, and removed or elevated when the train starts. In modern passenger cars the platform steps usually consist of three and sometimes four separate steps below the platform. Wooden steps are sometimes called box steps.

Platform Tail Gate. A gate used to close the passageway at the rear of the last car of a train which is ordinarily used for passage from one car to the other. Figs. 834, 839-845; Page 451.

Platform Tail Lamp. A signal lamp which stands on the rear platform of a train.

Platform Tie Rods. Horizontal rods passing through the platform end timber and end sill or body bolster, for the purpose of holding them and the other portions of the frame of the car securely together.

Platform Timber. See PLATFORM SILL.

Platform Trap Door. A door which covers the space occupied by the steps, and thus extends the platform out to the side of the car. It is used on wide vestibuled cars, private cars equipped with open platforms, and suburban, elevated and subway train cars, which commonly make stops at station platforms which are level with the car platform. Figs. 813-826, 960, 962; Pages 447, 449, 957.

Platform Trap Door Bumper. A stop for a trap door to prevent its striking the vestibule wall when opened.

Platform Trap Door Lift. A metal device attached to trap doors, with a recess for inserting the fingers to pull the door open.

Plow. See SNOW PLOW and BALLAST PLOW.

Plug. See REFRIGERATOR CAR PLUG.

Plug Connector. The term applied to the jumper and receptacle used in connection with electro-pneumatic signal and brake equipments, and which provides flexible electric connections between cars for the electric operation of these equipments.

(Pipe Fittings.) A short, solid metal cylinder, with a screw on the outside and a square or hexagonal end to take hold of with a wrench, screwed into the end of a pipe or hole in a plate, to close the opening.

Plush. A fabric so constructed that the nap or face presents a "pile" of closely woven fibres in a straight standing or a slanting position.

Plush may be made of silk, cotton, wool, mohair or other fibres, but the plush most used in American railroad passenger cars is made of mohair—the hair of the Angora Goat.

The pile of mohair plush is springy or elastic and retains a standing position so that the wear comes on the ends of the fibres, and if the fibres are firmly secured, endures through a severe and continual service of upward to twenty-five years.

The mohair fibres take dyes so fast as to retain their original color almost unimpaired during the life of the fabric and carefully conducted physical and chemical tests have proven it to be a sanitary upholstery fabric. Figs. 1029, 1030; Pages 487, 488.

Plumbago. Graphite; one of the forms of pure carbon from which pencils, etc., are manufactured.

Pneumatic Jack. A jack operated by compressed air. See JACK.

Pocket (Drawbar Attachment). A yoke.

(Sleeping Car.) A receptacle for the clothing and small baggage of occupants of sleeping berths. Known as the head board pocket for the lower berth and upper berth pocket.

Any object having a cavity or opening which forms a receptacle to hold anything in its place. See PUSH POLE POCKET.

Pole Changer (Electric Lighting). Figs. 2330-2332; Page 840.

Poling Car. A car provided with a push-pole on each side and used to push cars about a railroad yard. It is coupled to and pushed by the switching locomotive.

Pop Safety Valve. A valve set with a spring so as to open suddenly with a wide opening at a fixed pressure.

Port. An opening in a valve for the passage of steam or air.

Positive. An arbitrary term used in electrical engineering to denote a pole or connection away from which current flows towards a negative pole or conductor. See NEGATIVE.

Post. A piece of timber or metal set upright and intended to support something else, as the posts of a house. See QUEEN POST, SIDE POST, etc.

Post Cap. See POST POCKET.

Post Office Car. See POSTAL CAR.

Post Pocket. A casting attached to the top of the side or end sill or the bottom of the side or end plate of a car to receive and hold a post or a post and a brace, in distinction from a stake pocket which is bolted to the outside of the side sill. Such pockets are commonly used with box and stock cars. The post pockets used below the plates are sometimes called post caps. See POCKET.

Postal Car. A passenger equipment car for carrying mail. Some postal cars are fitted with pigeon holes, etc., for the distribution of mail, and others are for storage only. Figs. 435-474; Pages 314-334. See CAR.

Postal Car Specifications and Floor Plans. Pages 314-334.

Pouch Catcher. See MAIL CATCHER.

Pouch Hook (Postal Car). A hook used for suspending mail bags while assorting the mails.

Pouch Rack (Postal Car). A rack built of standards and horizontal rods to which the pouch hooks are attached and which support the pouches or bags while

mail is being distributed into them. Figs. 464, 465; Page 337.

Poultry Car. A form of stock car equipped for carrying live poultry. See CAR and STOCK CAR. Fig. 198.

Pressure Bar (Buffing Apparatus). A stiff iron bar of a cross-shaped (+) cross section, which connects the drawbar to the buffer spring, so that the draft spring reinforces the buffing spring and the buffing spring takes up part of the pull on the drawbar, thus relieving the draft spring. The pressure bar also forces out the buffer stem and plate when the drawbar is pulled out, thus maintaining a continuous platform between the cars.

Pressure Gage (Pintsch Gas). A gage usually placed in a saloon. It registers atmospheres or pounds and atmospheres, for convenience in computing the volume of gas in the tank. Page 944.

Pressure Head (Brake Cylinder). The head that covers the end of the brake cylinder into which air pressure is admitted when the brakes are applied.

Pressure Limiting Valve (Air Brakes). Fig. 1966.

Pressure Regulator (Car Heating). A valve designed to regulate the delivery pressure of steam in a steam heating system. It depends entirely upon the elasticity of springs, the pressure of which can be gaged or regulated by screw studs that bear upon one end of the springs. Figs. 2140, 2141, 2163, 2188.

(Pintsch Gas.) The valve by which the pressure of the compressed gas is reduced for consumption. The pressure regulator is one complete fixture, adjusted by the maker. Names of the principal interior parts are diaphragm, diaphragm connecting rod, diaphragm lever, regulating valve and dust arrester.

Pressure Retaining Valve. A device by means of which a certain part of the brake cylinder pressure may be retained to aid in retarding the acceleration of a train in descending long grades while the brake pipe pressure is increased after one application to recharge the anxiliary reservoirs. It is controlled by a small handle, the position of which causes it to operate or not, as desired. There are four different types, the ordinary, the vestibule, the double pressure, and the driver brake. The first two types may be made to retain 0 to 15 lbs.; the third to retain 0, 15 or 30 lbs. or 0, 25 and 50 lbs.; the fourth to retain 0, 15 lbs., or all cylinder pressure. In descending grades the handle is turned to the proper position to retain the desired pressure while on the level the handle is turned to allow the air to escape to the atmosphere. Also called retaining valve. Figs. 1927-1930, 1939.

Pressure and Vapor Heating System. A combination of the pressure and vapor heating systems by which it is possible to operate with an open drip and the lowest temperature in the pipes, or by various pressures with the closed drip, up to the pressure on the train line. Figs. 2148, 2176-2181; Pages 863, 877.

Priming (Painting). The first coat in car painting. See also PAINTING.

Private Car. A car for private use, usually containing eating and sleeping facilities. Private cars used by railway officials are often termed business cars. Freight cars owned by companies other than the railways are termed private line cars or sometimes simply private cars. See CAR. Fig. 355.

Produce Car. A modified form of refrigerator car, provided with ventilators and ice boxes, for the transportation of fruit, vegetables and perishable produce.

Propelling Gear (Steam Shovel). The gears which turn from the main winding drum when the propelling chain is to be operated.

Propelling Lever (Hand Car). The main lever, to which power is applied.

Profile Carline. A carline bent to conform to the shape of the clere-story and extending from one plate to the other. See also UPPER DECK CARLINE.

Protection Cap. A LAMP JACK.

Protection Strip. A strip used on a freight car side door to protect it from wear when being opened and closed. Such strips are also used to stiffen the door and to prevent the entrance of sparks. See SPARK STRIP.

Pull. A catch or lip upon a drawer, door or window, by which it is pulled open. See DOOR PULL.

Pull Hook or Deck Sash Opener. A rod with a small hook at one end for opening deck sashes. Also called a ventilator staff.

Pull Iron. A roping staple. A U-bolt passing through the side sill for the purpose of attaching ropes in switching. See also PUSH POLE POCKET.

Pull Ring. A metal ring with a screw attached, by which it is fastened to any object, as a sash, drawer, etc., to take hold of in opening it.

Pull Rod Carry Iron. A carry iron for an uncoupling rod.

Pulley. A wheel with a grooved, flat or slightly convex rim, adapted to receive a cord or band which runs over it. Its function is to transmit power or change the direction of motion. A sheave is a pulley wheel in a block, but sheave and pulley are used as almost synonymous terms. See SHEAVE and BERTH CHAIN PULLEY. See also Figs. 2268-2273, 2276.

Pullman Car. A name strictly applicable only to cars operated by the Pullman Company, but in common usage frequently applied to sleeping, parlor, or drawing room cars built after the same designs as those adopted by the Pullman Company. See DINING CAR AND SLEEPING CAR.

Pump (Wash Rooms). See BASIN PUMP.

Pump Governor. See AIR COMPRESSOR GOVERNOR.

Purline or Purlin. A longitudinal piece of timber over the carlines, extending from one end of the car roof to the other, to which the roof boards are fastened. Sometimes called a roof strip, but the latter more correctly applies to strips sometimes used above the purlins.

Purlin Bracket. An iron casting or forging used to connect a purlin to the end plate.

Push Button. Used in connection with the whistle of the train signal apparatus.

Push Button Faucet. A faucet controlled by a push button.

Push Car. A four-wheeled car used to carry materials and tools and moved or pushed by hand. See FERRY PUSH CAR, LORRY, INDUSTRIAL CARS.

Push Pole. A wooden pole or iron tube which is used as a strut to span diagonally the distance between the corners of a locomotive or a poling car and a freight car, standing on two parallel tracks, to push the car

without switching the locomotive to the same track that the freight car occupies.

Push Pole Pocket. A plate placed on the corners of freight cars, and having a cavity for inserting a pole or bar in switching, to enable the car to be moved from the side by an engine on a parallel track. A roping staple serves the same purpose when it is desired to use a rope or cable.

A topical discussion on push pole pockets will be found in the 1909 M. C. B. Proceedings, page 100.

Push Rod (Brake Cylinder). A bar which transmits the braking force from the piston of the brake cylinder to the brake levers. It has a crosshead formed on one end, by which it is attached to the cylinder lever. It is guided by a hollow piston rod. As it has not a rigid connection to the piston, but can slide freely in the hollow piston rod, when the brakes are applied by hand, it does not become necessary to overcome the friction of the piston in the cylinder. Figs. 1813, 1814, 1844.

Pushover Seat. See WALKOVER SEAT.

Q

Quadruplet (Elliptic Springs). A nest of four springs side by side acting as one. Also called QUARTETTE.

Queen Post (Truss). One of a pair of vertical posts against which the truss rod bears. When one post only is used, it is called a King Post. Such posts are used for the truss rods under car bodies and occasionally on car trucks.

Queen Post Stay. A bar attached to a queen post to stay it laterally.

Quick Action Automatic Air Brake. A type of brake in which the triple valve is so modified that when a relatively quick reduction in brake pipe pressure is made, it also opens a direct communication from the brake pipe through the triple valve to the brake cylinder. The net result is to shorten the time from the movement of the brake valve handle until a full brake application is obtained on the entire train, and to increase the total braking power obtainable by such an operation (emergency application) about 20 per cent over the maximum obtainable during ordinary operations (service application), or when using the plain automatic brake. See AIR BRAKE. Page 767.

Quick Action Triple Valve (Air Brake). See TRIPLE VALVE.

Quick Service Valve. A valve used with the emergency straight air brake system to accelerate the application and release of brakes. It is located between the train line and the emergency valve.

Quill Drive (Motor Cars). A flexible connection—springs—between motors and driving wheels, providing a spring suspension for the motors and spring transmission of the motor torque.

Quintuplet (Elliptic Springs). A nest of five springs side, by side acting as one. Also called QUARTETTE.

R

Rabbet. A rectangular groove made longitudinally along the edge of one piece to receive the edge of another. It is common in paneling, and in door frames for the door to shut into.

Rack. A frame for receiving various articles. See BASKET RACK, etc.

In machinery, a rectilineal sliding piece, with teeth cut on its edge for working with a wheel. See also RATCHET.

Rack Catch (Sleeping Car Berth). A small cupboard catch to hold the headboard pocket closed.

Radial Draft Gear. A special pivoted form of draft gear and coupler yoke which permits a lateral radial movement of the gear.

Radiator (Heating Apparatus). The pipes passing through a car, through which the hot water or steam circulates.

An individual paper by Professor A. J. Wood, in the 1916 M. C. B. Proceedings, page 503, gives a complete account of the tests of four types of passenger car radiators.

Radiator Stand. A support for a radiator.

Rafter. A timber to support a roof. See CARLINE.

Rail. The horizontal part in any piece of framing or paneling.

Rail Saw. A machine, provided with a circular saw of either the toothed or friction type, used to cut steel rails. Small portable machines are in common use and larger units mounted on a railroad car have also come into use. Fig. 2679.

Railing. See PLATFORM RAILING.

Raised Roof. An upper deck or clere-story.

Rake (Postal Car). Used for handling the papers on postal cars. Fig. 442.

Ranges and Cook Stoves. A range is a fixed and more elaborate cook stove attached to the wall; in houses often built in with brick so as to need no stovepipe to connect with the chimney. A type of range is used in the kitchen of dining cars. See STOVE.

Ratchet. A serrated edge like that of a saw, sometimes straight and sometimes on a wheel, into which a pawl engages, for producing or (more commonly) restraining motion. See BRAKE RATCHET WHEEL, RACK, WINDING SHAFT RATCHET WHEEL. An undulating ratchet is one having no sharp edges, so that the ratchet catch will slide over them without removal on the application of force, as in deck sash pivots.

Ratchet Jack. A jack operated on the ratchet principle. See JACK.

Ratchet Wheel. A wheel with teeth like a saw cut into the outer edge to engage with a pawl, which prevents the wheel from being turned in one direction while allowing it to turn in the opposite direction. See BRAKE RATCHET WHEEL, WINDING SHAFT RATCHET WHEEL.

Receiver (Pintsch Gas). A cylindrical steel tank, with riveted and soldered seams, adapted to receive and retain gas at high pressures and hung under a car. See HOLDER.

Receiver Filling Valve (Pintsch Gas). A valve of peculiar construction for the admission of the compressed gas to the receiver, so that it can be transmitted to the regulator for consumption.

Reclining Chair. A chair the back of which can be inclined, and which is provided with leg and foot rests. Used in chair cars. See also TWIN CAR SEAT and CAR SEAT. Figs. 993, 1021, 1027; Pages 482, 483, 485.

Recording Table. The table on which is placed the recording apparatus of a dynamometer car. See DYNAMOMETER CAR.

Red Lead, Specifications for. Pages 1060, 1061.

Reducer. See Bushing and Reducing Pipe Coupling.

Reducing Pipe Coupling. A coupling for connecting two pipes of different diameters.

Reducing Tee (Pipe Fittings). A pipe fitting having three openings, one of which is smaller or larger than the other two. See Tee.

Reducing Valve (Train Air Signal Apparatus). A valve for reducing the pressure of air admitted to the train signal pipes below that maintained in the brake pipes and main reservoir. In the train air signal apparatus a pressure of from 40 to 45 lbs. is used.

(Air Brake.) See Feed Valve.

(High-Speed Brake.) See Reducing Valve, Automatic.

(Car Heater.) Used for reducing the steam pressure for the steam heating apparatus.

Reducing Valve, Automatic (High-Speed Brake). A valve attached to the brake cylinder to automatically bleed the pressure down to 70 lbs. after an emergency application, when the pressure in the cylinder rises to 85 lbs. or more. The triangular port gives a graduated reduction. It also prevents the brake cylinder pressure from exceeding 70 lbs. pressure in a service application. The triangular port then gives a wide opening. Fig. 1923.

Reflector. A device placed behind or above a lamp to throw the light in any desired direction.

Refrigerator (Refrigerator Car). The chamber, constituting the main body of the car, in which the revenue load is placed.

A box or chest for keeping articles cold by means of ice. Used in dining, buffet and private cars. Fig. 376.

Refrigerator Car. A specially constructed box car for carrying commodities that need icing in transit, equipped with two or more ice bunkers or baskets and suitable means for draining off melted ice or briny water; or with a circulating brine cooling system. Has side doors and doors in the roof for admitting ice and salt. The temperature usually desired in refrigerator cars is about 40 degrees F., or 8 degrees above freezing. Figs. 200-267; Pages 205-212, 964.

See Car, Ice Car and Ventilated Car.

Refrigerator cars are often converted to heater cars during cold weather when it is desired to transport perishable products. See Heater Car.

An M. C. B. committee report on refrigerator cars with special reference to the uniform height of such cars from the rail to the floor; adoption of standard drip cups; and relatively small ice tanks, will be found in the 1911 M. C. B. Proceedings, Page 272.

Refrigerator Car Doors. Doors for this class of cars are constructed to fit tight and are of a heavy double insulated construction in keeping with the rest of the car. Figs. 255, 256; Page 235.

Refrigerator Car Floors and Ice Tanks. See Refrigerator Cars.

Refrigerator Cars, Salt-Water Drippings. See Salt-Water Drippings, Collection of.

Refrigerator Car Plug. A plug which closes the entrance to the ice bunkers of a refrigerator car.

Refrigerator Express Car. An express car fitted with insulation and refrigeration apparatus. See Car.

Register. An aperture for the passage of air, provided with suitable valves, doors and sliding or revolving plates, by which the aperture is opened or closed. See Ventilator Register.

Register Cage (Postal Car). A compartment or cage for registered mail.

Register Case (Postal Car). A compartment case for the distribution of registered mail.

Reinforcing Wooden Freight Cars. See Cars, Wooden Freight, Reinforcing of.

Regulating Valve. See Vapor Regulating Valve, Pressure Regulator.

Regulator (Electric Lighting). The device for controlling the generator output and maintaining constant voltage on the lamp circuits. It is a form of automatic rheostat. See Lamp Regulator.

(Pintsch Gas.) See Pressure Rugulator.

Regulator Straps (Pintsch Gas). An iron strap used to secure the regulator to the under side of the car.

Relay. See Lamp Regulator Relay.

Release Cock. More properly release valve.

Release Spring (Passenger Equipment Truck). A spring attached to a truck frame and acting on the brake beams so as to prevent the brake shoes dragging on the wheels when the train is running and the brakes are released.

(Air Brakes.) A spiral spring which acts to move the brake piston inward, and thus release the brakes from the wheels after the compressed air is allowed to escape from the cylinders.

Release Spring Clip. The clip which holds the release spring.

Release Valve (Air Brake). A cock attached to the auxiliary reservoir for permitting the air pressure to be reduced therein, when the locomotive is detached or when the apparatus is out of order, so as to release or "bleed" the brakes. Fig. 1940.

Release Valve Rod. A rod extending from the release valve on the auxiliary reservoir to the side of the car to operate the release valve.

Release Valve Rod Guide. A small iron eye attached below the sills as a guide for the Release Valve Rod.

Relief Valve. See Gravity Relief Trap.

Repairs, Car. Pages 1145-1176.

Replacer. See Car Replacer.

Reservoir (Air Brake). A cylindrical container. Main reservoirs of large capacity are placed under all motor cars having air compressors; auxiliary reservoirs are placed under all cars equipped with automatic air brakes; in freight service a cast iron auxiliary reservoir is connected directly with the brake cylinder and triple valve. See Air Brake. See also Lamp Fount, Receiver, and Vapor Reservoir.

Reservoir Drain Cock (Air Brake). A cock for emptying the reservoir of any water condensed from the compressed air. Fig. 2004.

Reservoir Pipe (Air Brake). Also called air pipe and discharge pipe. The pipe conveying the air from the air compressor to the main reservoir.

Reservoir Support (Air Brake). A bracket by which a reservoir is attached to a car.

Resistance Coils. See Electric Heater.

Retaining Ring (Wheel Tires). A ring securing the tire to the wheel. See Wheels. Figs. 1608, 1623-1628.

Retaining Valve, Brine. A valve installed in the brine

tank of a refrigerator car for controlling the circulation of the brine. See Pressure Retaining Valve.

Retarding Spring (Triple Valve).

Retirement of Lighter Capacity Cars. A topical discussion on the retirement from interchange service of cars of 40,000 and 50,000 pounds capacity will be found in the 1913 Proceedings, page 534. This was followed by a committee report, which will be found in the 1914 Proceedings, page 417.

Return Bend (Pipe Fittings). A short U-shaped tube for uniting the ends of two pipes.

Reversible Car Seat. A name used to designate the form of car seat in which the back turns over to reverse the seat. A turn-over seat. See Car Seat.

Revolving Chair. See Parlor Car Chair, Car Seat.

Rheostat. A resistance used in connection with the controller for limiting the current taken by the motors, during acceleration. Usually consists of a number of iron grids or strips of iron ribbon properly connected and packed in a substantial frame, the whole being mounted on the under side of the car flooring.

Rib (Cast Car Wheel). A bracket. See Wheel Rib.

Ridge. See Roof Ridge.

Ridge Cap. A flanged metal strip to cover the ridge joint on a metal car roof.

Ridge Pole. A longitudinal member in the center of a roof, supported by the carlines or rafters on which the roof boards rest. In some cases the rafters are framed into the ridge pole, and in some cases the ridge pole is grooved to receive the roof sheets.

Ridge Pole Bracket. A forging or casting used to connect the ridge pole and the end plate.

Ridge Timber. A timber which caps the intersection of two inclined floors meeting in the center of the car as in side dump or ore cars. If the inclined floors were the two sides of a gable roof the ridge timber would then become a ridge pole.

Rigid Bolster Truck. A car truck with a bolster which has no lateral or swing motion. See also Bolster and Truck Bolster.

Rim (Car Wheel). That portion of a car wheel outside of the plate.

Rim Latch. A latch which is attached to the inside of a door and is not let into it.

Rim Lock. A lock having an exterior metallic case which projects from the face of the door, differing thus from a mortise lock.

Riser. A piece of marble or metal set on edge around a wash bowl to prevent water from running against the walls. See also Step Riser.

Rivet. A round piece of metal with a head on one end, used to hold two or more pieces of material together by passing it through them and turning over or upsetting the headless end.

Rivet Heater. A furnace or other device for heating rivets. Page 1172.

Rivet Steel and Rivets for Passenger and Freight Equipment Cars, Specifications for. Pages 1073, 1074.

Rocker (Tip Car). A crescent-shaped casting bolted to the rocker timbers of the car body on which the body rests and rolls when the body is tipped.

Rocker Bar (Heaters). A horizontal bar which supports the grate, and on which the latter is attached by a pivot in the center so that it can be turned horizontally and thus shake down the ashes.

Rocker Bearing Timber Hangers (Tip Car). Vertical timbers or iron bars framed and bolted to the end piece, to which the rocker bearing timbers are fastened.

Rocker Car Seat. A seat having the bottom adjustable so as to give it an inclination toward the seat back in all cases, on whichever side the seat back may be placed. All modern car seats have mechanism by which this inclination is automatically given to the seat when the back is reversed or swung back. See Car Seat.

Rocker Casting (Car Seats). A casting forming a part of the cushion carrier or stand, which is moved back and forth by the seat back arms, and moves the cushion forward, as well as giving it some inclination toward the back.

Rocker Side Bearing. A device somewhat similar to the roller side bearing. Instead of rollers, rockers are used, which tend to offer a gradually increasing resistance to the lateral motion of the bolster and tend to return it to its normal position at all times. Figs. 1487, 1512; Page 656.

Rolled Axle. An axle made of rolled iron or steel. See Axle.

Rolled Steel Wheel. A car wheel made of rolled steel.

Roller Center Plate. A center plate fitted with rollers to reduce the friction in turning.

Roller Side Bearing. A side bearing fitted with rollers to reduce the friction in curving. Figs. 1470-1519. Pages 649, 651, 653, 656.

Roller Side Bearing Truck. A lateral motion truck the frame of which is very like a swing motion truck with a rigid spring plank. Lateral motion is given to the truck bolster by placing it upon cylindrical rollers resting upon the spring caps. The spring cap and bolster bearing plate are concaved, so that the motion of the rollers is restrained and the truck bolster given stability. Figs. 1364-1371; Page 609.

Roof. See Car Roof.

Roof Corner Casting (Passenger Equipment Cars). A cast iron molding for the corners of platform roofs.

Roof Door. See Icing Door.

Roof Framing. See Body Framing and Frame.

Roof Grab Iron. See Roof Hand Hold.

Roof Hand Hold (Box and Stock Cars). An iron bar fastened to the roof to be grasped when ascending the ladder at the end of the car. Also called Roof Grab Iron. See Safety Appliances.

Roof Light. A deck sash.

Roof Panel (End). The panel over the door of a passenger car.

Roof Ridge (Freight Cars). The intersection of the two plane surfaces forming a pitching roof.

Roof Sheet Splice Tee. A commercial Tee, riveted to two roof sheets so as to form a splice between them and form a continuous surface.

Roof Sheets. Metallic sheets for covering car roofs. The joints are made in various ways. See Car Roof.

Roof Support. See Carline, Purline and Ridge Pole.

Roof Ventilator. A ventilator in the roof of a car.

Roofing. See Siding, Flooring, Roofing and Lining. Page 435.

Roping Staple. A U-bolt secured to the side sill near the end of a car into which the hook of a switching rope may be caught, so that a switching locomotive may pull cars on side tracks while it is on the main track, or vice versa.

Rotary Snow Plow. See SNOW PLOW. Fig. 2694.

Rotary Strainer. See CENTRIFUGAL DIRT COLLECTOR.

Rotary Valve (Motorman's Brake Valve). The main valve which rotates when the handle is turned.

Rotundity Gage for Solid Steel Wheels. See WHEELS, SOLID STEEL, ROTUNDITY GAGE FOR.

Round (Ladder). The horizontal bars on which the foot rests. They are called rounds, whether of wood or iron, and whether round or square.

Round Iron, Limit Gages for. See LIMIT GAGES FOR ROUND IRON.

Rules for Examination of Car Inspectors. See EXAMINATION OF CAR INSPECTORS, RULES FOR. Page 1163.

Rubber Tread (Step). A rubber covering fastened to a step, or threshold plate, of a car to prevent persons from slipping when ascending or descending the steps.

Running Board. A plane surface, made usually of boards, for trainmen to walk or run on. It is placed on the roof of box or stock cars and at the sides of tank cars. Gondola and flat cars usually have none. Figs. 769, 770.

Running Board Bracket. A support fastened to the roof of a box or stock car to carry the running board extension, also a running board saddle.

Running Board Extension. The part of the running board which extends beyond the end of the car body so as to bring the ends of the running boards on adjoining cars nearer together to facilitate the passage of trainmen from one car to another. See RUNNING BOARD.

Running Board Extension Bracket. See RUNNING BOARD BRACKET.

Running Board Saddle. A wooden block or an iron casting or forging, shaped on the lower side to fit the angle of a car roof and flat on the upper side, acting as a support for the running board. Figs. 769, 770.

Russia Iron. A form of sheet iron manufactured in Russia the process for making which consists essentially in forming a chemical compound of iron upon its surface at the same time that it is highly polished, so that it is not likely to rust. Modern substitutes for this iron are also known as planished iron.

Rust. The report of a committee on "What is the Best Preventative of Rust on Steel Cars?" will be found in the 1904 M. C. B. Proceedings, page 144.

S

Saddle. In mechanical structures, a block or plate which acts as a bearing or support for a rod, beam, etc.

Safety Attachment (Car Truck). A device attached to the car body which automatically causes an application of the air brakes when the trucks may be derailed or broken. It also causes a light application of the brakes when excessive speed on rough tracks causes abnormal or dangerous swaying of the trucks.

Safety Beam (Six-Wheel Trucks). See AXLE GUARD.

Safety Berth Latch. A device by which it is made impossible for an upper berth to shut in case of accidental overturning of the car. When this device is used the berth safety rope is dispensed with. Fig. 393.

Safety Appliances. Figs. 2744-2763; Pages 1017-1041.

Safety Chains, Platform. Pages 1077-1078.

Safety Chains for Steel and Wooden Freight Cars. Page 1078.

Safety Car Control Equipment. An equipment used principally on "Safety Cars" where a single operator is entirely responsible for the control of the car and the sole dependence in case of danger. With this equipment, the air brake and car door operating devices are interlocked; the air brake equipment is of the semi-automatic type; a dead-man's feature is provided; and convenient means are provided for sanding the rails.

Safety Chain Eye. An iron eye with a broad base bolted to the under side of the side sills of a passenger equipment car to receive the hook on the end of a truck safety or check chain.

Safety or Check Chain Eyebolt. An eyebolt for securing a safety or check chain to a truck or to the car body.

Safety or Check Chain Hook. A hook on the end of a check chain with which to attach it to an eyebolt on the car body.

Safety Guard (Spring Plank). An iron strap attached to the truck transoms and passing under the spring plank to hold up the latter in case of accidental breaking of the link hangers. See SPRING PLANK SAFETY HANGER.

Safety Hanger. A metal loop or eye surrounding a rod or bar to prevent its falling in case of breakage. Fig. 392, Fig. 381.

Safety Rod (Postal Cars). A rod suspended from overhead, over the pouch racks, within easy reach to serve as a handhold or grab iron in case of derailment, etc. Fig. 443.

Safety Rope (Sleeping Car Berths). More properly BERTH SAFETY ROPE. See also SAFETY BERTH LATCH.

Safety Strap. See SAFETY HANGER.

Safety Tread. Rubber or metal coverings for step treads which prevent the foot from slipping. See TREAD. Figs. 827-838; Page 451.

Safety Valve (Car Heating). A type of pressure relief valve used to provide against an accumulation of excess pressure.

(High Speed Brake.) An improved type of relief valve applied to the brake cylinders of such cars in a train as are not equipped with a high speed reducing valve, to relieve the brakes from excessive pressure. Fig. 1941.

(Tank Car.) A valve attached to the dome of a tank car to prevent excess pressure due to the vapors arising from volatile liquids such as Acetone, Distillates, Turpentine, etc. See TANK CARS. Figs. 271-276.

Safety Vent. An opening formed by a hollow casting or a piece of pipe inserted in the dome of a tank car. It is used on cars carrying products which are non-inflammable or do not give off inflammable vapors. To avoid losses due to evaporation or to splashing, or contamination by moisture, the opening is sometimes

covered by a frangible lead disk designed to rupture at a predetermined pressure. See TANK CARS.

Saloon. A retiring room, furnished with a dry closet or a water closet. The saloon is commonly also provided with washing facilities. Other terms are lavatory, closet, toilet. See LAVATORY.

One of the smaller subdivisions or staterooms of a sleeping or parlor car.

Salt-Water Drippings, Collection of. Page 211.

Sand Blast. A process of cutting glass by blowing sand upon it with a strong blast of air.

The same principle is used in larger machines for cleaning the rust and old paint from steel cars, and for cleaning rough castings. Page 1149.

Sand Plank. A common name for spring plank.

Sanitation of Passenger Cars. See PASSENGER CAR CLEANING.

Sandwich Plate. See FLITCH PLATE.

Sash. The frame of a window or blind in which the glass or slats are set, but commonly used, especially in compound words, as a substitute for window, which means the window and sash complete. The various members used in framing a sash are the same as in a door frame. See DECK SASH, etc.

Sash Balance. A spring or weight, with or without a cord, so connected to a sash as to counterbalance its weight and make it easy to raise or lower. Figs. 870, 879, 898, 913, 920, 921; Pages 461, 465.

Sash Bars. See SASH LATCH.

Sash Fastener. A sash lock.

Sash Holder. See SASH LOCK.

Sash Latch. Similar to a sliding door latch. See LATCH.

Sash Lift. A metal finger hold attached to the bottom rail of a window sash for raising and lowering it. They are sometimes let in flush, but are usually attached on the outside. Sometimes, but rarely, the sash lift is a mere knob, and so called. A window blind lift is a somewhat similar device. See BAR SASH LIFT.

Sash Lock. A spring bolt attached to a window sash, or (rarely) a window blind, provided with a thumb lever to withdraw the bolt with by one hand, while the sash is lifted by the other. Both hands must thus be used. To accomplish this end less awkwardly sash balances have been adopted. Figs. 864-946; Pages 461, 463, 465, 954, 956.

Sash Lock Plate. A sash lock stop.

Sash Lock Rack. A rack or stop bar used as a sash lock step. Figs. 865-933.

Sash Lock Spring. See SASH LOCK.

Sash Lock Stop. Either a socket or a projection on the window frame to engage the sash lock. There are two kinds of stops, upper stops for holding the window open, and lower stops to hold it shut. Sash lock bushings, plates, or racks, are substitutes and equivalents for sash lock stops. Sash lock racks are often called stop bars.

Sash Parting Strip. See PARTING STRIP.

Sash Opener. A contrivance, as a lever or rod, for opening a window, used chiefly for the deck sash which are out of reach.

Sash Pivot. A metal pin or pivot attached to a sash on which the latter turns. See DECK SASH PIVOT.

Sash Pull. See DECK SASH PULL.

Sash Rail. A horizontal bar in the frame of a window or blind.

Sash Spring. A metal spring attached to the edge of the stile of a window sash to prevent it from rattling.

Scheme Rod (Postal Cars). A rod supported upon a scheme rod bracket, and carrying the scheme or schedule of the proper distribution of mail matter for the various post offices; used in distributing mail.

Scoop Car. A car of special construction having a scoop which is pushed along on top of the track. It is used for removing rock or earth slides from railway tracks. Fig. 2646.

Scheduling, In Car Shops. Pages 1159-1162.

Screen (Window). A wire netting stretched on a frame to admit air but exclude cinders. Figs. 724; Page 471.

Screw. A cylindrical piece surrounded by a series of spiral ridges and grooves, every part of which forms an equal angle with the axis of the cylinder. When used alone the term commonly means a wood screw, having a slotted head and gimlet point, for driving in with a screw driver. Machine screws are similar, except that they have no gimlet point and have a metal screw thread. They are used for uniting metallic parts. All ordinary forms of bolts have screw threads cut on them, but are not commonly called screws. A special form of wood screw is a lag screw, which is a large sized screw with a head like a bolt, so that it may be inserted with a wrench instead of a screw driver.

Screw Coupling (British). The means by which passenger train vehicles are coupled together. On the Continent of Europe it is used for both passenger and freight cars. It comprises a right and left-handed screw provided with a handle, which always hangs downward, so that it has no tendency to unscrew and slacken the coupling, and two nuts with gudgeons taking in the eyes of U-shaped coupling links or shackles. The screw coupling may be either loose, or one shackle may be attached to the drawbar.

Screw Gages. See EXTERNAL SCREW GAGE, INTERNAL SCREW GAGE, SCREW PITCH GAGE, and SCREW THREAD GAGE.

Screw Jack. A jack, the power of which depends upon a screw, turned by a lever. See JACK.

Screw Pitch Gage. A gage for determining the number of threads to the inch on screws and taps. It consists of a number of toothed plates turning on a common pivot, so that the serrated edge of each may be applied to the screw until one is found which corresponds therewith. The figures stamped on the plate indicate the number of threads to the inch. In the ordinary single thread screw the pitch is indicated by the number of threads to an inch.

Screw Threads, Bolt Heads and Nuts. Pages 1080-1088.

Screw Thread Gage. A steel plate with notches in the edge of the precise form of screw threads, used for giving the proper form to the edges of screw cutting tools.

Sealed Jet (Car Heating). A piece of apparatus in which live steam is brought directly into contact with the circulating water and heats it, at the same time forcing the circulation.

Seat. That flat portion of a chair or sofa to support

the person. See CAR SEAT. See Figs. 993-1030; Pages 482, 483, 485, 487, 488.

In Mechanics: The part on which another thing rests, as a valve seat.

Seat Arm. An arm by which the back of a seat is attached to the seat end or to the side of the car. Such arms are usually attached by a pivot, so that the seat back can be reversed. Sometimes called striker arm, seat back arm, and also seat back reversing arms.

This term is also used to designate the portion of a seat end which supports the arm of a person sitting in the seat, and sometimes, incorrectly, to designate a seat arm cap.

Seat Arm Cap. A piece of metal shaped to the form of the seat arm and screwed to the top to take the wear and as an ornament.

Seat Arm Pivot. A metal pivot by which a seat arm of a reversible seat is attached to a seat end or the side of a car. In some cases the pivot is made in one piece with the seat arm plate, which is attached to the seat end. The two combined then become a seat arm pivot plate. A seat arm pivot is sometimes called a seat arm rivet.

Seat Arm Plate. A plate fastened to a seat end with a hole in the corner, which receives and holds a seat arm pivot. In some cases the pivot is made in one piece with the plate. The part formed by combining the two is then called a seat arm pivot plate. Sometimes a seat arm pivot plate or washer and a bolt is used.

Seat Arm Rest. See SEAT ARM.

Seat Arm Rest Bracket. A bracket secured to the wall to carry a wood arm rest.

Seat Arm Rivet. See SEAT ARM PIVOT.

Seat Arm Stop. A metal lug or bracket attached to a seat end, and sometimes to the side of the car, on which the seat arm rests. Seat stops are either attached to a long plate (curved or straight seat stop), or as in round seat stops, have a flange entirely surrounding them, by which they are attached to the seat arm or side of the car. They are also called seat stops.

Seat Arm Washer. A small washer for the head of a screw, by which a seat arm is fastened to a seat end. Now little used.

Seat Back. That part of a car seat which forms a support for the back. It has an arm, called the seat back arm, attached to it, by which it is attached to the seat ends with a seat arm pivot, so that it can be swung over so as to face the other way. In some styles the seat back arm is pivoted below the seat cushion and the seat back swings over the cushion so that both sides are used alternately. In sleeping cars the back does not swing, but a part of it pulls out to form the lower berth. See SEAT. On some suburban cars, and commonly on street cars, longitudinal seats are used, with the backs against the sides of the car.

Seat Back Arm Lock. See SEAT LOCK.

Seat Back Arm Pivot. The swinging joint or seat back pivot in the seat arm. See SEAT ARM PIVOT.

Seat Back Band. A seat back molding.

Seat Back Corner. A metallic cornice piece to screw to the backs of seats and protect the upholstery from wear.

Seat Back Curved Stop. A seat back stop of a curved form.

Seat Back Molding. A wood, or more usually, metal band or molding fastened around the edge of a seat back to give it a finish and protect it from wear.

Seat Back Paneling. The panels forming the partition between the seat backs in a sleeping car.

Seat Back Pivot Plate. The plate bearing a seat arm pivot fastened to the seat back.

Seat Back Reversing Arms. A seat back arm of a car seat.

Seat Back Round Stop. A round seat stop.

Seat Back Slats. Narrow strips of wood used to form a seat back; used chiefly for seats which are not upholstered.

Seat Back Spring. A weak spring placed in the upholstering in the back of a seat. Usually called simply back spring.

Seat Cover Guard Rail. A strip of wood tacked to the flap of the seat cover to keep it straight.

Seat Cushion. The upholstered part of a car seat. Ordinarily there is a separate cushion for the seat and for the back. In sleeping cars the two cushions are used to form the lower berth. Two kinds of cushions are used on cars; a squab cushion, which is a loose pad and is now little used, and box cushion, which is a cushion built upon a cushion frame, with springs, etc. Page 485.

Seat Division (Longitudinal Seats). A bar of wood or metal to separate the seat space into sections.

Seat End. A frame of wood or metal at the end of a car seat which supports the arm of the occupant and to which the seat back arm is attached. Seat ends are designated as long or short, according to whether they extend entirely to the floor or are supported upon a seat stand. They are also designated as aisle seat ends, or wall seat ends, and, for corner seats, as left-hand or right-hand seat ends.

Seat End Arm. The portion of a seat end which supports the arm of a person sitting in the seat. An arm rest.

Seat Head End. The upper part of the seat end projecting out beyond the head rest.

Seat Hinge (Sleeping Car). A strap hinge used to connect a seat with the seat back. See also SOFA HINGE.

Seat Leg (Longitudinal Seats). A wooden post which supports a front seat rail.

Seat Lever (Water Closet). A lever projecting backward from the seat lid, to which the connecting rod is attached.

Seat Lid (Water Closet). A cover for the seat.

Seat Lock. A lock for holding the back of a seat so that its position cannot be reversed. Such locks are attached either to the seat end, seat back arm or seat back stop. A form for iron seat ends with a small escutcheon, not provided with screw holes is sometimes distinctively called a barrel lock, although the term is almost equally applicable to any form of seat lock. Seat locks operate by pushing the key inward, turning it a little and then pulling on the key.

Seat Lock Bolt. The beveled bolt by which locking is effected.

Seat Pull (Sleeping Car). A flush handle for pulling out the seat in making up the berth so as to drop the back and seat to the same level.

Seat Rail. One of a pair of rails, front and back, resting on and attached to the seat ends, and which support a cushion frame or seat bottom.

Seat Slat. A narrow strip of wood which forms part of a seat bottom, or seat back.

Seat Spring. A spiral or other metal spring used to give a seat elasticity. Spiral springs are the most common, the elliptic and spiral-elliptic having become nearly obsolete in new seats. A special form of seat springs called back springs, having little resistance, is used for seat backs. British seat springs are called sofa springs, and the back springs back squab sofa springs.

Seat Stand. A support on which an aisle seat end rests.

Seat Stop. See SEAT ARM STOP.

Seat Webbing. A form of coarse canvas used in upholstering car seats. See also JUTE.

Second-Class Car. A plainly finished passenger car for carrying passengers who pay a lower rate of fare than first-class passengers. See FIRST CLASS CAR.

Section (Sleeping Car). Two double berths, an upper and a lower, making up into two seats facing each other when not used as a berth.

Section Car. Figs. 2697-2712; Pages 974, 975.

Sectional Seat Cushion. One with spiral springs separately attached to narrow slats so that the seat can be made up or repaired in sections.

Self-Clearing or **Self-Cleaning Car.** A car having a floor forming one or more hoppers, with doors at the bottom which, when opened, permit the load to discharge by gravity. Most hopper cars are self-clearing. See also CAR, DROP-BOTTOM CAR, and HOPPER CAR.

Self-Closing Faucet or Cock. A faucet having a horizontal bar handle provided with a spring by which it is closed when released. See FAUCET.

Self-Propelled Car. A car propelled by a motor which is carried by the car itself. See MOTOR CAR.

Sellers System of Screw Threads. A system of screw threads designed by William Sellers of Philadelphia. Often called Franklin Institute or United States Standard Thread. See SCREW. Page 1081.

Series. A method of connecting two or more pieces of electrical apparatus to a common circuit. The connections are made so that the negative side of one piece of apparatus is connected to the positive of the next and the full current passes successively through each piece of apparatus in the circuit.

Service Application. See AIR BRAKES.

Set (Springs). The amount of compression of which the spring is capable. In elliptic springs the distance between the spring bands when unloaded. The arch is half the set, plus the thickness of the spring band.

Sextuple (Elliptic Spring). Six elliptic springs coupled together, side by side, to act as one.

Shackle Bar. A coupling link.

Shade. See LAMP SHADE, WINDOW SHADE.

Shade Holder. Fig. 2565; Pages 954, 956.

Shade Roller (Window Shade). A device serving the purpose which its name implies; the only forms now in general use are automatic and hold the shade in any position desired.

Shaft. That part of a machine to which motion is communicated by torsion. See BRAKE SHAFT, WINDING SHAFT, etc.

Shank (Coupler). That part of a coupler or drawbar between the draw head and tail. The body of the coupler.

Sheathing. The side and end covering of a car. Tongued and grooved lumber is used on wooden cars and steel plates on all-steel cars. Lining is also used on some cars in addition to the ordinary outside sheathing and is sometimes called inside sheathing. Figs. 574, 859, 860.

Sheathing Furring. Wooden strips or blocks to which to nail sheathing.

Sheave. A wheel, roller or pulley, over which a cord or rope runs, or on which any object, as a door or window rolls. Sheave is often used to designate a block or pulley, but more properly it designates simply the grooved wheel in the block. See PULLEY.

Sheave Pin or Pintle. The axle of a sheave.

Sheet. The plates used in inclosing all types of steel cars are termed sheets, as end sheet, side sheet, roof sheet, floor sheet, etc.

Sheet Iron. Iron rolled into thin sheets.

Shelled Out (Car Wheels). A term applied to wheels which become rough from circular pieces shelling out of the tread.

Shim. A thin piece of wood or metal used as a lining or filling piece. Sometimes called a Dutchman.

Shoe. A plate, block or piece of any material on or against which an object moves, usually to prevent the latter from being worn. See also BRAKE SHOE.

Shops, Car Repairs. Pages 1145-1176.

Shops, Car, Scheduling. Pages 1159-1162.

Shop Equipment. Pages 1172-1176.

Short Sill or Floor Timber. An auxiliary longitudinal timber sometimes used in a car floor, but not extending its whole length. See PLATFORM SHORT SILLS.

Shot (Car Wheels). See COLD SHOT.

Shovel. See STEAM SHOVEL.

Side Bearings. Bearings attached to the bolsters of a car body, or truck, on each side of the center plate to steady the car, to prevent excessive rocking, and upsetting, while passing curves. The upper, or body side bearing, and the lower, or truck side bearing, both are usually made of box shape castings, forming large flat bearing surfaces to mate with each other.

To overcome friction between these surfaces, balls, rollers, and rockers have been used in many different ways. Such frictionless or anti-friction side bearings are ordinarily furnished complete as one device to fill the space between the two bolsters. If the portion containing the anti-friction member is fastened to the truck bolster, it is known as a truck side bearing; if fastened to the body bolster, it is considered a body side bearing. Figs. 1470-1519; Pages 649, 651, 653, 656, 970.

See ANTIFRICTION, BALL, ROLLER, and ROCKER SIDE BEARINGS.

Side Bearing Arch or Bridge (Six-Wheel Truck). An iron bar, truss, or wooden beam attached to the bolsters to support the truck side bearing.

Side Bearing Truck. A truck in which the weight of the car is transmitted at the side instead of the center. The term balanced side bearing truck is also used to indicate that the car body is so balanced on the truck that the weight is equally distributed to all the wheels at all times. See TRUCKS.

Side Brace. Commonly designated as body brace or brace, except when the end braces are to be distinguished from them.

Side Brace Rod. See BRACE ROD.

Side Casting. See CHEEK or DRAFT CASTING.

Side Chute Plank. The planking of an inclined floor which discharges its load transversely to the car, either toward or from the middle of the car.

Side Deck Lamp. A bracket lamp fastened above the windows and to the deck sill, or to the lower deck ceiling and the deck post.

Side Door. Designated thus to distinguish from end doors on both freight and passenger equipment. See DOOR, and BOX CAR DOOR.

Side Door Bottom Guide. An iron bracket attached to the side of freight cars having sliding doors to guide the door while it is being opened and shut and also to prevent its swinging away from the car at the bottom.

Side Door Fixtures. See DOOR FIXTURES, BOX CAR.

Side Door Hanger. See DOOR HANGER.

Side Door Protection Strip. See PROTECTION STRIP.

Side Door Stiffener. See STIFFENER.

Side Door Top Track. See DOOR TRACK.

Side Dump Car. A car so constructed that its contents may be discharged to either side or both sides of the track through doors in the car sides, or drop doors in the floor; by means of an inclined floor and side doors; or by tipping the car body sidewise. See also DUMP CAR, HOPPER CAR, and TWO-WAY DUMP CAR.

Side Eave. A term sometimes used to designate a steel plate running along the eaves or edge of the roof of a steel passenger equipment car.

Side Fascia. See FASCIA.

Side Frame. The frame which forms the side of a car body or a truck. It includes the posts, braces, plate, belt rail, etc., for the car body; and the side member of a truck frame. See TRUCK SIDE FRAME.

Side Furring. See FURRING.

Side Lamp. A lamp attached to the side of a passenger car in distinction from a center lamp, which hangs from the roof. They are usually made with brackets, by which they can be conveniently fastened.

Side Nailing Strip. A piece of wood bolted outside the side sills of steel underframe cars to which the ends of the floor planks and the bottom ends of the sheathing are nailed. See NAILING STRIP.

Side Piece (Platform Hood). A thin block cut to the curve of the hood.

Side Plank Tie Rod. A vertical rod passing through the side sill and side planking of a wooden gondola car and tying them together.

Side Plate. More properly, simply plate. The longitudinal member connecting the tops of the side posts of the car body. So called as distinguished from the end plate.

Side Plate Stiffening Angle (Steel Cars). An angle iron riveted to the side plate, and serving the same purpose as the stakes. Often called stake.

Side Plate Tie Rod. A rod extending across the top of the car and tying the side plates together.

Side Post. Vertical member used in the side framing of freight and passenger cars.

Side Post Strap Bolt. A strap bolt joining the post to the side sill.

Side Rail. A longitudinal timber extending along the top of the side frame of a coal or ore car. It rests upon posts and braces and connects with end rails, which go across the end of the car. It corresponds to the plate of a box car, but does not carry any rafters or carlines, as does a plate.

Side Seat. A longitudinal car seat, the back of which is against the side of a car.

Side Sheet. A plate used for closing in the sides of a steel car.

Side Sill. The outside longitudinal members of the underframe. In some designs of steel cars the side sills are dispensed with and the entire side of the car is designed as a deep plate girder to carry most of the load to the bolster.

Side Sill Flitch Plank. One of the planks which enclose the flitch plate and make up a composite or built-up side sill.

Side Sill Step. See SILL STEP and SAFETY APPLIANCES.

Side Slope. That part of the floor which slopes from the side of a hopper to the hopper door. See HOPPER SLOPE SHEET.

Side Stake. See STAKE.

Side Stake Pocket. See STAKE POCKET.

Side Stem. A bar attached to the side of a three-stem coupler to transmit part of the force to springs separate from the regular draft springs. See THREE-STEM EQUIPMENT.

Side Straps (Gondola Car). The straps to which the end planks and sometimes also the side planks, are bolted. They are also called side plank tie straps.

Side Strut for Hopper Floor (Hopper Cars). An inclined strut or support for the hopper floor between the bolster and the end of the car, fastened to the corner of the end sill.

Siding. A side track. See also SHEATHING, and LUMBER SPECIFICATIONS in MATERIALS SECTION.

Siding, Flooring, Roofing and Lining. Figs. 574-576.

Signal. See BACK-UP AIR SIGNAL, and TRAIN AIR SIGNAL APPARATUS.

Signal Branch Pipe. A pipe leading from the train air signal pipe to the car discharge valve.

Signal Cord. Where the train air signal system is used a separate signal cord is used in each car and is attached to the car discharge valve; a pull on the cord releases the air in the signal pipe and blows the signal in the cab. For details see Figs. 947-952.

Signal Cord Bushing. A thimble lining a hole through a partition for a signal cord to pass through, in distinction from a signal cord guide, which is attached to the side or roof of the car or to the signal cord hanger and serves solely the purpose which its name

implies. For passing the signal cord through inclined surfaces beveled bushings are used, which are frequently provided with one or more pulleys to avoid friction.

Signal Cord Coupling. The hook attached to the end of a signal cord to enable it to be connected or disconnected at pleasure with another signal cord. See also SIGNAL CORD SPLICE.

Signal Cord End Hook. A common metal hook with a screw shank by which it is attached to the end of the car. The hook is used to fasten the end of a bell cord to the last car and thus hold it in its place and prevent it from being drawn out of its guides.

Signal Cord Guide. A metal eye or ring attached to the roof or ceiling of a car, or to the end of a Signal Cord Hanger, and by which a signal cord is carried or conducted. See also SIGNAL CORD BUSHING.

Signal Cord Hanger. A guide for the signal cord, hanging usually from the center of the clere-story or upper deck.

Signal Cord Pulley. A wheel in a signal cord guide over which a signal cord runs.

Signal Cord Sheave. See SIGNAL CORD PULLEY.

Signal Cord Splice. A metal coupling with right and left hand screws for permanently splicing the ends of a broken cord. See also SIGNAL CORD COUPLING.

Signal Cord Strap. See SIGNAL CORD HANGER.

Signal Cord Thimble. See SIGNAL CORD BUSHING.

Signal Hose. An air hose similar to, but of smaller diameter than, an air brake hose, and used between cars to connect the train air signal lines.

Signal Lamp. See TAIL LAMP. Figs. 2541-2560.

Signal Lamp Bracket. A bracket attached to the car body to hold the signal lamp or marker.

Signal Lamp Socket. A tapered slot set in the outside corners of a passenger equipment car to receive the signal lamp bracket.

Signal Pipe (Train Air Signal Apparatus). A continuous pipe running from car to car through the train, substantially a duplicate of the brake pipe, but working with a lower pressure of air. The signal pipe couplings are also similar to brake pipe hose couplings, but are arranged so that they will not couple with the latter.

Signal Pipe Cut-out Cock (Train Air Signal Apparatus) A cock placed at each end of every car for closing the signal pipe when desired.

Signal Pipe Strainer. An air strainer used in signal pipe to exclude dirt. See also BRAKE PIPE AIR STRAINER.

Signal Reducing Valve (Train Air Signal).

Signal Reservoir (Train Air Signal Apparatus). See WHISTLE RESERVOIR.

Signal Valve (Train Air Signal Apparatus). A valve attached to a branch from the signal pipe, which, on the opening of the car discharge valve in any car, and the consequent reduction of pressure in the signal pipe, permits the air to escape to blow the signal whistle. On motor cars this valve and whistle are placed in the cab at each end of the car.

Signal Whistle (Train Air Signal Apparatus). See WHISTLE.

Sill (Car). The main longitudinal timbers which are connected transversely by the end sills, body bolsters, and cross ties. Sills are divided into side sills, intermediate sills and center sills. See also END SILL, PLATFORM END SILL, SIDE SILL, etc. Figs. 571-573.

A topical discussion on the advisability of using metal center sills in wooden car construction, will be found in the 1902 M. C. B. Proceedings, page 62.

See also LUMBER SPECIFICATIONS in MATERIALS SECTION.

The lower horizontal member of the frame surrounding a window or door. See DOOR SILL, WINDOW SILL.

Sill Knee Iron. An L-shaped or right-angle iron casting or forging bolted into the side corner of a car frame to strengthen it.

Sill and Plate Rod Washer. A large rectangular washer for the ends of the sill and plate tie rod.

Sill and Plate Tie Rod. A vertical iron rod which passes through the sill and plate of a car body frame and ties the two together.

A similar part for low passenger car trusses below the windows is called a brace straining rod.

Sill Splicing. Figs. 571-573; Pages 363-367.

Sill Step (Freight Car). A U-shaped iron attached to the sill of a car as a step for trainmen. See SAFETY APPLIANCES.

Sill Strap Bolt. A strap bolt used to fasten the side and end sills together. When set into the sill it is called a joint bolt.

Sill Tie Rod. A transverse iron tie rod in the floor of a car for holding the sills together.

Sill Timber Key. A metal block let into a gained seat on the sills to relieve the sill bolts from shearing stresses.

Sills, Uniformity for Section of. Page 363.

Single Plate Wheel. A wheel, in which the hub and rim are united by only a single plate, which is strengthened usually by ribs, called brackets, or sometimes by corrugations. See WHEEL.

Single Track Snow Plow. A snow plow for use on single track railroads and so constructed that it throws the snow to both sides of the track. See SNOW PLOW.

Sink (Dining Car). A shallow metallic box to receive and carry off dirty water and liquid refuse.

Six-Wheel Truck. A car truck having six wheels. See TRUCK.

Skid Shoe. An iron shoe used to slide broken car wheels to a side track in order to avoid blocking the road. Fig. 2643.

Slack Adjuster. A device for automatically taking up the slack in the foundation brake gear when normal piston travel is exceeded. Figs. 2025-2035; Pages 841, 955.

Sleeping Car. A car provided with fixed seats, arranged to face each other, which can be used for day travel and at night can be converted into berths. A pair of seats, which makes a lower berth, and its corresponding upper berth, together make up a section. The mattress and bedding are carried in a pocket under the deck, the cover of the pocket being hinged to lower and form the upper berth, while the seat cushions and backs are arranged on the seat frame to form the lower berth. Figs. 360, 380-401, 2835, 2837; Pages 960, 964, 967.

EMIGRANT SLEEPING CARS, COLONIST CARS and TOURIST SLEEPING CARS resemble standard sleeping cars, but

are without such expensive upholstery. Compartment sleeping cars are divided into compartments, generally with one upper and one lower berth in each. A corridor runs along the side of the car. See also CAR.

Sleeping Car Section. The space in a sleeping car occupied by two double seats in daytime and by two berths (a lower berth and its corresponding upper berth) at night.

Slide Valve (Triple Valve). A plain slide-valve, controlled in its motion by the piston, by means of which the air is admitted to, and exhausted from, the brake cylinder, applying and releasing the brake.

Slide Valve Feed Valve. See FEED VALVE.

Slideover Seat. See WALKOVER SEAT, CAR SEAT.

Sliding Chair. A casting attached to a brake beam which slides on an inclined member in such a way as to secure a proper adjustment of the brake shoe as it wears. Figs. 1846-1855; Page 761.

Sliding Door. A door which opens by sliding sideways instead of swinging on hinges. Such doors are almost universally used on freight cars, excepting refrigerator cars; also on baggage, express and postal cars. They are hung by hooks called the door hangers, which slide on a top door track. See also CAR DOOR HANGER.

Sliding Door Bracket. A DOOR BRACKET.

Sliding Door Curtain. A curtain which automatically rolls up when a sliding door is opened. Used to darken the motorman's cab on electric cars.

Sliding Door Friction Roller. A small wheel attached to the top or bottom of a sliding door to make it run easily. It may or may not carry the weight of the door.

Slip Case (Postal Car). A small pigeon hole case used on a postal car for holding slips, pouch labels, etc. See POSTAL CAR SPECIFICATIONS.

Slope Sheet. See HOPPER SLOPE SHEET.

Smoke Bell. A cover or screen of glass, porcelain or metal, shaped somewhat like a bell, and placed over a lamp to protect the ceiling of a car or room. Large smoke bells are often called canopies.

Smoke Bell Bracket. A separate carrier for a smoke bell.

Smoke Bell Stem. A tube attached to the upper part of a smoke bell and serving to carry away the gases so as to bring the smoke bell lower and nearer to the lamp.

Smoke Flue. A smoke pipe.

Smoke Jack. A term commonly applied to the outside portion of a smoke flue when used on caboose and work cars. See also SMOKE PIPE CAP.

Smoke Pipe (Heaters). The pipe by which the smoke is conducted to the outside of the car, usually called stove pipe, but the stove pipe of heaters is called a smoke pipe or smoke flue, to distinguish it from the air pipes.

Smoke Pipe Cap. A covering on top of the smoke pipe to exclude rain and wind. Also called smoke jack.

Smoke Pipe Casing (Heaters). An outside pipe which incloses a smoke pipe, leaving a space between the two through which air is admitted from the top and is thus warmed.

Smoke Screen (Baker Heaters). A conical-shaped box, box, the front of which is the feed door and the bottom of which is the hole through which the coal enters the fire pot, and which is covered by the safety plate.

Smoke Top (Baker Heaters). The upper part of the heater, made of Russia iron, in a conical form.

Smoking Car. A passenger car reserved for smokers. Combination cars frequently have a smoking compartment. See CAR.

Smoking Room (Sleeping Car). A compartment now almost universal in modern sleeping cars and parlor cars.

Snatch Block. Properly a single block which has an opening (notch) in one cheek to receive the rope. The snatch block is usually provided with a swivel hook. The term is also popularly applied to any form of single block provided with a hook, although more properly it applies to only one with an opening at the side for readily inserting or removing the rope.

Snow Flanger. See FLANGER.

Snow Plow. A car so constructed that it will remove snow from railroad tracks. Snow plows are generally of either the wedge or rotary types. What is frequently called a wedge plow has a wedge-shaped front end, and is pushed through the snow by a locomotive. A wing-elevator snow plow has large wings which may be swung out by means of compressed air. Such a plow clears a wider space than one without the wing-elevator, and the sloped surfaces on the wings throw the snow well clear of the track. Snow plows are usually also equipped with FLANGERS. See DOUBLE TRACK SNOW PLOW, SINGLE TRACK SNOW PLOW.

A rotary snow plow has at the front end a wheel, set at right angles to the track, and furnished with blades. This wheel is driven through a horizontal shaft by a steam engine located on the car and when the whole machine is pushed forward by a locomotive the blades cut the snow from before the plow and discharges it to one side of the track. Figs. 2694-2696.

Snow Scraper. See FLANGER.

Snow Sweeper. A car equipped with brushes, near the rails, and the necessary machinery to revolve them. Used for sweeping snow from railroad tracks. See SWEEPING CAR. Figs. 2688, 2689.

Soap. See LIQUID SOAP FIXTURE.

Soap Holder. A soap dish attached to a partition like a bracket. See LIQUID SOAP FIXTURE.

Socket, Signal Lamp. See SIGNAL LAMP SOCKET.

Socket Washer. A large washer with a cavity to receive the head or nut of a bolt or rod so that it will not project beyond the surface of the wood to which it is attached. Also called cup washer.

Sofa (Sleeping Car). A longitudinal seat which makes up as a berth by pulling out sidewise so as to drop the back. Now used only in staterooms.

Sofa Bolt (Sleeping Car). A sliding bolt used for holding a sofa in its place. It is operated from the front by a sofa pull working through a sofa crank. Sofas standing against the side of the cars are now little used.

Sofa Caster. See CASTER.

Sofa Hinge. A hinge by which the seat and back of a sofa are fastened together so that they can be changed from a sofa to a bed.

Solenoid. A coil of insulated copper wire wound on a

spool which, when the electric current flows through it, may draw or attract an iron rod, core or plunger into its interior. A modified form of electro magnet. Used as a means for operating regulators, switches and other electrical apparatus.

Solid Bottom Gondola Car. A gondola car without openings in the floor or bottom for discharging the load. See CAR and GONDOLA CAR.

Spanner. A wrench for uncoupling hose, etc., formed like the arc of a circle, with notches or lugs for engaging in dogs or grooves on a spanner nut. An ordinary flat wrench with a straight jaw is also termed a spanner.

Spark Strip. A filling strip placed between a box car side door and the car to prevent the entrance of sparks or cinders.

Specifications. A committee of the M. C. B. Association was asked to standardize the forms for specifications and tests of materials. Its reports will be found in the M. C. B. Proceedings, 1913, page 582; 1914 Proceedings, page 357; 1915 Proceedings, page 371; and 1916 Proceedings, page 466.

Specifications for Axles. See AXLES.

Specification for Cast Steel Truck Sides. See TRUCK.

Specifications for Tank Cars. See TANK CARS.

Specifications for Wheels. See WHEELS.

Speed Recorder. A device, usually driven from an axle of a truck, which records the speed of a train. Its use is confined practically to official cars, dynamometer cars and locomotives.

Spiral Elliptic Sea Spring. A spring made of a thin band of steel wound in a spiral coil, the transverse section of which is elliptic.

Spiral Seat Spring. See SEAT SPRING.

Spiral Spring. See HELICAL SPRING.

Spiral Spring Cap. A casting or plate which forms a bearing for the top of a spiral spring, and which also holds it in its place. A similar seat is used at the other end. See SPRING CAP.

Splice Plate. A plate used to fasten the ends of two members of a frame together, so that they make a continuous member.

Splicing Sills. See SILL SPLICING.

Split Key. A form of pin which is self-fastening, consisting essentially of two parallel strips or bars of metal, which, when united, constitute one pin, but the ends of which may be forced apart to prevent the pin being withdrawn. See COTTER PIN.

Spoke. One of the radial arms which connect the hub with the rim of a wheel.

Spoke Wheel. A wheel, the rim or tire of which is connected with the hub by spokes instead of one or more plates. See WHEEL.

Spraying Car. A car equipped with a tank and spraying apparatus to spray the roadbed with various chemicals to kill weeds, prevent dust, and by using a mixture having a strong odor, keeping cattle away from the tracks. Also called weed killer. Fig. 2682.

Spreader. See BALLAST PLOW.

Spring. An elastic body designed to resist concussion. Springs are also used to produce motion in a reverse direction to that caused by some other applied force, as a brake spring and the spring of a door latch. The leading forms of springs are elliptic springs and spiral or helical springs. Spiral springs are designated according to the number combined one within the other, as double coil, triple coil, etc., or if the springs are placed side by side, as two group, four group, six group, etc.; elliptic springs, according to the number united to work together as one spring, are designated as double or duplicate, triple or triplicate, quadruple, quintuple and sextuple. The main springs about a car are nearly all spiral springs, except that elliptic springs are almost exclusively used for the bolster springs of passenger cars.

The principal springs of a car supporting its weight are the bolster springs, also called bearing springs or body springs. Equalizing bar or equalizer springs are used in addition on passenger cars, as also sometimes journal springs. See DRAFT SPRINGS, SPRING DAMPENER. Figs. 1650-1686; Pages 705-712, 713, 714, 715, 716, 717, 718.

Spring Band (Elliptic Springs). A wrought iron strap which embraces the plates at the center.

Spring Block. See EQUALIZER SPRING BLOCK.

Spring Buffer. See BUFFER.

Spring Cap. A cup-shaped piece of cast or wrought iron for holding the top of a spring and against which the latter bears. They are further distinguished by the name of the spring, as bolster spring cap, etc. The spring seat comes below the spring, but both these parts are very commonly called spring plates, especially in large group springs. See also SPRING SEAT.

Spring Caps for Freight Car Trucks. See SPRINGS and SPRING CAPS FOR FREIGHT CAR TRUCKS.

Spring Controller. A telescopic band which guides or keeps coil springs in proper position.

Spring Dampener. A device to increase the capacity of a spring by bringing into play a certain amount of friction which helps to absorb the load or shock, the friction increasing at a greater rate than the load as the latter increases. Some spring dampeners are intended to retard the sharp vibration of a coil spring and make its motion more like that of an elliptic spring. See also FRICTION DRAFT SPRING.

Spring Door Latch. A latch, the bolt of which is thrown into contact with a catch by a spring, and is disengaged by a knob or handle. Such latches are not arranged so as to be fastened with a key. See LATCH.

Spring Door Lock. A lock usually called a night latch.

Spring Edge (Car Upholstery). A term applied to a method of upholstery which protects the frame work entirely by springs, so that it is not felt by the occupant of the seat.

Springs, Elliptical, Specifications for. Pages 705-707.

Springs, Helical, Specifications for. Pages 707-712.

Spring Hanger. See SWING HANGER.

Spring Hinge. A hinge fitted with a spring to make the door self-closing. A double acting spring hinge is one which will permit the door to open either way and also to make it self-closing.

Spring Plank. A transverse member underneath a truck bolster and on which the bolster springs rest. Also called sand plank. A spring plank safety hanger passes under the spring plank. A swing spring plank is used in passenger and other swing-motion trucks. In rigid bolster trucks the spring plank is bolted to the lower arch bar of the truck frame.

Spring Plank Bearing. A casting on which a spring plank rests.

Spring Plank Bolt. A horizontal bolt connecting the spring plank and truck columns. Rivets are also used.

Spring Plank Safety Hanger (Passenger Equipment Trucks). A U-shaped strap of iron attached to the transoms, and passing under the spring plank. Its purpose is to support the spring plank in case the swing hangers or their attachments should break.

Spring Plate. A spring seat or cap.

Spring Pocket or **Strap Drawbar.** A drawbar with a rectangular strap or "pocket" at the back end, in which the draft spring is placed.

A topical discussion on spring pockets for freight cars will be found in the M. C. B. Proceedings, 1904, Page 251.

Spring Seat. A cup-shaped piece of cast or wrought iron, on which the bottom of a spring rests. Also called spring plate. They are further distinguished by the name of the spring for which they serve, as bolster spring seat, equalizer spring seat, etc. See also SPRING CAP.

Springs, Specifications for Carbon Steel Bars for Railway Springs. See SPRINGS, SPECIFICATIONS.

Sprocket. A wheel having teeth on its circumference so designed as to engage the links of a chain.

Spud. A bushing or coupling by which the hole of a sink or water cooler drip is connected with the drain or drain pipe.

Square Door Bolt. A door bolt made of a square and straight bar of metal. When the bolt has an offset it is termed a square neck door bolt.

Stake. A piece of timber inserted in a pocket on the sides and ends of flat cars to hold the load in place. The sides of wooden gondola cars are sometimes held in a similar manner. The side stiffening pieces on steel hopper and gondola cars are frequently called stakes.

Stake Pocket (Gondola and Flat Cars). A metal receptacle or collar, attached to the side and end sills to receive the end of a stake which supports the side or confines the load. Also used near the top of gondola cars to receive the stakes used in applying a coke rack or other appliance for increasing the depth of the car. Figs. 645-647.

Stake Pocket Strap or **U-Bolt.** A U-shaped bolt which sometimes serves as a substitute for the ordinary form of stake pocket, when the stakes are intended as permanent attachments.

Stake Pockets, Permanent. Page 369.

Stake Pockets, Temporary. Page 369.

Stanchion. A prop or support.

A metal post or hanger with an eye in one end, which holds a rod or other object, as a hand rail or curtain rod. The opposite end is usually fastened by a nut, or with a flange or lugs, which form a part of the stanchion.

Movable stanchions are required in postal cars. Figs. 446, 447.

Standard Gage. The most common distance between the rails of railroad tracks, which is 4 ft. 8½ in. See GAGE. This gage originated from the use of an even 5 ft. gage, with outside flanges on the wheels. As inside flanges came to be preferred, and had to run on the same rails (then with much narrower heads than now), the present standard was of necessity used.

Staple. A U-shaped piece of metal which is pointed at the ends, to be driven into wood to hold a hasp, hook, pin, etc. The term is also applied to the keeper, which is screwed or bolted to the door frame, and which holds the door hasp.

Starting Valve (Car Heating). A valve on the locomotive to admit steam to the train line for heating purposes. Fig. 2144.

Stateroom. A compartment in sleeping and private cars sometimes containing a stationary bed and in other designs the usual berths.

Stateroom Sleeping Car. A sleeping car having one or more separate compartments or staterooms in addition to the standard sections or berths in the main part of the car. A drawing-room sleeping car has one or more separate compartments which are larger than a stateroom.

Stay. A beam, bar, rod, etc., by which two or more objects are connected to prevent lateral deviations of one or both of them.

Stay Rod. See STAY.

Steam and Air Connections for Passenger Equipment Cars. Fig. 1886.

Steam Car. A term used to designate ordinary railroad cars when it is desired to distinguish them from electric cars. Also a self-propelled car using steam as its motive power. See MOTOR CAR.

Steam Coupler. See STEAM HOSE COUPLER.

Steam Crane. A crane operated by steam engines. Also frequently provided with gears for propelling itself by means of the same engines that operate the hoisting apparatus. See LOCOMOTIVE CRANE, WRECKING CRANE.

Steam Drum (Car Heating). A part of the indirect steam heating system, being the covered coil or nest of tubes in which the circulating water is heated by the steam surrounding the pipes. Also called jacket.

Steam Gage (Steam Heating). A dial or gage for recording the pressure of steam in the steam pipes on a car or locomotive.

Steam Heat. Pages 863-866.

Steam Hose. A flexible tube of rubber and fabric used between cars and between cars and locomotive tenders to connect the steam heat train line. See STEAM PIPE. Page 865.

Steam Hose, Specifications for. Page 865.

Steam Hose Clamp. Figs. 2165, 2194, 2007, 2008, 2011.

Steam Hose Clamp Lock. Used on the coupler connecting the steam hose between the cars.

Steam Hose Coupler. Couplers for connecting steam hose between passenger train cars. Figs. 2138, 2142, 2143, 2195-2198.

Steam Hose Label. Fig. 2137.

Steam Motor Car. See MOTOR CAR.

Steam Hose Nipple. Figs. 2161, 2193.

Steam Pipe. The pipe under passenger cars corresponding to the brake pipe and connected with hose and couplings for conveying steam from the locomotive to heat the cars in the train. See STEAM HOSE and STEAM HOSE COUPLER.

A topical discussion on "What are the advantages or disadvantages of 2" main steam pipe with 1⅝"

hose?" will be found in the 1904 M. C. B. Proceedings, page 235.

Steam Shovel. A shovel operated by steam hoisting engines mounted on a car. The shovel or dipper may hold from 1 to 6 cu. yds. of dirt and is mounted on the end of a heavy beam, which is carried by a swiveling boom. The dipper is operated and controlled by engines in such a manner as to permit of its being filled with earth or rock, lifted and swung over an adjacent car and there dumped. Used in construction work. See CAR. Fig. 2644.

Steam Trap (Car Heating). A device for catching and liberating the water of condensation in any steam pipe line. Figs. 2147, 2164, 2168, 2184, 2186.

Steel Car Repairs. See REPAIRS.

Steel End. A reinforcement for box car ends. Figs. 626-635; Pages 385, 387.

Steel Freight Cars. See CARS.

Steel Passenger Cars. See CARS.

Steel, Shearing Values of Structural, Rivet and Mild. Page 1074.

Steel, Specifications for Galvanized Sheets for Passenger and Freight Equipment Cars. Page 1071.

Steel, Specifications for Mild-Steel Bars for Passenger and Freight Equipment Car. Pages 1075, 1076.

Steel, Specifications for Miscellaneous Castings for Passenger and Freight Equipment Cars. Pages 1066-1068.

Steel, Specifications for Structural Steel, Steel Plate and Steel Sheets for Freight-Equipment Cars. Pages 1071-1073.

Steel, Specifications for, Structural Steel, Steel Plate and Steel Sheets for Passenger-Equipment Cars. Pages 1073, 1074.

Steel Tired Wheel. A wheel with a steel tire which is usually shrunk on, welded, bolted, or fastened with retaining rings. See WHEELS.

Stenciling. See MARKING ON FREIGHT EQUIPMENT CARS.

Step. A ledge consisting of a riser and tread on a stair, or a round or rung of a ladder. A footpiece for ascending to or descending from a car or for standing in certain places or positions. Passenger car steps are from their location generally called platform steps and sometimes box steps. In freight cars a U-shaped iron, called a sill step, is used. A small ledge on the end of a freight car near the top for a brakeman to stand on when applying brakes, called the brake step, is also sometimes used. A bracket called a tank step is attached to the tanks of tank cars.

Step Box. A portable box-shaped step, for use between the bottom passenger car step and a low station platform.

Step Hanger. A vertical board or metal plate by which the steps are supported from the corner of a car and from the platform end sill.

Step Iron (Platform Steps). A flat iron bar bent to conform to the shape of the steps and their risers, and to which they are fastened. It is bolted at the upper end to the platform end sill.

Step Ladder (Sleeping Car). A folding step ladder for use in a sleeping car, to reach the lamps, upper berths, etc. See also POSTAL CARS.

Step Nosing. A metallic facing or molding for the tread of stair steps.

Step Riser. The vertical portion of a step in stairs.

Step Timber. A timber bolted to the end sill and platform end sill, to which the platform steps are hung.

Step Treads. See SAFETY TREAD and TREAD.

Stiffener. A reinforcing member. The term is commonly applied to bars used to strengthen the doors of freight cars.

Stile. The upright pieces on the outer edge of a door or sash, as door stile, sash stile, window stile, etc.

Stirrup. A kind of ring or bent bar of iron resembling somewhat the stirrup of a saddle. A drawbar carry iron is sometimes called a stirrup.

Stock Car. A car for the transportation of live stock, equipped with roof, slatted sides and side doors, single or double deck and frequently with feed and water troughs. See DOUBLE DECK STOCK CAR, POULTRY CAR, and CAR. Figs. 174-198, 2863, 2950, 2951; Page 1128.

Stock Cars, Rounding Corners of Doors, etc. See DOORS, DOOR JAMBS and ALL OTHER INSIDE CORNERS, etc.

Stop Bar (Sleeping Car). A bar to connect the two seats on which the seat bottoms may rest when drawn down to make up a lower berth. It rests upon a stop bar plate. See also SASH LOCK STOP.

Stop Bar Guide. An attachment to hold a stop bar in place laterally.

Stop Bar Hinge. The hinge which enables the stop bar to swing horizontally.

Stop Bolt (Door Lock). An attachment for throwing a door latch out of gear.

Stop Cock. A simple form of cock having a body and tapered plug which has an opening through it. When the plug is turned so that the holes in it correspond to the ports in the body the liquid flowing in the pipe can pass through the cock. When the plug is turned so that the openings do not correspond, the flow is stopped.

Stop-Key Journal Bearing. A key or wedge with a lug or projection which bears against the end of the axle to restrain lateral motion and thus dispense with a collar on the axle.

Stop Latch (Door Lock). A spring door latch with a stop bolt by which the latch can be fastened on one side so as not to act.

Storage Battery. Figs. 2293-2309, 2347.

Storage Battery Car. Figs. 538, 540; Page 889.

Storage Gas Tank (Acetylene Lighting). An iron tank filled with asbestos discs saturated with acetone, into which acetylene gas is forced under pressure. See also HOLDER.

Storage Heaters. See CAR HEATING.

Storage System of Car Heating. A direct system of car heating, in which the radiating pipes are enlarged and inclose a smaller pipe or tube which is filled with salt water or other heat-retaining substance, and which when heated continues to radiate heat after the steam is shut off. See PASSENGER TRAIN HEATING.

Stove. An apparatus in which a fire is made for warming a room, house or car by direct radiation. Stoves are out of use for heating passenger cars, but cast

iron stoves are still in use for heating caboose cars.

A cook stove permanently fixed against the side of a room and directly connected with the chimney without the use of stove pipe, is called a range; used in dining cars, etc.

Alcohol and oil stoves are used for heating refrigerator cars or produce cars for the transportation of perishable products in cold weather.

Stove Pipe. A tube, usually of sheet iron, for conveying the smoke from a stove or heater, and creating a draft. A smoke flue. See SMOKE PIPE.

Stove Pipe Damper. A circular disc in the stove pipe which may be turned to open or close the passage thus regulating the draft.

Stove Pipe Jack. A covering or bonnet for the aperture of a stove pipe on the outside of a car.

Straight Air Brake. Figs. 1947, 1953, 1990, 1993; Pages 767, 812, 813.

Strainer. See BRAKE PIPE AIR STRAINER, BRANCH PIPE STRAINER, SIGNAL PIPE STRAINER.

Strap. A term commonly applied to long, thin, narrow pieces of wrought iron used to bind members of a structure together.

Strap Bolt or **Lug Bolt.** A round bolt with a flat bar of iron welded to it, and usually with a hook on the end which serves the purpose of a head. The flat bar has holes in it, by which it is attached to a piece of timber or other object by one or more separate bolts or screws.

Strap Hinge. A door hinge, the two parts of which are made longer than those of a butt hinge, and of a triangular shape.

Strap Washer. A wrought iron strap which takes the heads of several bolts. Also called washer plate.

Strike Plate. The keeper for a beveled latch bolt against which it strikes, so as to snap shut automatically.

Striker Arm. A seat arm. The terms striker arm, seat back arm and seat arm are commonly used.

Striker Plate. See STRIKE PLATE.

Striking Casting. See STRIKING PLATE. See also BUFFER BLOCK FACE PLATE.

Striking Horn. The stop shoulder, or horn of a coupler, arranged to touch the striking plate before the back of the head of the coupler strikes the ends of the draft timbers. See also COUPLER HORN.

Striking Plate. A metal plate placed on the end sills of freight cars against which the horn of the coupler strikes, preventing damage to the end sill. Also called striking casting.

String Board (Passenger Car Steps). A vertical board which supports the ends of the steps. A step hanger.

Stringer. A term sometimes applied to a floor nailing strip or a steel member which acts as a support for a nailing strip. A longitudinal floor stringer sometimes occupies a position similar to that of an intermediate sill but is not designed to perform its duties. See NAILING STRIP.

Stringer Pocket. A casting for supporting the end of a beam or stringer. In automobile and similar cars, for facilitating the use of a second or upper deck for increasing the loading capacity for small freight.

Stringer Support. See FLOOR BEAM.

Strut (Truss). A member subjected to a strain of compression. A vertical strut is usually called a post. See also BRAKE BEAM STRUT.

Stud. A comparatively short vertical wooden post in the side or end framing, usually to act as a brace or support for some other member of the frame. Also used as a nailing strip or furring. See NAILING STRIP and FURRING.

A headless bolt, threaded on both ends. A standing bolt, pin, boss or protuberance designed to hold an attached object in place. Especially a headless bolt permanently screwed into a tapped hole in a casting or forging so as to become a part thereof.

Sub-Carline (Refrigerator Car). A strip of wood under the main carline, supporting the sub-roof. See CARLINE.

Sub-Floor (Refrigerator Car). A layer of flooring boards under the main floor, and usually separated from it by an air space and hair felt or some other form of special insulation.

Sub-Roof (Refrigerator Car). The inside layer of boards of the roof proper, supported on sub-carlines.

Sub-Sill. A sill or timber bolted under another sill to reinforce it. See BUFFING SUB-SILL.

Suburban Car. A passenger car for use on short runs, particularly between large cities and their suburbs. See PASSENGER CAR, CAR and COACH.

Subway Car. An electric motor car for use in subways in large cities.

Sugar Cane Car. A flat car especially arranged for carrying sugar cane. See CANE CAR.

Supply Pipe (Air Compressor). A pipe sometimes connected to the air inlet of an air compressor by means of which the air supply is drawn from a point some distance away from the compressor.

(Lavatory Fittings.) Pipes which carry hot or cold water to the basin faucets.

Supply Valve (Steam Heating). A valve for regulating the supply of steam in the radiator pipes of a car. Fig. 2153; Page 869.

Suspension (Motor Car). The method of supporting a railway motor. Except in the case of gearless motors, the suspension is designed to put as little dead weight as possible on the axle.

(Electric Lighting.) The iron work and fittings which are attached to a truck for supporting or suspending the axle generator and which include the belt tightening and aligning devices. The generator is almost invariably carried outside the truck frame, the four most-used systems of suspension being the bottom pivoted, top pivoted, parallel link and sliding. Figs. 2283-2285, 2287, 2319-2321, 2337-2340, 2345, 2354; Pages 909, 917, 925.

Sweeping Car or **Sweeper.** A car with rotary brooms for sweeping snow from a railroad track. The brooms are attached to a horizontal shaft which is connected by suitable gearing with the axles, and the brooms are thus made to revolve. Figs. 2688, 2689.

Swing Bolster. A truck bolster (so called in distinction from a rigid bolster) which bears on springs that are supported by a transverse timber called a spring plank, which is suspended by hangers or links so that it can swing laterally in relation to the truck. As the springs rest on this plank and they support the

bolster, the latter can swing with the spring plank. The object of providing this swinging motion to the bolster is to prevent, as much as possible, lateral blows and shocks from being communicated to the car body, and, vice versa, to prevent the momentum of the car body from acting with its full force on the truck frame and wheel flanges. See LATERAL MOTION, SWING HANGER, and SWING MOTION.

Swing Bolster Spring. See LATERAL MOTION SPRING.

Swing Hanger. Bars or links, attached at their upper ends to the transoms or some other rigid member of a swing motion truck, and carrying the spring plank at their lower ends. Various forms are (1) solid bars with an eye at each end; (2) swing link hangers, made like a long link of a chain; (3) those made with a fork or clevis at one end and an eye at the other, and used commonly on passenger equipment trucks; and (4) those made with a very short link attached to an eye bolt passing through the transom. Also called bolster hanger. See EYE BOLT LINK HANGER.

Swing Hanger Axle. See SWING HANGER PIN.

Swing Hanger Carrier. A bearing for the upper swing hanger pin.

Swing Hanger Friction Block. A casting or bearing of considerable diameter, on which the upper end of a swing hanger rests.

Swing Hanger Friction Washer (Lower and Upper). A cast iron chafing block serving no other purpose than to take the wear. It is only occasionally used. A friction block is almost synonymous, but is usually a larger casting.

Swing Hanger Pin (Lower and Upper). An iron bar by which a swing hanger on a car truck is suspended, or which supports a spring plank. The lower swing hanger pivot is sometimes called a cross bar or mandrel pin or axle. The upper one is carried in a swing hanger pin bearing attached to the transom.

Swing Hanger Pin Bearing. A casting acting as a bearing for a swing hanger pin.

Swing Hanger Shaft. See SWING HANGER PIN.

Swing Joint. See FLEXIBLE METALLIC JOINT.

Swing Link. See SWING HANGER.

Swing Link Hanger. A swing hanger made in the form of an open link.

Swing Motion. A term applied to an arrangement of hangers and other supports for the springs and truck bolster which enables a car body to swing laterally on the truck. See SWING BOLSTER, SWING HANGER.

Swing Motion Truck. A truck with a bolster and spring plank suspended on swing hangers so that they can swing laterally in relation to the truck frame. Also called swing bolster truck in distinction from a rigid bolster truck. See TRUCK.

Swinging Platform (Pile Driver) A platform carrying the entire pile driving gear in such manner that it can be swung about at right angles to the car so as to project for a considerable distance on either side. It swings upon a center plate, and its movements are controlled by the SLEWING GEAR.

Swing Spring Plank. A transverse timber underneath the bolster of a four-wheeled truck, or the spring beam of a six-wheeled truck, on which the bolster springs rest. A swing spring plank differs from an ordinary spring plank in being supported by hangers or links. See SPRING PLANK.

Switch (Tracks). An arrangement of rails, movable at one end by means of a lever or other mechanism, which may be moved to connect with either of two tracks.

For electric switches see LINE SWITCH, ELECTRO-PNEUMATIC COMPRESSOR SWITCH.

Switch Group (Motor Cars). A combination of two or more unit-switches or contactors mounted in a suitable frame and protected by a removable cover. See MOTOR CAR EQUIPMENT.

Switch Box Support. A bracket for securing an electric lighting switch to the underframe or car body.

Switch Regulating. See ELECTRIC HEATER.

Switch Stand. Usually a housing containing the switching apparatus for a railroad track, and provided with lamp and other signals.

Swivel (Chain). A twisting link, consisting of a headed pin, entering an eye or ring in an adjacent link. The object is to avoid kinking. Hence the term is applied to many forms of equivalent devices, consisting essentially of a ring surrounding a headed bolt in such manner as to permit rotation.

T

T or Tee (Pipe Fitting). A T-shaped tube for uniting one pipe at right angles to two others in the same line. The pipes are screwed into the arms of the T. A reducing tee has the arms of different diameters.

T-Hinge. A door hinge, one part of which is made like a strap hinge, and the other like a butt hinge, so that the shape of the whole resembles a letter T. See HINGE.

Table. A removable board attached to the side of the car by inserting a table hook fixed to the table into a table hook plate fixed to the side of the car. The outer end of the table is supported by a table leg, which is sometimes vertical and sometimes slanting and which folds back against the table when not in use. The tables of dining cars are generally permanently fastened to the floor and sides of the car. A drop table is sometimes used in the kitchens of dining cars. See also DISTRIBUTING TABLE.

Table Fastener. A latch by which a folding table is fastened up out of the way.

Table Hinge. A hinge for a folding table.

Table Holder. A special form of table hook. See TABLE.

Table Hook. See TABLE.

Table Leg Hook. A metal hook which is attached to a slanting table leg. It engages in a plate attaching to the side of the car.

Tail Gate. See PLATFORM TAIL GATE.

Tail Lamp or **Tail Light.** A signal used to indicate the rear of a train, and carried on a bracket or socket at the side of the car in order to be visible from the engine. Two are used, one on each side of the train, on the rear of the rear car. Figs. 2542, 2545, 2548-2551, 2557, 2558.

Tail Lamp Socket. See SIGNAL LAMP SOCKET.

Tandem Hopper Car. A hopper having two double hoppers arranged in tandem. See HOPPER CAR.

Tandem Spring Draft Gear. A draft gear in which the springs are arranged in tandem.

Tank (Passenger Cars). A water tank for the wash room.

(Gas Lighting Apparatus.) More properly RECEIVER or HOLDER.

(Tank Car.) The body of a tank car. Usually a metal cylinder, but also made of wood and rectangular. Glass lined tanks are also in use for carrying mineral water and liquids which would attack metal.

Tank Band. An iron strap which passes around the tank of a tank car to hold it in place on the underframe.

Tank Car. A car the body of which consists of a tank for carrying liquids, such as oil, molasses, vinegar, etc. Figs. 281-306, 2906-2909, 2943; Pages 239-260, 266, 267, 965, 1125, 1144.

Tank Cars, Specifications for. Pages 239-260.

Tank Dome. A vertical cylinder attached to the top of a tank car. It permits of the application of a manhole cover which need not be air tight, and also permits the tank proper to be filled full, which would be impossible if there were no dome. Figs. 268, 271-276, 279.

Tank Head. The circular end sheet of a cylindrical tank.

Tank Head Block. A block securely bolted to the underframe transverse to the sills at either end of the tank, to prevent any longitudinal motion of the tank with respect to the car. The block is shaped to fit the end of the tank. See CENTER ANCHOR, FILLER BLOCK and TANK CAR.

Tank Nozzle. A short pipe used to empty the tank. It is usually cast in one piece with the tank valve.

Tank Saddle. The bearing which supports the tank. In some tank cars the saddle is also the body bolster.

Tank Slabbing. Longitudinal strips or filling pieces between the tank and the saddle of a tank car.

Tank Step (Tank Car). A metal shelf or bracket fastened to the tank to facilitate access to the top of the dome.

Tank Valve (Tank Car). A valve attached to the bottom of the tank to draw off the contents. Figs. 269, 291; Page 267.

(Water Cooler.) A valve used with water tanks which extend to the roof, and sometimes with other smaller fixed tanks, for enabling them to be completely drained when desired. Also called water cooler valve.

Tank Valve Rod. An iron rod for opening and closing a tank valve, usually extending from the valve to the top of the dome.

Tank Valve Rod Bracket. An iron brace in the tank having a threaded hole or bushing through which the tank valve rod screw passes.

Tank Valve Rod Screw. The screw on the upper end of a tank valve rod which passes through the tank valve rod bracket and causes the valve to open or close when the rod is turned.

Taper Charge Vibrator or Relay (Electric Lighting). An automatic and sensitive electrical device similar in construction to the battery voltage relay. It acts as an auxiliary regulator in connection with the generator regulator to taper the charging current of the generator after the voltage of the battery has reached a predetermined value, indicating that the latter is fully charged. Its action on the regulation differs from that of the battery voltage relay in that instead of abruptly cutting off the charging current it tapers the same, causing the charging current to decrease gradually to zero. The taper charge vibrator or relay gradually assumes control of the apparatus and finally regulates the axle generator as a constant potential machine. This taper charge is always secured with a constant voltage system and in one particular system constant voltage is maintained by the generator at all times when operating above the cut in speed. This result is secured without the use of vibrators, relays or other moving parts.

Telegraph Cock or Faucet. A self-closing cock, the lever of which resembles the key of a telegraph instrument. See LEVER FAUCET. When the water enters the cock horizontally they are called horizontal telegraph cocks. When it enters vertically they are called vertical telegraph cocks. See FAUCET.

Temperature Regulator. A device for automatically controlling the supply of steam to maintain any desired temperature in the car. See PASSENGER TRAIN HEATING.

Temporary Safety Chains. See SAFETY CHAINS.

Tenon. The projecting end of a piece of timber fitted for insertion into a mortise by cutting away a portion on one or more sides. Sometimes the tenon is made cylindrical. Tenons are secured in their mortises by pins or by giving them a dovetail.

Tenoner. A machine for cutting tenons. Page 1174.

Tension Bar. Any bar subjected to a tensile stress, as the top cover plate of a body bolster.

Terminal. The part of a storage battery plate to which the wires are connected. Fig. 2317, etc.

Terms and Gaging Points for Wheels and Track. See WHEELS AND TRACK, TERMS AND GAGING POINTS FOR.

Testing Air Brakes. See AIR BRAKES.

Test Weight Car. A car built in compact form and equipped with weights for the testing of track scales, etc. Figs. 2734-2737.

Testing Machine, Knuckle Pivot Pin. A machine designed for testing knuckle pivot pins. Figs. 1240-1245.

Test Rack (Air Brakes). Figs. 1905, 1995, 1996.

Texoderm. An artificial leather used for curtains and upholstering. It is made by coating a cloth fabric with a compound which gives it the appearance of leather. See also FABRIKOID, LEATHEROID, MERITAS, and PANTASOTE.

Thermo Jet (Steam Heating). A direct steam heating system which maintains the car temperature constant by means of an injector with a steam supply valve controlled by the expansion or contraction of a part of the radiating pipes, the steam supply valve being set to a position indicating the temperature of radiation desired.

Thermometer, Electric. Sometimes used in connection with the regulation of steam heat in passenger train cars.

Thermostat. An electric control device for heating apparatus. Figs. 2150, 2152; Pages 869, 877.

Thermostatic Steam Trap (Car Heating). A device to

regulate the escape of steam in proportion to the condensation that has taken place.

Thimble. A bushing. A sleeve or tube through which a bolt passes. A filler. See Bolster Thimble.

Third-Point Support. See Brake Beam Support.

Third Rail Clearances. The use of the third rail on electrified sections of steam railways made it necessary to establish new limiting dimensions for cars, and particularly freight cars. This was first called to the attention of the Master Car Builders' Association by George Gibbs; M. C. B. Proceedings, 1903, page 102.

A committee, appointed to investigate this subject, reported in the 1904 Proceedings, page 104, that the railroads entering New York City had found it necessary to confer and decide upon the necessary clearances. These were accepted by the association and it was felt that no further action was necessary.

Third Rail Shoe or **Collector.** A metallic sliding contact, usually of cast iron, mounted on the car truck, and insulated therefrom, for collecting current from an insulated third rail located alongside the running rails. Positive contact between shoe and rail is maintained by gravity or by a stiff spring. Figs. 509, 511.

Thread. See Screw Thread.

Three-Pipe Manifold. A pipe fitting forming a return bend for three pipes instead of two.

Three-Stem Equipment. A type of draft gear for passenger equipment cars. The coupler head is connected to the center stem and the two side stems and its movement to either side of the center line of the car is resisted by the side stem springs. The center stem is backed by the draft spring proper which is held in a pocket between the sills and which absorbs most of the shocks. The buffer plate is backed by two buffer stem springs which aid in absorbing buffing shocks. See Buffers.

Threshold or **Threshold Plate.** (Passenger Equipment Cars.) A plate placed across the bottom of a door opening. See Door Sill.

(Vestibule.) The plate which covers the buffer plate and connects it with the platform. See Vestibule and Platform Details.

Throat (Car Wheel). The interior angle formed by the wheel flange where it joins the tread of the wheel.

Throat Piece (Snow Plow Framing). The curved ribs connecting the inclined plane of the plow with the deck. Being curved they give a projection to the deck, which lessens the tendency of the snow to ride over the top of the plow.

Thumb Piece. A general term applied to many forms of lugs or projections for moving springs, catches, or other movable mechanical parts.

Thumb Screw. A screw with two projecting flat sided flanges adapted to be turned with the finger and thumb.

Tie. A beam or rod which secures parts together and is subjected to a tensile strain. A track tie.

Tie Bar. A bar or rod which acts as a tie.

Tie Timber. See Cross Tie Timber.

Timber Key. See Sill Timber Key.

Timber Pocket. An iron casting used as a seat or pocket at the junction of timbers in wooden car framing. It avoids the necessity of dove-tailing or mortising the timbers together. See Post Pocket.

Tip Car. A car from which the load is discharged by tipping the car body. See also Dump Car.

Tire. A heavy hoop or band of iron or (usually) steel forming the ring or periphery of a wheel to impart strength to it and to resist wear. See Wheels.

Tire Bolt. A bolt for holding a tire on a wheel center. When retaining rings are used the bolts pass through the rings and hold them and the center and tire together.

Tire Fastening. See Wheels.

Tires Mounting. See Wheels.

Tire Fastening for Steel Tired Wheels. See Wheels, Steel-Tired, Tire Fastening for.

Toe Nail. A nail driven in obliquely to fasten the end of a board or other piece of timber to the surface of another. The timber so fastened is said to be toed, or toe nailed.

Toggle Arms (Hopper Doors). The two arms of a toggle joint, which form a strut between the two opposite hopper doors, holding them closed.

Toilet. Another name for a saloon or lavatory.

Toilet Rack. A rack for toilet articles, etc.

Tongs or **Crabs** (Pile Driver and Wrecking Cars). A device for anchoring the body of the car to the track when in use. Also called rail clamps. A jack screw is used in connection with the tongs to raise the body of the car, so as to bring a strain upon the tongs. See Bolster Jack Screw.

Tool Car (Wreck Train Equipment). A car used for carrying chains, cables, blocking, jacks, and all the necessary tools used in clearing wrecks. Figs. 2625-2630.

Tools, Used in Car Repairs. Pages 1172-1176.

Top Chord (Truss). The upper outside member of a truss, particularly one divided up into panels. The members of mere trussed beams are not commonly designated as chords.

Top Door Rail. The uppermost horizontal bar or piece of a door frame.

Top Door Track. See Door Track.

Top Equalizer Truck. See Truck.

Top Rail (Door). See Top Door Rail.

Top Side Bearing. A body side bearing. See Side Bearings.

Torch (Pintsch System). A special device combining the ordinary wax taper torch, and a key, which fits the cock of any Pintsch lamp, and will open or close the globe of any lamp from the floor of the car.

Tornado Lamp. A general term applied to lamps which receive their supply of air through a long tube, usually connected with the supports or arms of the lamp, so as to check the effect of sudden gusts of wind. Hurricane lamp is another name.

Tourist Sleeping Car or **Tourist Car.** A sleeping car more plainly finished than a standard sleeping car and generally upholstered in rattan or leather, for the accommodation of travelers who cannot afford to use a standard sleeping car. See Sleeping Car.

Towel Rack. A tray composed of rods for holding towels.

Towel Rod. A rod fitted to the wall with brackets or otherwise, upon which towels may be hung.

Towel Rod Bracket. See Towel Rod.

Towel Vendor. A container for folded towels some-

times installed in railway car lavatories. The insertion of a coin in a slot provided for the purpose, releases the internal mechanism so that, by pulling a lever, a single towel may be withdrawn. Fig. 1069.

Track Laying Car. A low push car, primarily for carrying rails short distances in construction. They are frequently without a floor or platform and are provided with fixed rollers at the side for running the rails forward.

A platform car with a cantilever truss extending out from one end of the car or over the track and on which rails may be run out and distributed on the ties. Some track layers are equipped with carriers which carry the rails and ties forward from cars in the rear.

Track Sweeper. See Sweeping Car, Snow Sweeper.

Track and Wheels, Terms and Gaging Points for. See Wheels and Track.

Traction Air Brake. The adaptation of air brake equipment to electrically propelled cars or trains. The changed conditions of motive power and method of operating such cars or trains, have necessitated various changes in the details of the equipments. See Air Brake, Air Compressor Governor Synchronizing System. Figs. 1947-1954; Pages 768, 812, 813.

Trailer or **Trailer Car.** A car without its own motive power for use in trains operated by motor cars.

Trailer Truck. A motor car truck which is not equipped with motors.

Train Air Signal Apparatus. A substitute for the bell cord arranged to give train signals by compressed air. A separate line of signal pipe, similar to the brake pipe, extends throughout the train, connected between the cars by hose and couplings. A car discharge valve, connected to this signal pipe, is located in each car and attached to the bell cord in such manner that pulling on the cord releases air from the signal pipe. In the cab on the engine or motor car is a signal valve, which is also connected with the main signal pipe and a small signal whistle. The supply of air is received from the main reservoir through a reducing valve, which maintains a pressure of about 45 lbs. per square inch in the signal apparatus.

When the car discharge valve is opened, by pulling on the cord, the diaphragm in the signal valve is operated so as to blow the whistle. Signals can be given in this way with rapidity and great certainty. If the train breaks in two the whistle is blown loudly for a considerable time. Figs. 2001-2005; Pages 769, 777, 821, 832.

Train Air Signal Stop Cock. A stop cock in the air signal pipe. There is one placed at each end of a car.

Train Brake Pipe. See Brake Pipe.

Train Car. A caboose car.

Train Heating. See Passenger Train Heating.

Train Lighting. See Electric Lighting. See also Acetylene Gas Lighting, Pintsch Gas and Vapor System.

Train Lighting Instruction Car. A car equipped with train-lighting apparatus for the purpose of instructing employees. See Instruction Car. Fig. 2714.

Train Line. The complete line of air brake, air signal, or steam heat pipes in a railroad train. It includes the rigid piping secured under the cars and the flexible connections between cars and between the cars, the tender, and the locomotive. See Brake Pipe. See also Train Line, Electric Lighting.

Train Line End Valve. See End Train-Pipe Valve.

Train Pipe (Air Brake). See Brake Pipe.

Train Pipe Valve (Car Heating). See End Train-Pipe Valve.

Train Resistance. The force in a train which tends to counteract the pulling effort of the locomotive. This resistance is due to journal friction, wheel flange friction, air, wind and the rolling of the wheels on the rail; and varies widely under favorable conditions or unfavorable conditions.

Trainagraph. A testing and recording device by means of which the action of air brakes may be tested, the results being recorded on a chart inserted inside of the machine. Fig. 2012.

Train Line (Electric Lighting). A system of heavy conductors, generally three in number, running the entire length of the car either over the roof or under the car body and terminating at each end of the car in a suitable connection device, located either above the vestibule opening or below the platform. Two of these conductors are tapped and connections carried down inside of the car, where connections may be made with the electric lighting system of the car. The other conductor generally has no connection to it in the car. Its purpose is to act as an end feeder or equalizer when a head end generator is employed. The other two conductors or lines may be employed for tying together in parallel the lighting systems of the different cars, irrespective of whether a head end generator is used or not.

Train Line Connector (Electric). A device for connecting the train lines of one car to those of another in such a manner as to insure the proper connection of the conductors of one car with those of another independently of sequence or end relations of the various cars; that is to say, the conductor must always join wire No. 1 of one car with wire No. 1 of the next car, etc., no matter whether the cars have been turned end for end or in what order they may stand in the train. Fig. 2778.

Train Line Jumper. A connection made generally at the rear end of the train on the end farthest from the head end generator conecting the conductor which is not tapped in the cars to one of the conductors that is tapped. The current is carried from the generator clear through to the end of the train and by means of the jumper brought back on one of the other wires. This arrangement of train lines, known as the equi-potential or return loop, insures uniform voltage at each of the cars, irrespective of the drop or loss that may take place in the conductors themselves. Fig. 2778.

Transfer Table. A platform and section of track on wheels, its length being equal to or greater than the length of a car. Its chief use is to transfer cars from one section of a shop to another, connecting with parallel tracks and running transversely to them. A smaller car of this type is also used industrial plants. See Industrial Cars.

Transformer (Electricity). A device used with alternating currents for transforming a quantity of energy from one pressure or voltage to another, either higher or lower. It consists of a primary coil supplied with current from some source or generator, a secondary coil, in which the energy is

utilized, and an iron core that connects the two coils magnetically. The periodical alternating induction caused by the current in the primary coil induces an electromotive force in the secondary coil; and the primary and secondary electromotive forces are directly proportional to the relative number of turns on the two coils, thus providing means of either raising or lowering the voltage. Fig. 494.

Transom. Primarily a cross piece.

(Carpentry.) A horizontal piece framed across the top of a door or double light window. The term is also applied in the general sense of a cross piece in other ways.

(Car Trucks.) One of two horizontal cross beams attached to the side frames, between which the swing bolster is placed.

Transom Bearing Block. A piece of wood or iron placed on top of a transom under the bearing of a swing hanger to raise it.

Transom Chafing Plate. See Bolster Chafing Plate, and Friction Block.

Transom Casting. A casting used to attach a transom to a truck frame.

Transom Corner Plate (Passenger Equipment Trucks). A plate or casting connecting and bracing the transom and wheel pieces. Also called Truck Frame Corner Plate.

Transom Draft Gear. A special arrangement of draft gear.

Transom and End Piece Tie Rod. A rod extending through the transom and end piece to stiffen the truck frame.

Transom Opener. A device consisting of a jointed rod and guide for opening a transom over a door; very similar to a deck sash opener.

Transom Plate. Iron plates on both sides of wooden transoms of passenger equipment trucks for strengthening purposes.

Transom Tie Rod or Bar. A bar passing across a truck close to the transom to hold the wheel pieces and transoms rigidly together.

Transom Tie Rod Washer. A washer bearing for the nut on a transom tie rod.

Transom Truss Rod. A transverse rod attached at its end to the wheel pieces, extending alongside the transoms and inclined downward under a central transom truss block, so as to strengthen the transoms. Generally, two such rods are used with each truck.

Transom Truss Rod Seat. A bearing for the transom truss rod on the under side of the transom.

Trap (Refrigerator Car). An S-shaped pipe, as largely used in all forms of plumbing work for permitting the exit of water, while preventing the entrance of air. See also Steam Trap.

Trap Door. A door in a floor or roof, closing flush therewith when shut. See Platform Trap Door.

Trap Door Latch (Vestibule). The latch for the vestibule trap door. Figs. 821, 824, 825.

Trap Door Lock. See Trap Door Latch.

Traversing Jack. A jack that can be moved horizontally on a bed or track while under its load. See Jack.

Tread (of a Step). The part on which the foot is placed. See Tread Board and Safety Tread.

(Of a Car Wheel.) The exterior cylindrical surface of a car wheel inside of the flange which comes in contact with the rail. See Wheel.

Tread Board (of a Step). The horizontal part on which the foot is placed. Usually covered with rubber or metal safety treads to prevent slipping. See Tread and Safety Tread.

Triangular Washer. An iron plate or block, the cross section of which is triangular, and which forms a bearing for the nut or head of an inclined brace rod. Also called beveled washer, but the latter term is chiefly used when the angle between the two faces is small.

Triple Valve (Air Brake). A valve device consisting of a body or case, called the triple valve body, which has connections to the brake pipe, the auxiliary reservoir and the brake cylinder. See Air Brakes. Figs. 1891-1894A, 1899, 1902, 1903, 1968, 1915-1917, 1931, 1934, 1937, 1946, 1947; Pages 783, 785, 791, 812, 823-832.

Triple Valve Body. See Triple Valve.

Triple Valve Branch Pipe (Air Brake). A short pipe by which the triple valve is connected with the brake pipe.

Triple Valve, Cleaning and Lubricating. See Air Brakes, Cleaning and Testing of.

Triple Valve Gasket. A gasket placed in the joint between the triple valve and the brake cylinder.

Triple Valves, Mounting of. See Air Brakes, Cleaning and Testing of.

Triple Valve Piston (Air Brake). See Triple Valve.

Triple Valve Tests. See Air Brakes, Cleaning and Testing of.

Trolley. See Pantagraph Trolley.

Truck. A small, low, four-wheel or six-wheel car, carrying one-half the weight of a car body. The car body is carried on a pair of center plates (truck center plate and body center plate), with a center pin or king bolt passing through them, about which the truck swivels. There are now some types of trucks in use in which the weight of the car is transmitted to the truck through side bearings. The trucks commonly used under freight cars have four wheels, but six-wheel trucks are used under many modern freight cars of very heavy capacity. Passenger equipment cars use either four or six-wheel trucks, the latter being generally used under very heavy cars. See Diamond Arch Bar Truck, Flexible Truck, Logging Truck, Pedestal Truck, Rigid Bolster Truck, Roller Side Bearing Truck, Side Bearing Truck, Swing Motion Truck. Figs. 1343-1406; Pages 600-602, 605, 607, 609, 613, 619.

The term is also applied to different kinds of small vehicles used on and about stations for handling freight and baggage by hand. Many large terminal stations now use motor driven baggage trucks.

Truck Bolster. A cross beam in the center of a truck, to which the lower center plate is fastened, and on which the car body rests. The truck bolster is connected to the body bolster by a center pin, which passes through it. Figs. 1429-1463; Pages 632, 637, 955, 962, 965.

Truck Bolster Chafing Plate. A plate attached to a wooden swing bolster to protect it from wear.

Truck Bolster Flitch Plate. See Bolster Flitch Plate.

Truck Bolster Guide Bar. See Bolster Guide Bar.

Truck Bolster Guide Block. A cast iron shoe for the end of a truck bolster, which slides vertically between the columns or bolster guide bars.

Truck Bolster Truss Rod (Rigid Bolster Trucks). A rod attached near the ends of a wooden truck bolster and passing over a central truss block. In swing bolster trucks, rods of a similar nature are sometimes used, and are termed transom truss rods.

Truck Car. A car used in a wreck train for carrying spare trucks. See Wreck Train Equipment.

Truck Center Bearing Truss. The truss formed by the center bearing top and bottom arch bars.

Truck Center Frame. A frame made in one piece, riveted to the side frames or wheel pieces of steel passenger equipment trucks and taking the place of the transoms in the older types.

Truck Center Plate. See Center Plate.

Truck Frame. A structure composed of wooden beams, iron bars or of cast steel in one piece, to which the journal boxes or pedestals, springs and other parts are attached, and which forms the skeleton of a truck. See Truck Side Frame. Figs. 1343-1430; Pages 600-602, 605, 627, 629, 631, 632.

Truck Frame Corner Plate (Passenger Trucks). See End Piece Corner Plate and Transom Corner Plate.

Truck Frame End Piece or End Sill. See End Piece.

Truck Frame Knee Iron (Passenger Trucks). An interior angle plate of cast or wrought iron to connect the truck frame together. See End Piece Corner Plate and Transom Corner Plate.

Trucks, Freight Car. See Trucks.

Truck Lever Connection. A rod or bar connecting the brake levers on the truck brake gear. Figs. 1818, 1826-1828, 1833-1835, 1844; Page 755.

Truck Side Bearing. A device attached to the top of the truck bolster and having an upper bearing surface which comes in contact with a similar bearing surface fastened to the underside of the body bolster. See Side Bearings.

Truck Sides, Cast Steel, Limiting Dimensions. See Truck.

Truck Sides, Cast Steel, Specifications for. See Truck.

Truck Sides, Cast Steel, Welding. See Welding Cast Steel Trucks. Pages 1151-1153.

Truck Side Frame. The longitudinal portion of a truck frame, on the outside of the wheels, which extends from one axle to the other, and to which the journal boxes and bolsters or transoms are attached. Figs. 1343-1430; Pages 602, 605, 627, 629, 631, 632.

Trunnion. The pivot upon which any body, as a gun, revolves. The term is usually applied to bearings for objects of irregular shape, and having slow or irregular motion, as distinguished from the journals of wheels, etc.

Truss. A frame to which rigidity is given by uniting the parts so that its figure shall be in effect cut up into triangles, making it incapable of distortion by turning of the bars about their joints. The simplest form of truss is that in which a truss rod and king post are put underneath a beam to strengthen it, or two beams are framed together in the form of a letter A, and tied together at their lower ends by a rod or another beam. These are called king post trusses. Another form is that in which two posts are used, which are called queen post trusses. This is not a perfect truss, since it is capable of altering its shape by simply bending without rupturing its parts, when unequally loaded; in order to prevent this counterbalances should be added. This type of truss is used to strengthen the underframe of some types of railroad cars. The sills resist bending and act as straining beams, thus preventing great distortion.

The usual forms of trusses used for the side framing of cars are the Pratt and the Howe types. In the former all the braces are subject to tension, and in the latter the braces are compression members. The Pratt truss is rarely used alone for side trussing, but is often used in combination with the Howe truss. The Howe truss is rarely used in its simple form, being usually provided with vertical posts alongside of the vertical tension members. The side of a box car is not a perfect truss as ordinarily built, the middle panel, which contains the door, lacking the essential element of braces or counterbraces. Long cars are reinforced with heavy trusses of the bridge or roof type, and further strengthened by body truss rods.

Truss Block. A distance piece between a truss rod and the compression member of a trussed bear, which forms a bearing for both.

Truss Plank (Passenger Car Framing). A wide piece of timber, set on edge and bolted to, or sometimes gained into, the posts on the inside of the car immediately above the sills.

Truss Plank Cap. A strip of wood attached to the top of a truss plank between the seat frames.

Truss Rod. A rod used in connection with a king or queen post truss, or trussed beam, to resist deflection. It is attached to the ends of the beam, and is supported in the middle by a king post, truss block, or two queen posts between the beam and the rod. See Body Truss Rod.

Truss Rod Anchor. An iron forging or casting bolted to the sills, to which the end of the side truss rod is fastened. It is commonly made integral with the body bolster when a double body bolster is used.

Truss Rod Bearing. A bearing used to furnish support to a truss rod at an angle or bend.

The bearing, over the bolster, of a long body truss rod running from end sill to end sill is called a body truss rod saddle, probably in part from its form. See Queen Post.

Truss Rod Iron. A bar of iron, having an eye, to which a body truss rod is attached, bolted to the under side of a sill below a body bolster. It is a form of attaching body truss rods almost out of use for freight cars, but in use on wooden passenger cars. A Truss Rod Anchor.

Truss Rod Saddle. See Body Truss Rod Saddle and Truss Rod Bearing.

Truss Rod Strut. See Queen Post.

Truss Rod Washer. A large flat or beveled washer, used under a nut on the end of a truss rod. Sometimes called a skew back.

Tufting Button. A button used in upholstery to hold the cord which passes through the upper covering of the upholstered surface, dividing it into squares or diamonds.

Tumbler. A drinking glass.

(Lock.) A latch engaging with a notch in a lock bolt, or otherwise opposing its motion until it is lifted or arranged by the key so as to remove the obstacle.

Tumbler Holder. A bracket or stand for holding glass tumblers or drinking cups. They are either single or double.

Tumbler Holder and Drip. A water cooler drip, the top of which is made large enough to hold a glass.

Tup. See HAMMER.

Turbo-Generator. A steam turbine of small size direct-connected to a generator for furnishing electric current to light trains by the head end system. The turbo-generator may be mounted in the baggage car or on top of the locomotive boiler and receives steam from the locomotive. See PASSENGER TRAIN LIGHTING.

Turn Over Seat. See REVERSIBLE CAR SEAT. CAR SEAT.

Turnbuckle. A device having an internal thread made right and left hand and inserted in the middle of a long two-piece rod for changing its length, turning the device in either direction.

Turtle Back Roof. A roof for a passenger equipment car which is arched, and without a clere-story or upper deck.

Twin Car Seat. A seat stand with a division arm, two cushions and two seat backs with two striker arms each, so that they may be turned to bring the occupants face to face. See RECLINING CHAIR CAR SEAT.

Twin Hopper Gondola Car. A gondola car with two hoppers. See GONDOLA and HOPPER BOTTOM GONDOLA.

Twin Spring Draft Gear. A draft gear in which the springs are arranged alongside of one another.

Twin Washer. A double washer.

Two-Way Dump Car. A car from which the entire load may be dumped to either side of the track. See also SIDE DUMP CAR.

U

U-Bolt. A double bolt made of a bar of iron bent to the shape of the letter U, with a screw thread on each end.

U-Bolt Casting. A casting so shaped that a U-bolt can fit around it and connect it to a timber or sill to form a bearing or carrier for a pin or bolt.

Uncoupling Apparatus. See UNCOUPLING LEVER.

Uncoupling Arrangements. Page 563.

Uncoupling Lever or **Uncoupling Rod.** An iron rod with a bent handle forming a lever, usually attached to the end sill, by which the lock of the automatic coupler is opened and the cars uncoupled without going between them. The lever proper is the part attached to the rod and operating the unlocking mechanism, but in the case of freight cars the lever and rod are generally made in one piece. In passenger equipment cars the lever is located on the platform or in the vestibule. The short lever which is directly connected to a passenger coupler is also sometimes called an uncoupling lever. Figs. 1237, 1325-1339.

Uncoupling Lever Bracket. A bracket supporting the uncoupling lever on the end of the car. Page 961.

Uncoupling Rigging. See UNCOUPLING LEVER.

Uncoupling Rod. See UNCOUPLING LEVER.

Uncoupling Rod Foot. The bottom uncoupling rod guide.

Uncoupling Rod Guide. A guide or support port for the uncoupling shaft used on passenger equipment cars having wide vestibules. Preferably termed uncoupling shaft guide.

Uncoupling Shaft (Passenger Equipment Cars). A vertical rod extending up through the platform floor having a square end at the top to make the uncoupling lever and a crank arm at the bottom to which is attached an uncoupling rod. A partial turn of the uncoupling lever pulls out the uncoupling rod and releases the coupler lock, allowing the knuckle to open and the cars to part.

Uncoupling Shaft Bracket. See UNCOUPLING LEVER BRACKET.

Underframe. A framework, which receives the buffing and pulling stresses and carries the weight of the floor and body of the vehicle. In America both in freight and passenger cars the underframe and body are rigidly connected and mutually stiffen and strengthen one another, but in British carriages the body is framed as an independent structure, and merely rests on the underframe, rubber pads or body cushions being interposed to deaden shocks. The only connection is through a body holding-down bolt. Underframe includes all the framing below the floor and includes the sills, platforms, draft timbers, etc. See general drawings of the various types of cars. Figs. 59, 270, 336, 414, 581-602; Pages 373, 376, 377.

Underhung Door. A sliding door which is supported and slides on a rail below the door.

Union (Pipe Fittings). A means of uniting the ends of two pipes with a nut. The nut is attached to one pipe by a sleeve with a collar, and is screwed on a sleeve attached to the other pipe. See also PIPE FITTINGS.

Union Elbow. A union having one section in the form of an elbow.

Unit-Switch Control (Motor Cars). A control apparatus for single cars and cars operated in multiple unit service. Parts are standardized to permit of ready renewal. Main power circuit connections are made by pneumatically operated switches assembled in a switch group underneath the car. See MULTIPLE UNIT CONTROL.

United States Gallon. A U. S. gallon contains 231 cubic inches and a U. S. gallon of water weighs 8⅓ lbs. See IMPERIAL GALLON.

United States Government Specifications for Postal Cars. See POSTAL CARS.

Universal Joint. A device for connecting the ends of two shafts so as to allow them to have perfect freedom of motion in every direction within certain defined limits.

Universal Valve. A valve mechanism used with passenger brake equipments, which corresponds in a general way to the triple valve in that it operates to charge the reservoirs and to control the admission of air to and exhaust from the brake cylinder. See AIR BRAKES. Figs. 1920-1922, 1955, 1958, 1970; Pages 769, 793.

Unloading Machines. A report of an M. C. B. committee on damage to freight car equipment by unloading machines will be found in the 1912 Proceedings, page 264; also in the 1913 Proceedings, page 563; and 1914 Proceedings, page 355. See pages 975, 997.

Unotherm. A device for automatic control of steam or vapor heating apparatus. See PASSENGER TRAIN HEATING.

Upholstery. In passenger car construction, the term includes the cushions, curtains, carpets, beds, etc., and generally the materials from which they are made. P ges 487, 488.

Upper Belt Rail (Passenger Car Exteriors). A horizontal bar attached to the posts on the outside and above the windows. See BELT RAIL.

Upper Berth. The top berth in a sleeping car section. It folds up by day against the roof, being secured by a berth latch, and the head board, mattresses and bedding are stored in the pocket between it and the roof. See BERTH.

Upper Berth End. The end piece of a sleeping car upper berth.

Upper Berth Front Panel. The central panel of an upper berth.

Upper Berth Ladder. A short ladder for use in entering and leaving an upper berth in a sleeping car.

Upper Berth Lower Rail. The bottom or rear bar of the frame of a wooden upper berth. See BERTH FRONT.

Upper Berth Pocket. A pocket against the sides of the car which closes up flush therewith when the upper berth is folded up, but drops open when the berth is made up, to afford a receptacle for clothing and baggage. In modern cars it has been replaced by a hammock. Similar pockets for the lower berth are made by turning up the head rest of the seat.

Upper Berth Rest. See BERTH BRACKET.

Upper Berth Rest Pivot. A pin attached to a plate fastened to an upper berth. The pin engages in a hole in a BERTH BRACKET.

Upper Berth Safety Strap. See BERTH SAFETY ROPE.

Upper Berth Spring. See BERTH SPRING.

Upper Berth Top Rail. The upper or front bar of the frame of a wooden upper berth. See BERTH FRONT.

Upper Brake Shaft Bearing. A metal eye by which the upper end of a brake shaft is held in place.

Upper Buffer Spring. A spring at the top of a vestibule diaphragm to hold the vestibule face plates in contact.

Upper Deck (Passenger Equipment Cars). Also called clere-story. The raised central portion of the roof. See DECK.

Upper Deck Carline. A carline supporting the upper deck or clere-story, usually called simply deck carline. A through carline, extending under both lower and upper decks, is also sometimes called an upper deck carline or profile carline. See CARLINE and PROFILE CARLINE.

Upper Deck Eaves Molding. A molding, usually called simply deck eaves molding, on the outside edge of the roof.

Upper Door Sash. The part of a double window sash in a car door which covers the upper part of the opening. This upper section is usually made movable, so that it can be lowered for ventilation.

Upper Floor (Stock Car). More commonly called double deck. A deck or floor in a stock car half way between the main floor of the car and the roof, to double the carrying capacity of the car for pigs, sheep, calves, etc.

(Automobile Car.) A similar arrangement fitted in an automobile car.

Upper Wainscot Rail. A longitudinal wooden bar or rail, fastened to the posts on the inside of a passenger car immediately under the window. See WAINSCOT RAIL.

Urinal. A metal or porcelain receptacle used in saloons, connected to a pipe leading through the floor. They are distinguished as corner or side urinals. A concealing urinal, shutting up flush with the wood work when not in use, is sometimes used. See CLOSET.

Urinal Ventilator. A pipe attached to a cap on a urinal communicating with the top of a car, where some form of wind scoop is often added.

V

V-Shaped Screw Thread. A thread with a sharp edge at the top and sharp groove at the root. The Sellers' (U. S.) standard thread is flat at the top and at the root, and the Whitworth is rounded. See SCREW THREADS.

Vacuum Brake. A system of continuous brakes which is operated by exhausting the air from some appliance under each car, by which the pressure of the external air is transmitted to the brake levers and shoes. So called in distinction from air brakes, which are technically understood to refer only to brakes operating with compressed air, although in a literal sense the vacuum brake is also an air brake. Page 769.

Valve. A lid, cover, or plug for opening and closing an aperture or passage.

Valve Body. The shell case or frame of a valve. See TRIPLE VALVE BODY.

Valve Key (Pintsch Gas). A key for opening the high pressure valve, the lamp key being used for the low pressure valve connected with the burner.

Valve Rod. A rod for opening and closing a valve. Frequently an extension of the valve stem. See VALVE STEM.

Valve Seat. The surface on which a valve rests.

Valve Stem. A rod attached to a valve, and by which the latter is moved, is called a valve stem or spindle.

Van. See CABOOSE.

Vapor Regulating Valve (Car Heating). A valve by which the amount of steam admitted to the heater pipe is controlled. For a more detailed description of operation of the one used with the Pressure and Vapor Car Heating System see Vapor Reservoir, which acts in conjunction with it. It is possible with this system to combine the valve and the reservoir, in which case it is called a vapor regulating valve, as above. Figs. 2146, 2149, 2155-2160, 2182, 2183, 2190; Pages 869, 877.

Vapor Reservoir. Used in the Pressure and Vapor Heating System, in conjunction with the Vapor Regulating Valve. It is placed below the blow-off, or drip valve, forming an extension to it, and consists of a spiral coil of copper piping surrounding a pipe which forms an extension to the blow-off valve. See PASSENGER TRAIN HEATING.

Vapor System. A system of gas lighting designed for use in localities where Pintsch gas charging plants are not available. The gas is produced by mixing air with the vapor of gasolene. The air is taken from the air brake system and passing through a carburetor charged with gasolene becomes a gas suitable for illuminating purposes. The gas is burned in a mantle lamp and produces a soft white light. See PASSENGER TRAIN LIGHTING.

Vapor Trap. See STEAM TRAP.

Varnish. A liquid for covering paint or woodwork with a hard, impervious and glossy surface. See PAINT. Pages 1058-1064.

Vaulted Deck Window. A deck window shaped like an arch.

Velocipede Car. Generally a three-wheeled car, in which the rider sits astride and propels the car with his feet (or feet and hands together), after the manner of a velocipede. The term includes a variety of light cars for inspectors, telegraph line repairers, lamp lighters, etc. Fig. 2703.

Veneer. A thin leaf of a superior wood for overlaying an inferior wood. By trade usage it is a veneer if it covers other materials than inferior wood.

Vent. A small aperture; a hole or passage for air or other fluid to escape.

Vent Valve (Air Brake). A pneumatically operated valve placed in the air brake pipe to insure quick action of the brakes, especially when the brakes are cut out on one or more of the first cars in a train. It is also used when cars equipped with quick action devices may be placed too far apart in a train. Fig. 1942.

Ventilated Box Car. Similar to an ordinary box car, but arranged for ventilation and suitable for the transportation of produce or other food-stuffs not needing refrigeration. See CAR. Figs. 8, 10; Page 109.

Ventilating Jack (Saloons). Also called wind scoop. A flaring horizontal tube, constituting a simple form of the ventilating devices which use the current produced by the motion of the cars to cause an exhaust current of air. See VENTILATORS.

Ventilation, Passenger Car. A topical discussion on passenger car ventilation will be found in the 1907 M. C. B. Proceedings, page 272.

A report of a committee on the ventilating and heating of coaches and sleeping cars will be found in the 1908 M. C. B. Proceedings, page 338.

Ventilator (Saloon). The fixed oval sashes fitted in the saloons of many of the passenger cars are often arranged with a circular ventilator near the center.

A device for admitting or exhausting air to or from a railway car. Ventilators, according to their position, are designated as deck ventilators (end or side), frieze ventilators, etc. They are often designated as automatic or self-acting. Day coaches usually depend upon the deck windows for ventilation, the sash at every other window being hung on different sides, so that the open sash may be hinged on the front end. For a report of tests with various ventilators see Proceedings M. C. B. Association, 1894, page 234. See DECK VENTILATOR. Figs. 2237-2264; Pages 863-865, 885, 962.

(Fruit Car.) A system of slats at each end of the car, so arranged as to enable the ventilators to be readily opened or closed from the outside. See VENTILATOR BOX CAR.

(Refrigerator Car.) A current of air must be admitted to refrigerator cars, which passes through the refrigerator and comes in contact with the lading. As it becomes warm it rises upward and passes out. The ventilator controls the admission of air and its circulation.

See also HOPPER VENTILATOR.

Ventilator Blower. A blower used in connection with dining car ventilators.

Ventilator Deflector. A metal plate or board placed in such a position at a ventilator opening that it will cause a current of air to flow into or out of the car when the latter is in motion.

Ventilator Door. A door for closing the aperture of a ventilator. Figs. 257-264; Page 237.

Ventilator Hood. A shield over the outside of a ventilator to prevent the entrance of sparks, cinders, rain or snow. It is sometimes intended to direct the current of air either into or out of the car.

Ventilator Netting. A wire screen or netting fastened over the outer deck window sash to prevent the entrance of sparks and cinders.

A netting over the ventilator windows of a fruit car.

Ventilator Opener. See DECK SASH OPENER.

Ventilator Pivot. A pin on which a ventilator door or sash is swung or hinged. It is the same as a deck sash pivot.

Ventilator Plug. A hatch; a door for closing the opening in a refrigerator car ice bunker.

Ventilator Register. A metal plate or frame attached to a ventilator opening, provided with slats arranged so as to turn, or openings which can be controlled, and thus either open or close the ventilator. Fig. 2261.

Ventilator Sash. Usually a deck sash.

Ventilator Staff. A pull hook or deck sash opener.

Ventilator Valve. A door for opening or closing the aperture of a ventilator, usually made to turn on pivots at or near its center.

Vertical Steam Trap and Blow-Off. A thermostatic steam trap, and a blow-off valve combined. It may be operated from inside of the car.

Vestibule. Formerly that part of the car nearest the door, cut off from the main saloon by an interior door. It was occupied by the saloon, washing and heating arrangements, etc. Its purpose was to give protection to the interior of the car against drafts and noise.

Usually a platform enclosure, consisting of a face or buffer plate, constituting an arched doorway, connected with a spring extended rod, a foot plate combined with the buffer stems and face plate, a bellows-

like connection called a diaphragm between the face plate and carbody frame, and side doors opening to the steps. Figs. 773-845; Pages 441, 447, 449, 451.

Vestibule Body Corner Post. The inner post of a vestibule, set against the end of the car body and directly over the platform sills.

Vestibule Buffer Plate. An extra long and wide buffer plate, sometimes recessed or chamfered at the ends, where it is connected with the face plate of the vestibule, whose face is flush with the buffer plate.

Vestibuled Car (Passenger Equipment). A car equipped with covered enclosed platforms. See VESTIBULE.

Vestibule Corner Post. The outer corner post of the vestibule.

Vestibule Curtain. A curtain which is stretched across the inside surface made by the vestibule diaphragms and face plates when two cars are coupled, to protect passengers from injury. Figs. 791-800.

Vestibule Curtain Handle. A handle or catch used to secure a vestibule passageway curtain to its hook. A release handle is one which automatically unfastens in case of excessive strain. Fig. 792-800.

Vestibule Curtain Hook. See VESTIBULE CURTAIN.

Vestibule Curtain Shield. A shield to protect a vestibule curtain when rolled up. Fig. 791, 796.

Vestibule Diaphragm. See DIAPHRAGM.

Vestibule Diaphragm Post. The vestibule post to which the diaphragm is connected.

Vestibule Door. A door by which the vestibule of a car is entered from the side. In the older or narrow type of vestibule they are double or divided, the two doors being hinged together and swung from the vestibule corner post.

Vestibule Door Hinge. Strap hinges, which fasten the double doors of a narrow vestibule together.

Vestibule Door Latch. A device for holding a door in place, either open or shut, as may be desired.

Vestibule Door Rod. A bar or rod across the doors of a narrow vestibule to prevent their being pushed in.

Vestibule Dome Lamp. A VESTIBULE LAMP.

Vestibule End Carline. A platform hood end carline. See CARLINE.

Vestibule End Post. See VESTIBULE CORNER POST.

Vestibule End Window. The window in the end of the vestibule enclosure.

Vestibule Face Plate. An inverted U-shaped forging forming, with the diaphragm, a passageway from the platform of one car to that of the next. The weight of it is carried on the buffer plate and it is kept thrust out against the opposing face plate either by springs or by its own weight.

Vestibule Gate. A gate used to close the vestibule passageway at the rear of the last car in a train.

Vestibule Guard Rail. A hand rail or hand hold, pivoted at one end and fitting in a socket at the other, and located on the end of the car so that it may be swung across the vestibule door and hold it in an open position.

Vestibule Hood. The platform hood of a vestibuled car.

Vestibule Lamp. A lamp used for lighting a car vestibule. See DECK LAMP.

Volt. The unit of electric pressure or electro-motive force.

Voltmeter. An instrument for measuring the voltage of electric currents.

Volute Spring. Fig. 1684; Page 717.

W

Wainscot Panel (Passenger Car Interior). A panel under the windows between the two wainscot rails.

Wainscot Rail (Passenger Car Interior). A longitudinal wooden strip fastened to the posts and extending from one end of the car to the other. The lower wainscot rail comes immediately above the truss plank; the upper wainscot rail is immediately under the window. The wainscot end rails are the wainscot rails at the end of the car.

Walkover Seat. A term used to designate a type of car seats in which the back does not turn over when the seat is reversed. Also called GLIDEOVER, PUSHOVER and SLIDEOVER. See CAR SEAT, SEATS.

Wall Lamp. A lamp to fit in a recess in the wall of a car or corridor.

Wall Seat End. The seat end next to the wall or side of a car, so called in distinction from the aisle seat end.

Wardrobe (Postal Car). See POSTAL CARS.

Wards (Lock). The interior circular ridges which fit into corresponding recesses in the bit of a key (the latter also termed wards), the surrounding solid parts of the bit being called the web.

Wash Bowl or **Wash Basin.** See BASIN.

Wash Bowl Pipe. A waste pipe.

Wash Room. A compartment provided with toilet facilities. See LAVATORY.

Wash Room Pump. See BASIN PUMP.

Wash Stand. A cast stand carrying a basin. They are distinguished as corner or side wash stands. Figs. 1041-1049; Pages 954, 956.

Wash Stand Slab. A stone or metal slab which forms the top for a wash stand.

Washer. A plate of metal or other material, usually annular, which is placed under a nut or bolt head to give it a better bearing. Two or more washers are sometimes combined and called washer plates, strap washers, double or twin washers, triple washers, etc.; they are sometimes made beveled or triangular for a rod or bolt which is oblique with reference to the bearing surface. A socket washer or flush washer is one provided with a recess for the bolt head, so as to leave it flush with the surface of the adjoining parts. Cut washers or wrought washers are those stamped out of rolled iron plates. Cast washers are made from cast iron. Both are largely used. Washers in car work generally take their name from that of the bolt or rod to which they are attached.

Washer Plate. See STRAP WASHER.

Waste. Material used for wiping oil from machinery, and also for journal packing. Made largely of spoiled threads of wool or cotton mills and discarded fabrics, which are shredded for their threads. See JOURNAL PACKING.

A topical discussion on "What Constitutes Efficient Waste Packing" will be found in the M. C. B. Proceedings, 1901, Page 336.

A topical discussion, including the results of a series of tests on cotton and woolen waste, and proposed specifications for wool, cotton and white cotton waste, will be found in the 1903 M. C. B. Proceedings, Page 335.

Waste Cock. A cock for drawing off water from a tank or basin. (Baker Heaters.) A cock attached to the expansion drum or circulating drum of the Baker heater for drawing off or changing the water in the heater pipes.

Water Alcove. A recess in the side of a partition of a passenger car to receive the faucet of a water cooler or water pipe and a drinking cup. The term is generally used to designate the metal casing or lining with which the recess is covered. The water tank for supplying water alcoves is usually placed on the other side of the partition, in the saloon, and commonly when so placed extends to the roof.

Wastometer. A device for flushing water closets.

Water Circulation Heating System. See HOT WATER CIRCULATION HEATING SYSTEM.

Water Closet. A commode with water supply to rinse the basin and carry off the contents. See CLOSET.

Water Cooler. A tank or vessel for carrying drinking water, which is usually cooled with ice. The sides are generally made double, and the space between filled with some non-conducting substance. They frequently extend to the roof. See WATER ALCOVE, WATER TANK. Figs. 1031-1044; Page 956.

Water Drip. A pan or receptacle to receive the waste water from a water cooler. A drip pipe, or waste pipe, connects with it.

A slight projection or raised seam in the roof of a passenger or baggage car over the side doors, or at the end of the car in the platform roof to divert the water so it will not fall upon persons entering the car or passing from one car to the next.

Water Gage. See GLASS WATER GAGE.

Water Seal. See TRAP.

Water Supply. The system of water supply used in Pullman sleeping cars is under air pressure, thus doing away with the old method of using pumps for raising water for washing purposes. The system consists of forcing water into the wash bowls by air pressure taken from the air brake system. The water is usually heated by using live steam from the locomotive.

Water Tank. A vessel or reservoir for holding water. Those used on cars for drinking water are usually made of sheet iron, and often extend to the roof. They are then usually drawn from by a water alcove, the tank usually being in the corner of the saloon, concealed from the interior of the car.

For size and arrangement of water tank in postal cars, see POSTAL CARS.

Watt. The unit of electric power. The product of one ampere multiplied by one volt. It is equal to 1-746 horsepower.

Wattmeter. An instrument for measuring electric power.

Waved Moldings. Moldings which by a special machine are made of a corrugated section longitudinally.

Way Car. See CABOOSE.

Weather Strips. A strip for application around the crevices of windows or doors, for excluding the dust and wind, and for preventing water from entering around the windows. Figs. 871, 888, 906-910, 917-919, 923, 926, 927.

Web. A term applied to the center portion of a beam, as an I-beam, which ties the flanges together. See BODY BOLSTER FILLER.

(Key.) The solid portion of a bit of a key, the recesses cut away being termed wards. See BIT.

Web Filler. See BODY BOLSTER FILLER.

Webbing. A strong fabric, made of hemp or other material which is not likely to stretch, used in upholstering car seats.

Wedge. The metal piece used to keep a journal bearing in its place in the journal box. See JOURNAL BOX WEDGE.

Wedge, Journal Box. See JOURNAL BOXES AND DETAILS.

Weed Burner. Figs. 2680, 2681.

Weed Killer. See WEED BURNER AND SPRAYING CAR.

Weight of Car, Light; Stenciling of. See FOUNDATION BRAKE GEAR.

Welding. Pages 1151-1153.

Welding Equipment. Page 1174.

Well Car. A flat car with an opening in the center to allow the load to extend below the floor level when it could not otherwise come within the overhead clearance limits. Figs. 38-40, 50-51. See CAR, and FLAT CAR.

Wheel. A circular frame or solid piece of material which revolves on an axis. See BRAKE RATCHET WHEEL, HAND BRAKE WHEEL, etc.

A circular frame or disc, as above defined, serving to support a moving vehicle, as car wheel, hand car wheel, etc. Car wheels are generally either cast iron (chilled), forged, cast steel, or steel tired. Figs. 1591-1649; Pages 681-693, 695, 697, 699, 701, 703, 704, 965.

Wheel and Track, Terms and Gaging Points for. Fig. 1607; Page 691.

Wheel Bar (Passenger Truck). See WHEEL PIECE.

Wheel, Cast Iron. See WHEELS.

Wheel Center (Steel Tired Wheels). The portion of a wheel inside of the tire and between it and the hub or boss. The wheel center is sometimes in one piece and sometimes made up of two parts, the hub or boss and the central filling piece. Face plates, front and back, are also used. The term is seldom applied to chilled or cast wheels.

Wheel-Circumference Measure for Cast-Iron, for Steel and Steel Tired, and Cast Steel Wheels. Figs. 1599; Pages 691, 1176.

Wheel Defect Gage. Fig. 1609, 3098; Page 1176.

Wheel, Diameter of Steel and Steel-Tired. See WHEELS.

Wheel Fit. See WHEEL SEAT.

Wheel Flange. The projecting edge or rim on the periphery of a car wheel for keeping it on the rail.

Wheel Flanges, Distance Between the Backs of. Fig. 1607.

Wheel Flange Thickness Gages, for New Wheels. Fig. 1601, 3100; Page 1176.

Wheel, Limit Gages for Inspecting Second-Hand, for Remounting. Fig. 1605.

Wheels, Mating. Page 692.

Wheel, Minimum Thickness for Steel Tire of. Page 693.

Wheels, Mounting. Figs. 1605.

Wheel Piece. The upper side member of a pedestal truck, to which the pedestals are attached.

Wheels, Plane Gage for Wrought Steel. Fig. 1603.

Wheel Piece Plate. A plate used to strengthen a wooden wheel piece.

Wheel Plate. That part of a plate car wheel which connects the rim and the hub. It occupies the place and fulfills the same purpose as the spokes do in an open or spoke wheel. See WHEEL, PLATE WHEEL and FACE PLATE.

Wheel Press. A machine for pressing wheels on car and locomotive axles. Page 1175.

Wheel Ribs (Cast Iron Wheels). More commonly, brackets. Projections cast usually on the inner side of plate car wheels to strengthen them.

Wheels, Rotundity Gage for Wrought Steel. Fig. 1602.

Wheel Seat or **Wheel Fit** (Axle). The part which is inserted in the hub of a wheel. It is made truly cylindrical and very slightly larger than the axle seat of the wheel. The wheel is pressed on it by hydraulic pressure. See WHEEL.

Wheel, Solid Steel. Figs. 1595-1598; Pages 685-690.

Wheel, Solid Steel, Plane Gage for. Fig. 1603.

Wheel, Solid Steel, Rotundity Gage for. Fig. 1602.

Wheel, Solid Steel, Sizes and Dimensions for. Figs. 1595-1598.

Wheel, Specifications for 33-Inch Cast-Iron, for Cars of Maximum Gross Weights, Not to Exceed 95,000 Pounds, 132,000 Pounds and 161,000 Pounds. Pages 681-685.

Wheel, Steel, Branding of. Fig. 1606; Page 687.

Wheel, Steel, Gage for Measuring Thickness of Rim. Figs. 1605, 1610; Page 693.

Wheel, Steel-Tired, Tire Fastening for. Fig. 1608.

Wheel Timber. A term sometimes applied to a wooden wheel piece.

Wheel Tread and Flange for Steel and Steel-Tired Wheels. Fig. 1600, 1605.

Wheel Tread and Flanges, Form of. Figs. 1600.

Wheel Truing Brake Shoe. A brake shoe with abrasive inserts to grind the wheel tread and flange true to center while in service. See BRAKE SHOE.

Wheels, Steel and Steel-Tired. Figs. 1600-1606.

Wheels, Steel and Steel-Tired, Diameter of. Figs. 1595-1598.

Wheels, Wrought Steel, for Freight and Passenger Service; Specifications Governing Dimensions and Tolerances for. Pages 685-690.

Whistle (Signal Apparatus). An air whistle used with the train signal apparatus.

Whistle Reservoir. A small tank or reservoir to store air for operating a pneumatic signal whistle on electric motor cars.

Whistle Valve. A valve for admitting air to the alarm whistle on electric cars.

White Lead for Lettering. Specifications for. Pages 1059, 1060.

Whitworth Gages. See CYLINDRICAL GAGES.

Wide Gage. In general usage, the distance between the heads of the rails of a railroad when it is slightly greater than 4 ft. 8½ in., in distinction from Broad Gage, which means a material increase, as to 5 ft. or 6 ft.

Wide Vestibule. The modern vestibule extends the full width of the car. The first vestibule extended over the platform proper (or the width of the end door) only. When the present type of vestibules began to be used they were commonly termed wide vestibules and the older type narrow vestibule. See VESTIBULE.

Wind Guard (Pintsch Gas). A perforated brass disc fitting in globe holder below the opal globe, and supplied with a small covered hole for admitting a match or taper when lighting the gas. Its purpose is, as indicated by its name, to protect the flame from the action of drafts from below the globe.

Wind Scoop. See VENTILATING JACK.

Winding Shaft (Drop Doors of Coal Cars, etc.). An iron bar supported by winding shaft plates or bearings, around which the drop door chain or hopper chain is wound. It carries a ratchet wheel and is usually formed with a square end for applying a wrench or handle to turn it. See DOOR OPERATING GEAR.

Winding Shaft Plate. A plate which acts as a bearing for the winding shaft. See WINDING SHAFT.

Winding Shaft Ratchet Wheel and Pawl. The ratchet wheel and pawl attached to the end of the winding shaft to prevent its turning and allowing the doors to drop.

Windows. An opening for the admission of light and air when necessary. It has a frame on the sides, in which are set movable sashes containing panes of glass. Hence the window itself, especially in compound words, is often termed simply the sash. Car windows are now generally made of uniform size throughout. In sleeping and parlor cars double windows are almost always used to inclose an air space between them and prevent radiation of heat and drafts. See also SASH. Figs. 864-946; Pages 461, 463, 465, 467, 471.

Window Balance. A device in which a spring is used instead of a weight to counterbalance the weight of the sash and glass. See SASH BALANCE.

Window Blind. A wooden screen composed of a frame

called the sash, carrying slats, placed in a window to exclude sunshine. Window shades have displaced blinds in first-class passenger cars, blinds being seldom used except in the saloon or lavatory.

Window Blind Bolt. A bolt used for holding a window blind in any desired position. It enters a window blind bolt bushing or plate.

Window Blind Lift. Commonly called simply blind lift or blind pull. A metal hook fastened to the blind for raising and lowering it, usually attached to the bottom rail.

Window Blind Mullion. An upright bar in the center of a window blind sash.

Window Blind Pull. See Window Blind Lift.

Window Blind Rest. A wooden strip to fill up the lower part of the groove in which an upper window blind slides, and on which it rests when down.

Window Blind Sash. The frame in which the inclined thin slats of a window blind are held.

Window Blind Spring. A Sash Spring.

Window Blind Stile. An upright bar in a window blind sash.

Window Casing. A frame which incloses or surrounds a window.

Window Cove Molding. A small concave molding around the sides and top of a window on the inside of a passenger car.

Window Curtain. A cloth or some kind of textile material loosely hung over a window to exclude sunshine, and which can be spread or drawn aside at pleasure. Curtains of this kind are now little used. See Window Shade. Figs. 882-929; Pages 463, 467.

Window Curtain Bracket. More commonly simply curtain brackets, for supporting window shade rollers. A more correct term would be shade or window shade brackets, but in common usage, curtain brackets support shade rollers.

Window Curtain Roller. More properly a Shade or Window Shade Roller.

Window Deflector Ventilator. See Dust Deflector and Ventilator.

Window Dust Guard. See Dust Deflector.

Window Fastener. A Sash Lock.

Window Frame. A frame set into the side, end or roof of a car, into which the window sash fits.

Window Guards. Small rods to act as fenders for the end windows.

(Postal Cars). Metal rods are used on the outside and wooden rods on the inside of all postal car windows.

Window Head. A steel plate placed across the top of a window opening or a series of window openings.

Window Latch. A Sash Lock.

Window Lift. See Sash Lift.

Window Lintel. A horizontal strip on the outside of a passenger equipment car between the posts, and over the window openings.

Window Molding (Passenger Car Interiors). A molding used around, or on each side of, a window, particularly to cover the joint between the panel and post. It sometimes forms a groove in which a window or window blind slides, in place of the inside window stop.

Window Panel. A panel between windows.

Window Panel Furring. Horizontal distance pieces between the window posts to which the panel is fastened.

Window Post (Passenger Equipment Cars). A side post located between windows, sometimes extending only from the belt rail to the side plate and sometimes the entire way between the side sill and side plate.

Window Protection Rod or Bar. See Window Guards.

Window Rod Bushing. A support for the ends of a curtain rod.

Window Sash. The frame which holds the glass of a window.

Window Sash Balance. See Sash Balance.

Window Sash Holder. See Sash Lock.

Window Sash Lift. See Sash Lift.

Window Sash Lock. See Sash Lock.

Window Sash Rail. A horizontal bar in a window sash.

Window Sash Spring. See Sash Spring.

Window Shade. A window curtain, which is wound on a roller above the window, in distinction from one which is drawn aside. In passenger cars window blinds have been superseded by shades. An automatic shade roller is always used, the old-fashioned pulleys and cord tighteners being obsolete. Figs. 885, 899-905, 928, 929; Page 467.

Window Shade Roller. The cylinder on which the shade is rolled up, containing within it the springs which actuate it.

Window Shade Stop. That part of a shade holder which engages with or bears against the window casing and holds the shade.

Window Shade Thumb Latch. Usually a pair of short bars which, when pinched together with the thumb and finger, release the mechanism which locks the shade in a stationary position, permitting it to be raised or lowered.

Window Sill. A horizontal piece of wood or metal under a window, on which the sash rests when down.

Window Sill Molding. A small wooden molding under an inside window sill. In modern cars it is usually a belt molding.

Window Spring. See Sash Spring.

Window Stile. The upright bars of a window sash.

Window Stop. The strips, or beads, attached to the window posts which hold the sash in place.

Window Ventilator. See Dust Deflector, Ventilator.

Wing Elevator Snow Plow. See Snow Plow.

Wire Gauze (Ventilator). A fine netting made of wire, with which the outside of deck windows and ventilator openings is covered to prevent the admission of cinders.

Wiring. See Electric Wiring.

Wood Screw. A small cylindrical bar of iron or steel with a wood screw thread cut on it and a slotted head so that it can be turned with a screw driver. A lag

screw is a heavy type of wood screw. It has a square, instead of a slotted head. See SCREW, and LUG SCREW.

Wood Screw Thread. A form of screw thread used for screws which are intended to screw into wooden objects. It differs from a metal thread in having the spaces between the projections wider.

Worm. A helix, like a screw thread, for winding a rope or a chain upon or for driving a spur wheel.

Worn Flat (Car Wheels). Under the rules for the interchange of traffic this defect is defined to be irregular wear under fair usage, due to unequal hardness of the tread of the wheel, and to be carefully distinguished from slid flat, which is a defect produced by the slipping of the wheels from excessive brake pressure. See WHEELS.

Wreck Train Equipment. The cars and tools used in clearing wrecks. The train usually consists of a steam wreck crane, a bunk or sleeping car, a kitchen and dining car, cars for carrying spare trucks, and cars for carrying tools and blocking. Figs. 2624-2643.

Wrecking Crane or Wreck Crane. A powerful crane mounted on trucks and operated usually by steam, but in some cases by electricity, for use in clearing up wrecks. Figs. 2627, 2631; Pages 973, 989.

Wrecking Frog. See CAR REPLACER.

Wreck Hook. A hook which can be attached to an automatic coupler and will allow a chain to be used in pulling the car. Fig. 2638.

Wrench. A contrivance for screwing and unscrewing a nut. A monkey wrench is adjustable to take nuts of various sizes. A socket wrench is one having a cavity to receive nut. A spanner is a wrench for use on round or many-sided nuts, like hose couplings, to which lugs or slots are added for engaging with the wrench.

Wrought Steel Wheels. See WHEELS.

Y

Yale Lock. A trade name—which has come into general use—designating a lock of special construction. The principal types are: Time locks, combination locks; cylinder or pin-tumbler locks. These locks have small keys bitted on their upper edge to engage with pin tumblers contained in the cylinder. The original flat key has been superseded by the corrugated and paracentric forms. The key raises the pin tumblers to the proper height and is then able to rotate a plug in the cylinder and thus to actuate the lock.

Yard Pick-Up Car. See PICK-UP CAR.

Yard Poling Car. See POLING CAR.

Yoke. A pocket strap, U-shaped, which contains the spring and follower plates of a drawbar. It is the means of attaching the drawbar to the draft gear. See COUPLERS and COUPLER YOKE. Figs. 1085, 1122-1131, 1186-1225, 1342; Pages 542, 543, 549, 553, 555, 968.

Yoke Rivets. See RIVETS.

Freight Cars

THE IMMENSE VOLUME OF COMMERCE in the United States and the long railroad hauls required to transport many of the materials used has made it necessary to provide rolling stock capable of handling freight in large quantities. To meet this demand with the least possible amount of non-revenue load—weight of equipment—freight cars built for use on American railroads have been increased greatly in size and capacity in the last two decades; cars ranging upward to 120 tons each in capacity have been built. This increase in size has required careful design and construction in order to provide ample strength to withstand the severe service but with the use of only a minimum amount of material.

The increased cubical capacity has necessitated cars of greater length since railway line clearances place a limitation on the height and width and this in turn necessitates a greater distance between truck centers which, together with the severe stresses encountered in the operation of the heavy trains, renders the design of car underframes a matter of vital importance. The use of all-steel underframes has become universal for practically all classes of freight cars, particularly for those cars intended for handling heavy materials, such as coal and iron, or ores in bulk; in many cases the body framing also and sometimes the entire car is constructed of steel. The use of wood has practically been abolished in car truck construction and the use of cast steel, pressed and forged steel, or rolled steel parts has become general.

In 1922 there were more than 2,900,000 freight equipment cars on the railroads of the United States. Of these about 190,000 were privately owned; about 2,600,000 were operated by the railroads in revenue service—transporting revenue producing freight; the remainder consisted of caboose cars for freight train service and various other types of cars, such as ballast cars and other equipment used by the Maintenance of Way Department. These cars are divided into several general classes or groups: box and other closed top cars; open-top cars; other revenue cars; and non-revenue cars. The total number of cars in each group is as follows:

Type of Car	Privately Owned	Railroad Owned	Total
Flat	1,300	140,235	141,535
Gondola	5,602	577,948	583,550
Hopper	20,904	462,238	483,142
Coke	623	30,944	31,567
Stock	367	96,575	96,942
Poultry	1,600	34	1,634
Box	669	1,218,965	1,219,634
Refrigerator	36,007	69,675	105,682
Tank	120,872	13,221	134,093
Ballast — Revenue		4,585	33,320
Ballast — Non-revenue		28,735	
Other revenue cars	1,146	12,039	13,185
Other non-revenue cars		101,053	101,053
Caboose		33,254	33,254
	189,090	2,789,501	2,978,591

To easily identify these various classes and types of cars and to briefly indicate their use, the American Railway Association, in 1910, adopted the following classification as recommended practice.

Classification of Freight Cars

CLASS "F."

"FM"—Ordinary flat car for general service. This car has flooring laid over sills and without sides or ends.

"FG"—Flat or gun truck car for special transportation of heavy ordnance.

"FW"—Flat well-hole car for special transportation of plate glass, etc. This car is a flat car with hole in middle to enable lading to be dropped down on account of clearance limits.

"FB"—Flat car having skeleton superstructure, suitable for carrying barrels, known as "Barrel Rack Car."

"FL"—Flat logging car or logging truck. This is either an ordinary flat car, or car consisting of two trucks fitted with cross supports over truck bolsters; the trucks connected by a skeleton of flexible frame and logs loaded lengthwise on cross supports.

"FT"—Flat car. A car equipped with holders for the transportation of illuminating gas.

CLASS "G."

"GA"—Gondola Car. This car has sides and ends; open at top, and drop bottom; suitable for general coal or ore trade, stones or general trade.

"GE"—Gondola car having drop bottoms and drop ends; suitable for general coal or ore or mill trade.

"GC"—Gondola Coke Car. Gondola car fitted with coke racks and having drop bottoms.

"GD"—Gondola car having side-dump arrangement.

"GM"—Gondola Car. Suited to mill trade, having solid bottom, low sides and drop ends to facilitate twin shipments.

"GB"—Gondola Car. A car with solid bottom, sides and ends, and open on top; suitable for mill trade.

"GF"—Gondola Car. A car equipped with coke racks and having solid bottoms.

"GS"—Gondola Car. A car with fixed sides and ends, and flat bottom composed of dump doors hung at inside edge, and dumping to the side of track.

CLASS "H."

"HM"—Hopper Car. Similar in general design to gondola car, having sides and bottom ends and open at top, equipped with hopper bottom and self-cleaning.

"HT"—Hopper (Twin). Similar to ordinary hopper, only equipped with two or more hopper doors instead of one

"HD"—Hopper car equipped with side-dump hoppers.

"HC"—Hopper car equipped with coke racks.

CLASS "N."

"NM"—Freight train service caboose for convenience of trainmen. This caboose is mounted on four wheels and has lookout at top over roof. It is fitted with bunks or benches and a stove for cooking and heating purposes,

also tank for storage of drinking and washing water, and small tool storage boxes.

"NE"—Caboose mounted on eight wheels and longer than four-wheel caboose, but of the same general design.

CLASS "R."

"RA"—Meat and Provision Refrigerator. A car with body, doors and hatch plugs equipped with insulation and brine ice tanks and without ventilating devices.

"RB"—Beer and Ice Refrigerator. A car with body and doors equipped with insulation, having no ice tanks or ventilating devices.

"RM"—Refrigerator or Produce Car. A car suitable for carrying commodities that need icing in transit. This car is equipped with two or more ice bunkers or baskets and suitable means for draining off melted ice or briny water. This car has body, door and hatch plugs equipped with insulation, with trap door in the roof for admission of ice and salt; also water seals inside of car.

"RS"—Standard Refrigerator. A car with body, doors and hatch plugs equipped with insulation, with ice tanks and either with or without ventilating devices.

CLASS "S."

"SM"—Stock Car. This car is for transportation of stock on the hoof, and is equipped with roof, slatted sides and side doors, and single deck. With or without feed and water troughs.

"SH"—Horse Car. A car specially fitted for the transportation of horses in freight service.

"SD"—Stock Car. Composite having drop doors in floor and means of housing in sides and making drop-bottom box car.

"SP"—Stock Car. Used in poultry trade, fitted with roof and sides usually of wire netting, fitted with shelves for storing crates of poultry and leaving space for poultrymen, feed bag and watering facilities.

"SC"—Stock Car. This car is for transportation of stock on the hoof, and is equipped with roof, slatted sides and side doors, and convertible single or double deck. With or without feed and water troughs.

"SF"—Stock Car. This car is for transportation of stock on the hoof, and is equipped with roof, slatted sides and side doors, and fixed double deck. With or without feed and water troughs.

CLASS "T."

"TM"—Tank car for general service. This car is for general oil or liquid service, and consists of a steel tank mounted on frame or mounted directly on cradles over truck bolsters. It is equipped with one or two safety release valves, and is emptied by valves or valve at bottom. At the top is a dome, with or without manhole, and openings through which the tank may be filled.

"TA"—Acid Tank. Of same general construction as oil tanks.

"TL"—Acid Tank. Of same general construction as oil tanks, but having lead lining.

"TG"—Tank car having glass or glass-lined tanks, for use in hauling mineral waters and other special products.

"TS"—Tanks for special commercial service.

"TW"—Tank car having wooden tank instead of steel and used for water, pickles, etc.

"TMI"—Tank car built under the specifications for Class IV Tank Cars and insulated for handling casing-head gasoline, etc.

CLASS "V."

"VA"—Vegetable Ventilator. A car equipped with insulation, but having common box car end and side doors which afford no protection against heat or cold.

"VS"—Standard Ventilator. A car equipped with insulation, including insulated side, end and top openings, and ventilating devices without ice tanks.

CLASS "X."

"XM"—Box Car. General service, suitable to lading which should be kept from the weather. A box car is a closed car having side and end housings and roof, with doors in sides or sides and ends.

"XA"—Automobile Car. Box car of similar design to general service car, having exceptionally large side doors or end doors.

"XF"—Furniture Car. Box car of similar design to general service car, except usually greater capacity in cubic feet.

"XV"—Box Car, Ventilated. Similar to ordinary box, only having ventilation, and suitable for the transportation of produce or other foodstuffs not needing refrigeration.

"XI"—Box Car, Insulated. A box car having walls, floor and roof insulated, not equipped with ice bunkers or ice baskets. This car ordinarily used for transporting vegetables, fruit, etc.

"XT"—Box Car Tank. A box car without doors, metal lined, or inclosing tank for the shipment of water or other liquids.

CLASS "Y."

"YM"—Yard Poling Car. This car used in hump classification and flatyard classification. This car is usually fitted with small house or protection and benches, tool box and stove, a counterweighted pole on each side and running board or step near the ground for convenience of yardmen. It is protected with safety appliances and, when in use, coupled to an engine.

"YA"—Yard pick-up car for use of car droppers and yardmen in performance of their duty. It might be termed a "Car Dropper's Car." It is protected by house, around which runs a platform and railing, a long running board on sides near ground and is fitted with benches, tool box and stove.

In addition to hopper cars and gondola cars, as described in the A. R. A. classification, there has been developed a type of side-dump car which has come into quite extensive use. These cars are suitable for use by the Maintenance of Way Department and also for ash and coal handling in railroad service, but, being fully equipped for freight train operation, they can also be used in revenue freight service for handling sand, gravel, cinders, and other loose bulk material.

Other types of freight cars as used in railway maintenance service are described in the section entitled "Railway Service Cars."

Fig. 1—All-Steel 50-Ton Capacity Box Car. Weight 52,590 lb.; Inside Length, 40 ft. 5¼ in.; Inside Width, 8 ft. 10⅞ in.; Inside Height, 9 ft. 1 in. Builder, American Car & Foundry Company.

Fig. 2—Steel Frame Box Car. Capacity 40-Tons, 2,778 cu. ft. Weight, 42,400 lb. Inside Length 40 ft. 0 in.; Inside Width, 8 ft. 6 in.; Inside Height, 8 ft. 2 in. Builder, American Car & Foundry Company.

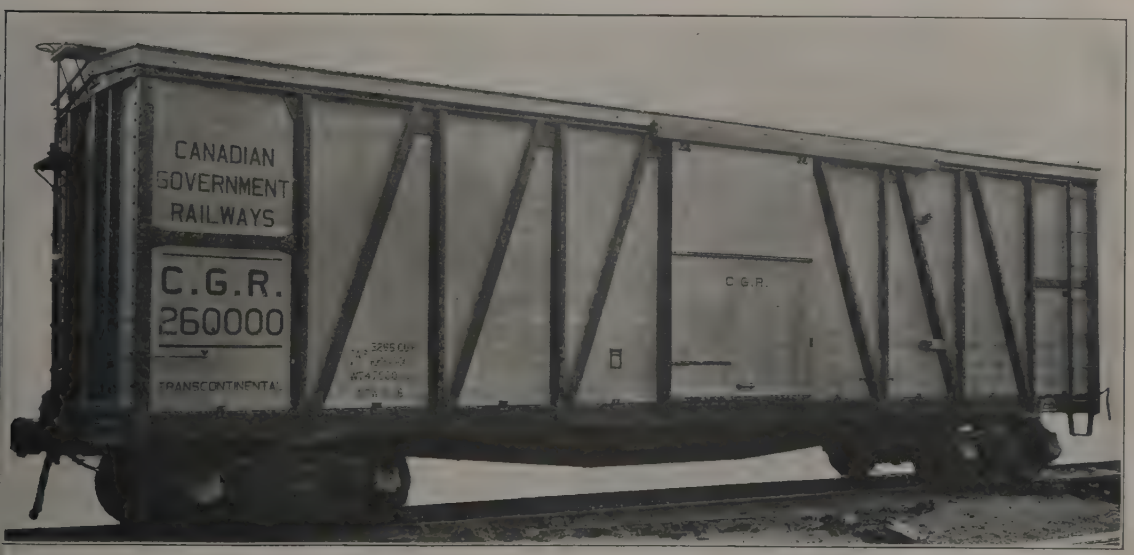


Fig. 3—Steel Frame, 50-Ton Capacity Box Car. Weight, 47,500 lb.; Inside Length, 40 ft. 6 in.; Inside Width, 9 ft. 0 in.; Inside Height, 9 ft. 0 in. Builder, Canadian Car & Foundry Company, Ltd.

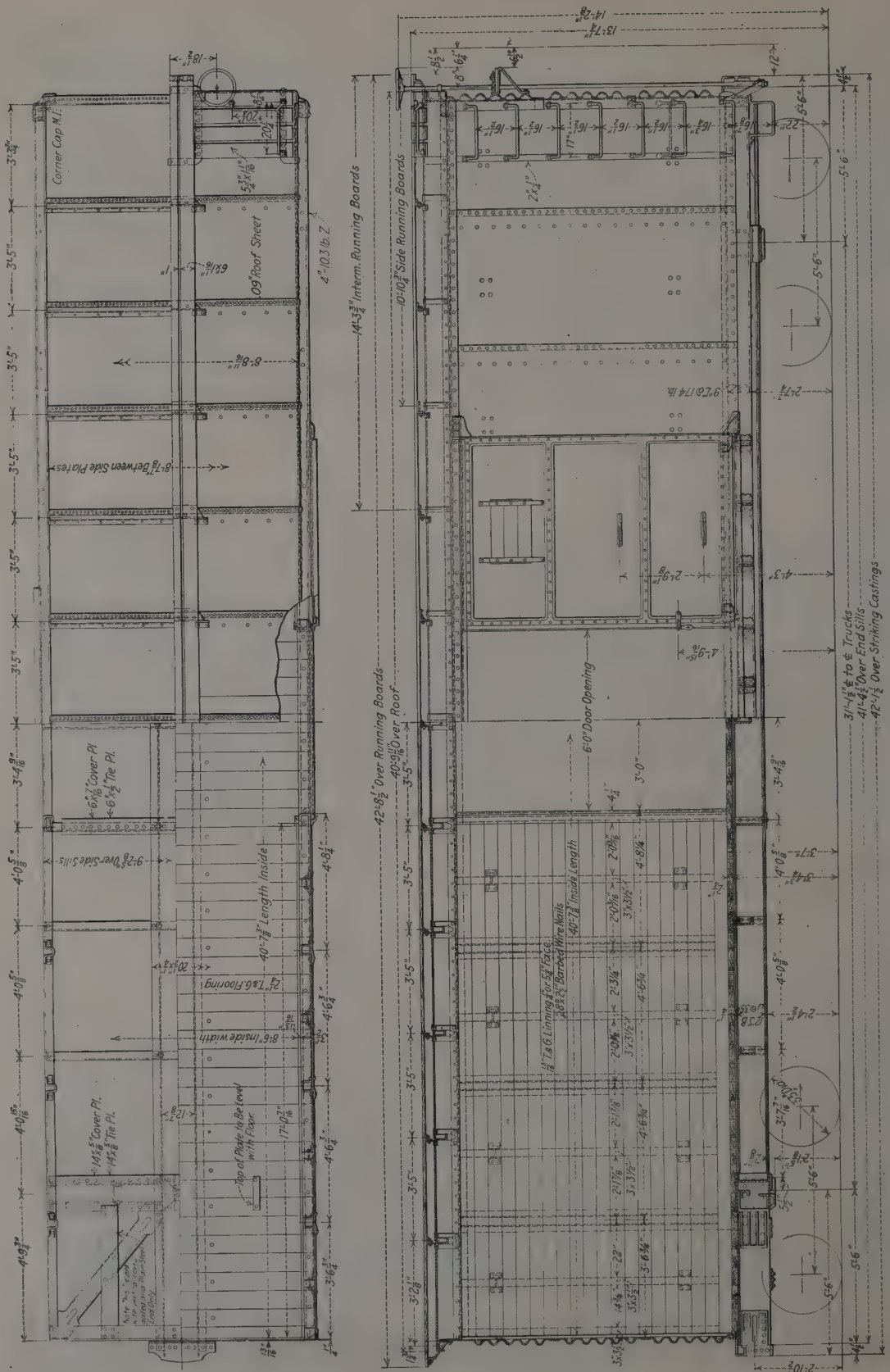


Fig. 4—U. S. R. A. Standard All-Steel 50-Ton Box Car
(See also Fig. 5.)

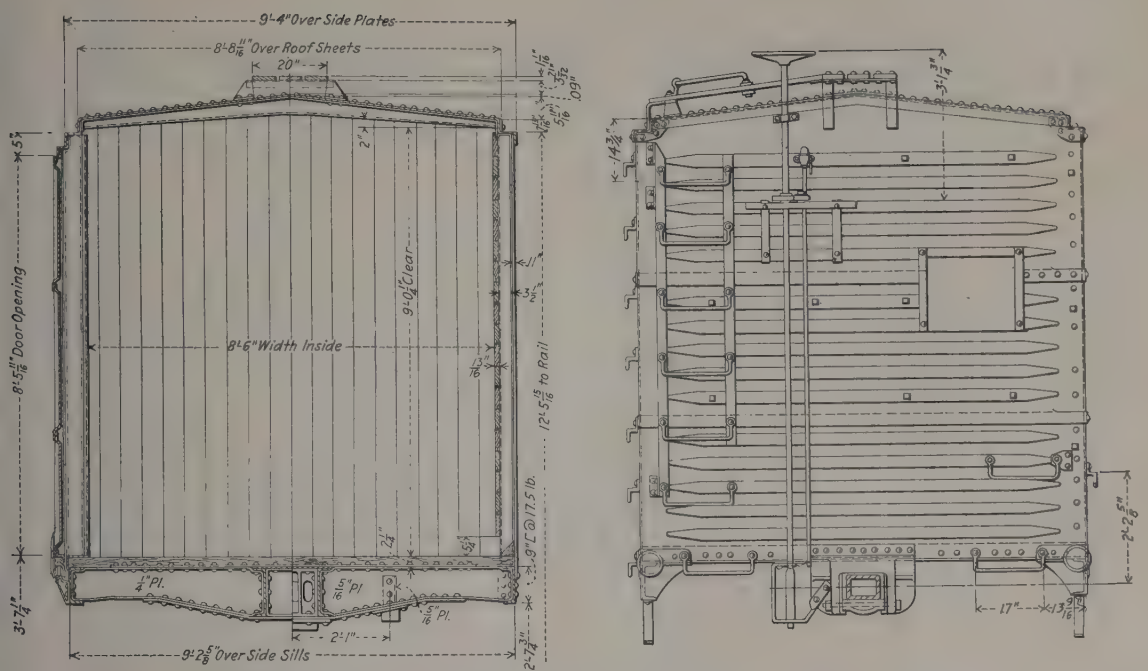


Fig. 5—Cross-Section and End of All-Steel 50-Ton Box Car Shown in Fig. 4.

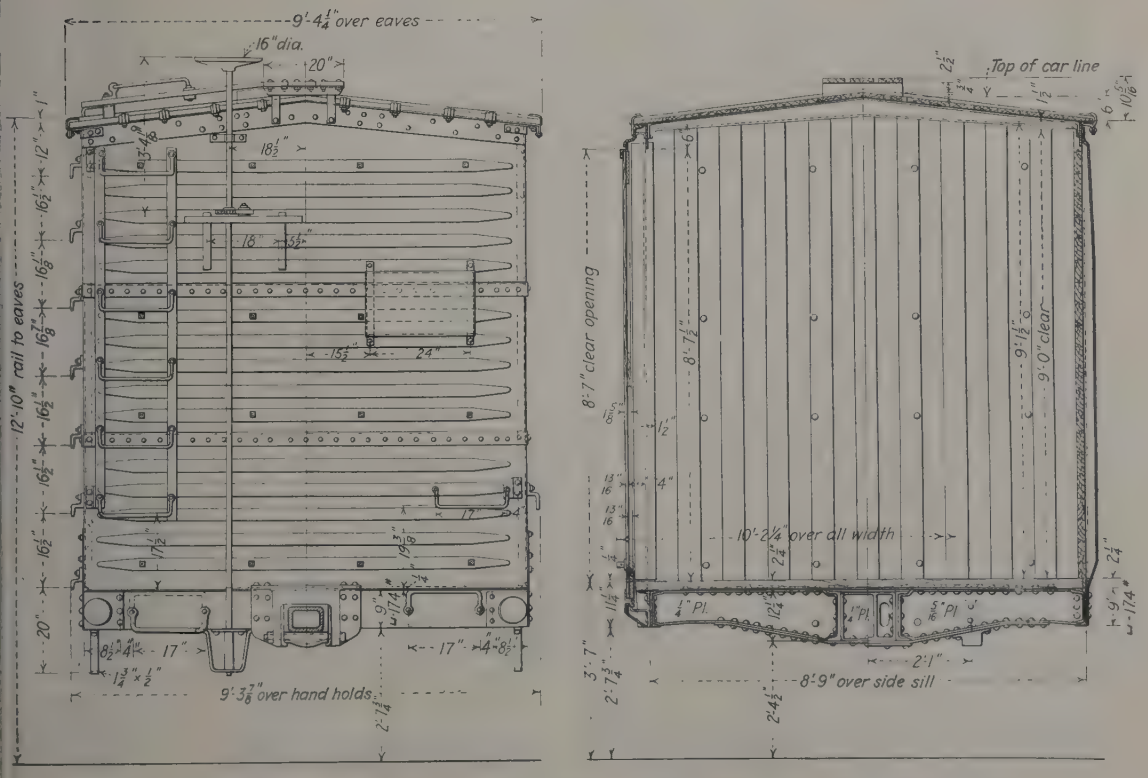


Fig. 6—Cross-Section and End of 40 and 50-Ton Single Sheathed Box Car Shown in Fig. 7.

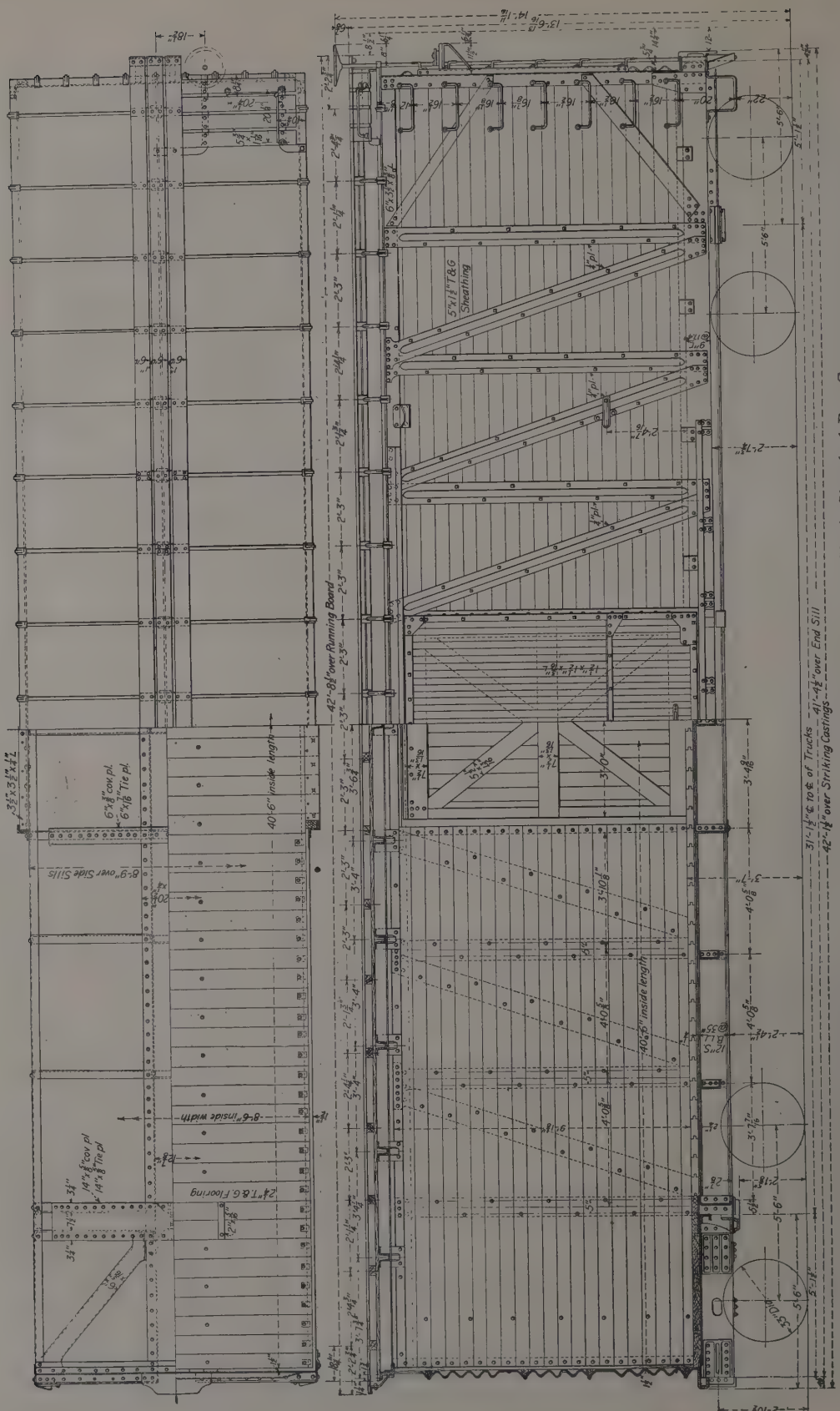


Fig. 7—U. S. R. A. Standard Steel Underframe 40 and 50-Ton Single Sheathed Box Car.

(See also Fig. 6.)

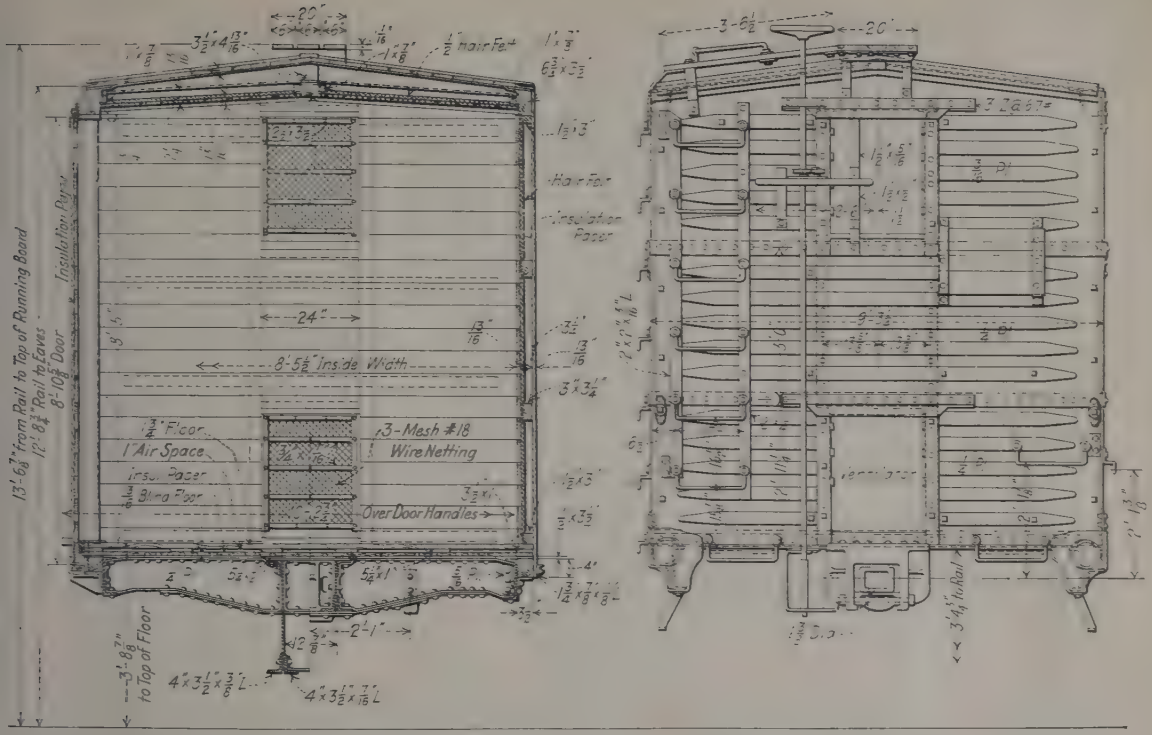


Fig. 8—Cross Section and End Elevation of 40-Ton Double Sheathed Ventilated Box Car Shown in Fig. 10.

Fig. 9—Steel Underframe 40-Ton Capacity Double Sheathed Box Car. Weight, 44,300 lbs.: Inside Length, 40 ft. ¾ in.; Inside Width, 8 ft. 7 in.

Standard Steel Car Company.

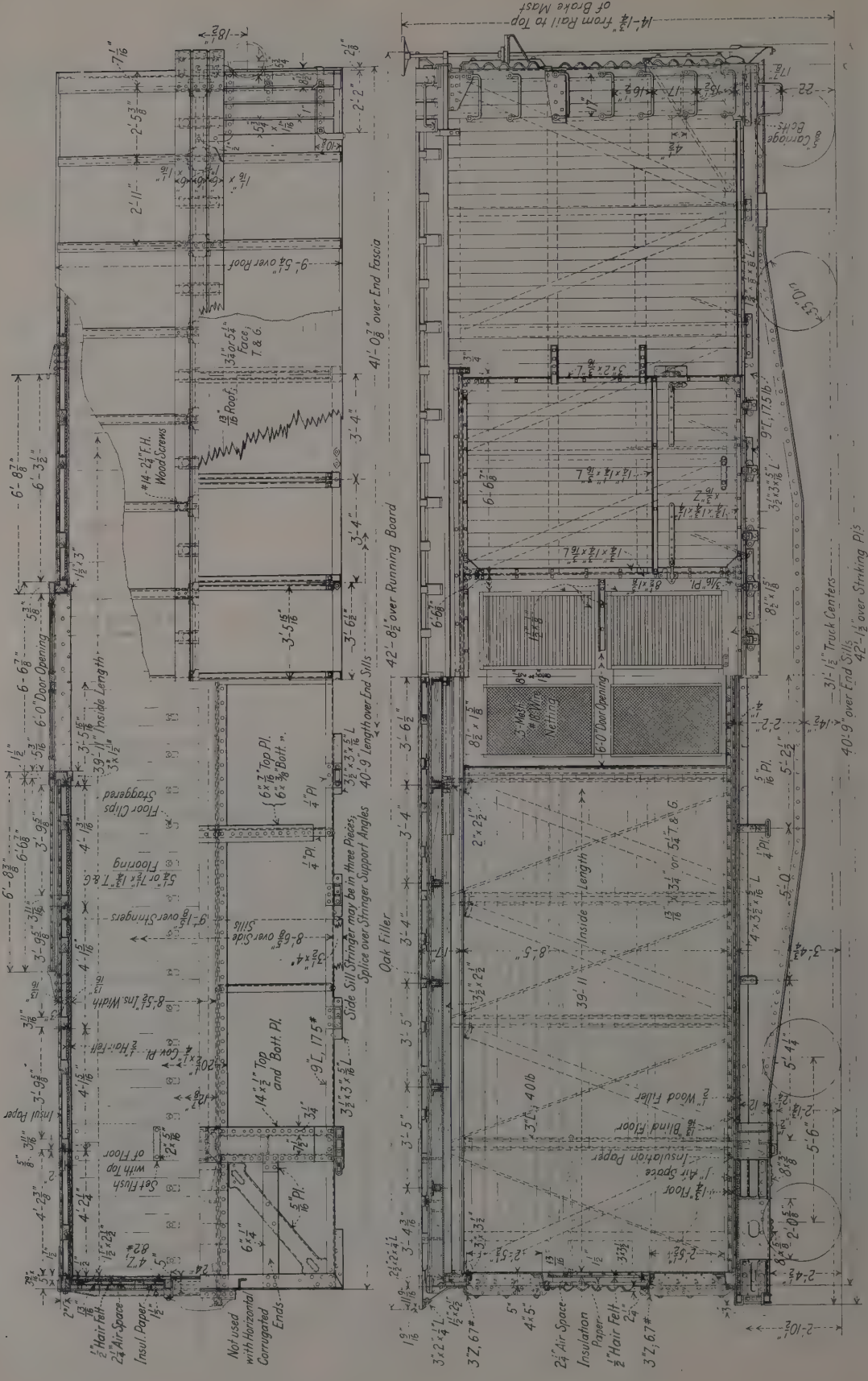


Fig. 10—Steel Underframe 40-Ton Double Sheathed Ventilated Box Car. Builder, Standard Steel Car Company.

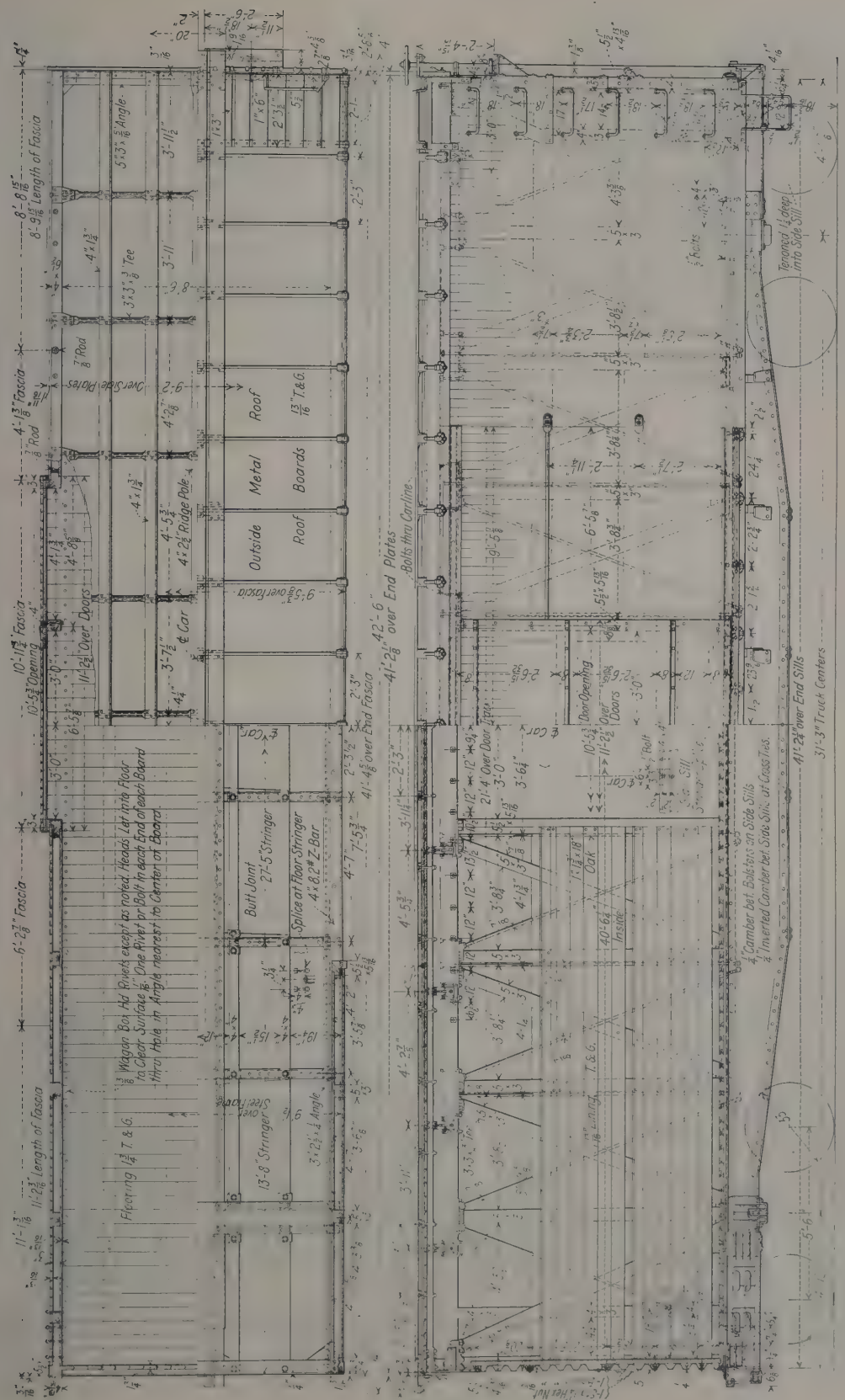

Outside Metal Roof Boards
Roof 13/16" T. & G.
Over Side Plates
Wagon Box Rd. Rivets except as noted. Heads Let into Floor to Clear Surface of 1" One Rivet or Bolt in each End of each Board thru Hole in Angle nearest to Center on Board
Butt Joint 27-5" Stringer
Splice at Floor Stringer 4"x8.2# Z-Bar
13'-8" Stringer
Flooring 13/16" T. & G.
Steel Lock over Floor
Bolts thru Centline
Door Opening
Tenoned 1½ deep into Side Sill
Truck Centers

Fig. 16—Steel Underframe 40-Ton Capacity Automobile Car. New York Central Lines.
(*See also Fig.* 14.)

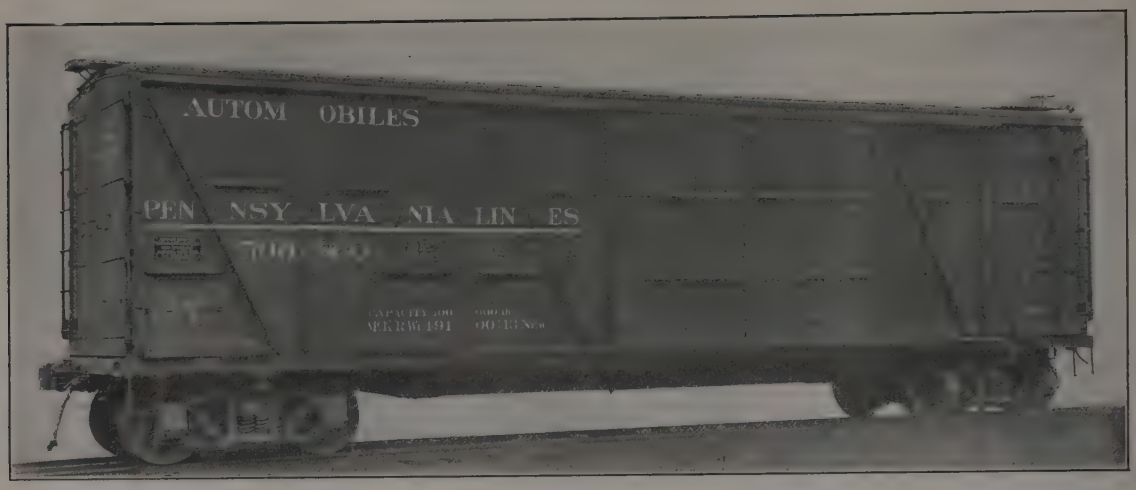


Fig. 17—Pressed Steel Frame 50-Ton Capacity Automobile Car. Weight, 49,100 lb. Inside Length, 40 ft. 5 in.; Inside Width, 8 ft. 10 in.; Inside Height, 9 ft. 1 in. Pennsylvania Railroad.

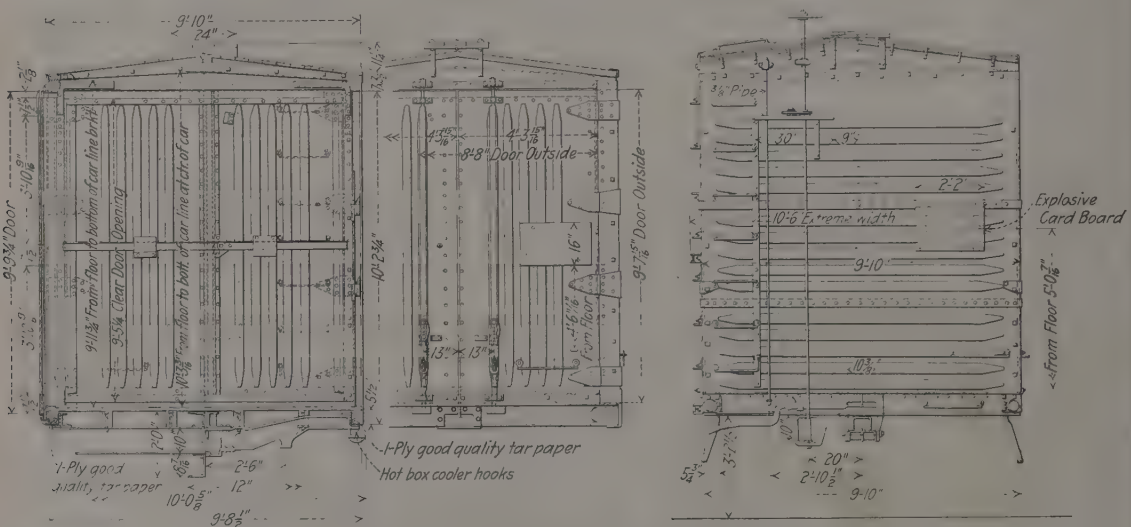


Fig. 18—End Elevations. Automobile Car Shown in Figs. 19 and 20.

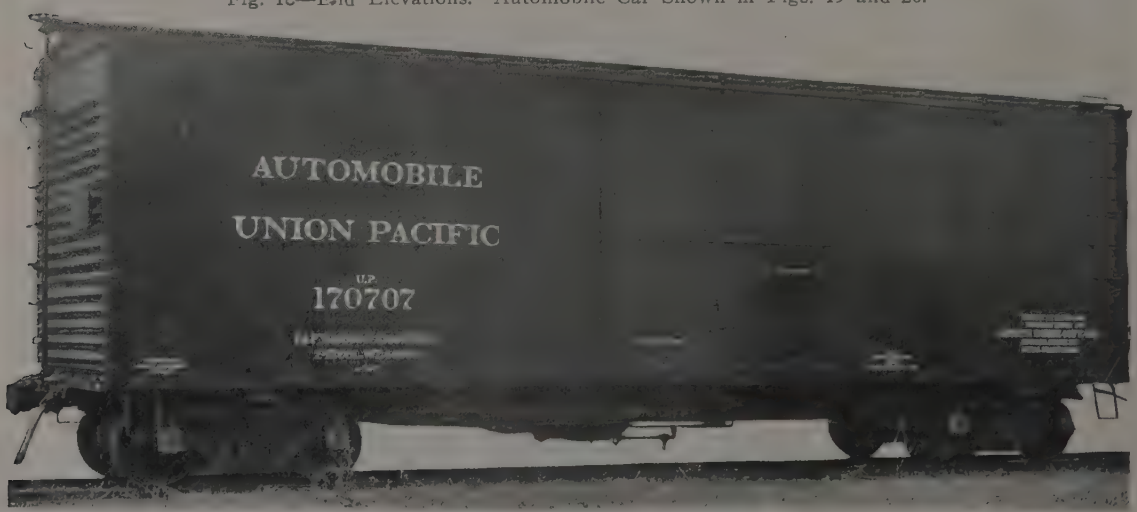


Fig. 19—Steel Frame 50-Ton Capacity Automobile Car. Weight 46,400 lb. Inside Length, 40 ft. 4 in. Builder, Ralston Steel Car Company.

(*See also Figs.* 18-20.)

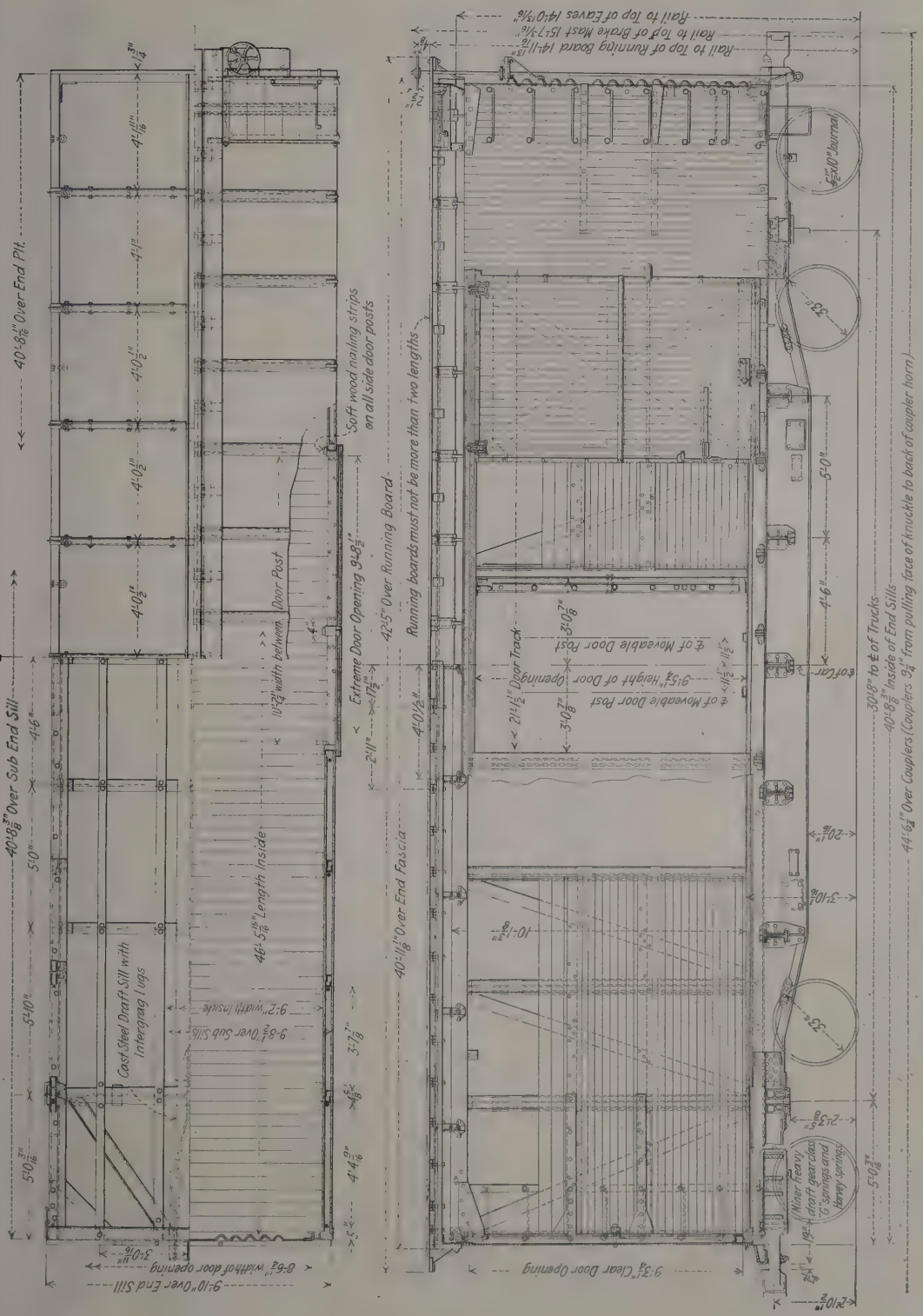

40'-8⅞" Over End Plt.
40'-8⅞" Over Sub End Sill
Soft wood nailing strips on all side door posts
Extreme Door Opening 9'-8½"
42'-5" Over Running Board
Running boards must not be more than two lengths
40'-1⅛" Over End Fascia
Rail to Top of Running Board 141'-11⅜"
Rail to Top of Brake Mast 151'-7⅛"
Rail to Top of Eaves 140'-1⅛"
Journal
Door Post
Door Track
℄ of Moveable Door Post
9'-5½" Height of Door Opening
℄ of Car
℄ of Trucks
30'-8"
40'-8¾" Inside of End Sills
44'-6½" Over Couplers (Couplers 3¼" from pulling face of knuckle to back of coupler horn)
46'-5⅛" Length Inside
Cast Steel Draft Sill with Intergrag Lugs
9'-2" Width Inside
9'-8½" Over Sub Sills
10'-2" width between
9'-10" Over End Sill
8'-6¾" width of door opening
9'-3¾" Clear Door Opening
Miner heavy draft gear class 'G' springs and Janney springs

Fig. 20—Steel Frame 50-Ton Capacity Automobile Car. Builder; The Ralston Steel Car Company.
(*See also Figs.* 18-19.)

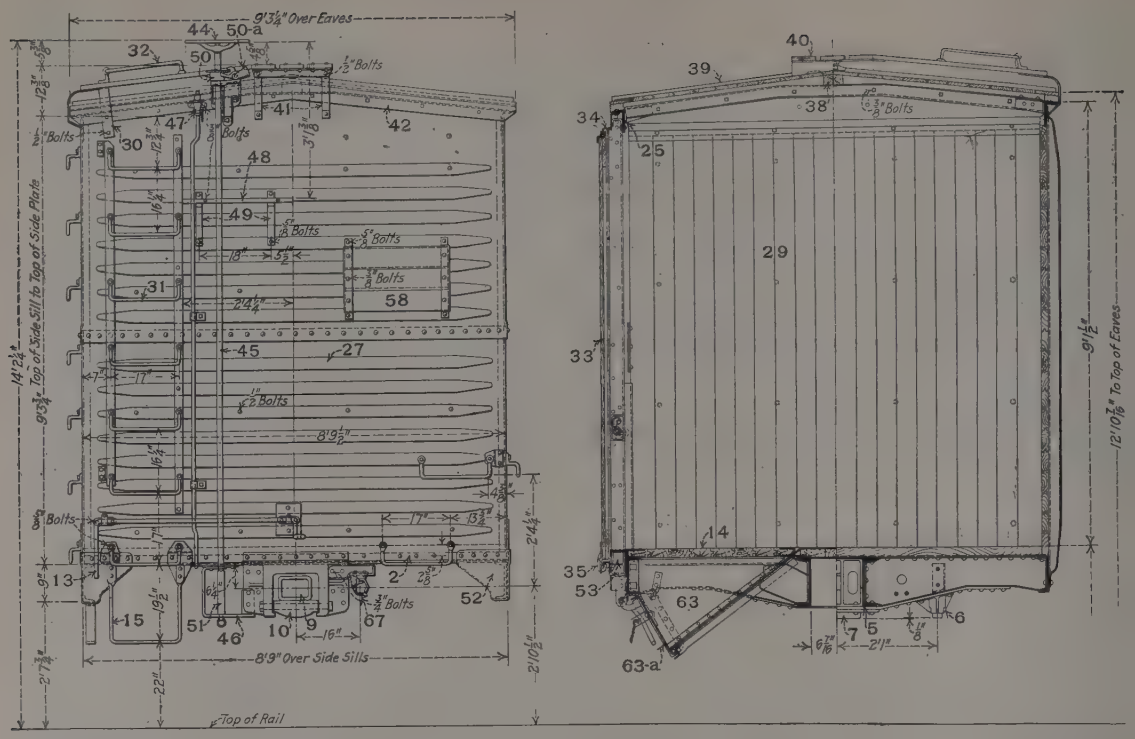


Fig. 21—End Elevation and Cross Section of 50-Ton Capacity Box Car Shown in Fig. 22. Builder, Canadian Car & Foundry Company, Limited.

Names of Box Car Parts Figs. 21-22.

1 *Side Sill*
2 *End Sill*
3 *Floor Stringers*
4 *Center Sill*
5 *Body Bolster*
6 *Body Side Bearing*
7 *Body Center Plate*
8 *Crosstie*
9 *Drawbar*
10 *Carry Iron*
11 *Draft Casting*
12 *Striking Plate*
13 *Uncoupling Rigging*
14 *Floor*
15 *Sill Step*
16 *Side Brace*
17 *Post Pocket*
18 *End Brace*
19 *Sill and Plate Tie Rod*
20 *Side Post*
21 *End Siding*
22 *Corner Angle Iron*
23 *Door Post*
24 *Grain Shoe*
25 *Side Plate*
26 *End Plate*
27 *Steel End*
28 *Sheathing or Siding*
29 *End Lining*
30 *Hand Hold Bracket*
31 *Ladder Round*
32 *Hand Hold*
33 *Side Door*
34 *Side Door Top Track or Guide*
35 *Side Door Bottom Guide*
36 *Carline*
37 *Purline*
38 *Ridge Pole*
39 *Roof*
40 *Running Board*
41 *Running Board Bracket*
42 *End Fascia*
43 *Side Fascia*
44 *Hand Brake Wheel*
45 *Hand Brake Shaft*
46 *Hand Brake Shaft Step*
47 *Air Retaining Valve*
48 *Hand Brake Step*
49 *Hand Brake Step Bracket*
50 *Hand Brake Ratchet*
50A *Hand Brake Ratchet Pawl*
51 *Hand Brake Chain Drum*
52 *Side Sill Angle Plate*
53 *Side Nailing Strip or Floor Stringer Bracket*
54 *Diagonal Brace*
55 *Draft Gear*
56 *Cross Tie Floor Beam or Stringer Support*
57 *End Belt Rail*
58 *Card Board*
59 *Side Door Stop*
60 *Side Door Hanger*
61 *Door Handle*
62 *Door Back Stop*
63 *Grain Hopper*
63A *Grain Hopper Door*
64 *Body Center Plate*
65 *Center Pin*
66 *Floating Lever Guide*
67 *Air Pipe Bracket*

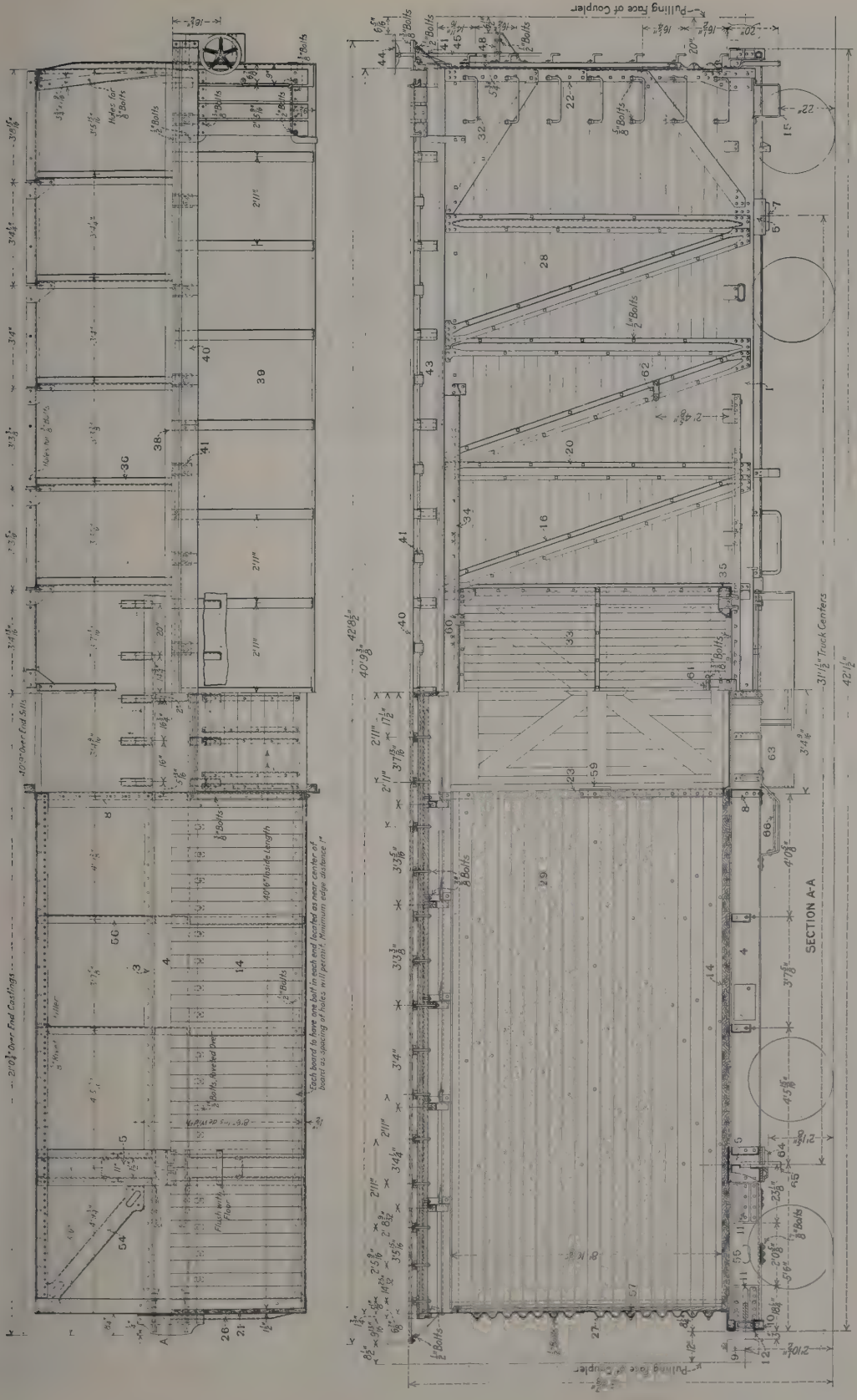

SECTION A-A
Pulling face of Coupler
Pulling face of Coupler
Each board to have one bolt in each end located as near center of board as spacing of holes will permit. Minimum edge distance 1"
40'0" Inside Length
40'10" Over End Sills
Over End Castings
Flush with Floor
Holes for 1/8" Bolts
Holes Riveted Over
31'1½" Truck Centers
42'½"
40'9⅜"
42'6½"

Fig. 22—Plan and Elevation of 50-Ton Capacity Box Car Equipped with Grain Hopper; for use in Grain or Merchandise Service.
Builder, Canadian Car & Foundry Company, Limited.
(*See also Fig.* 21.)

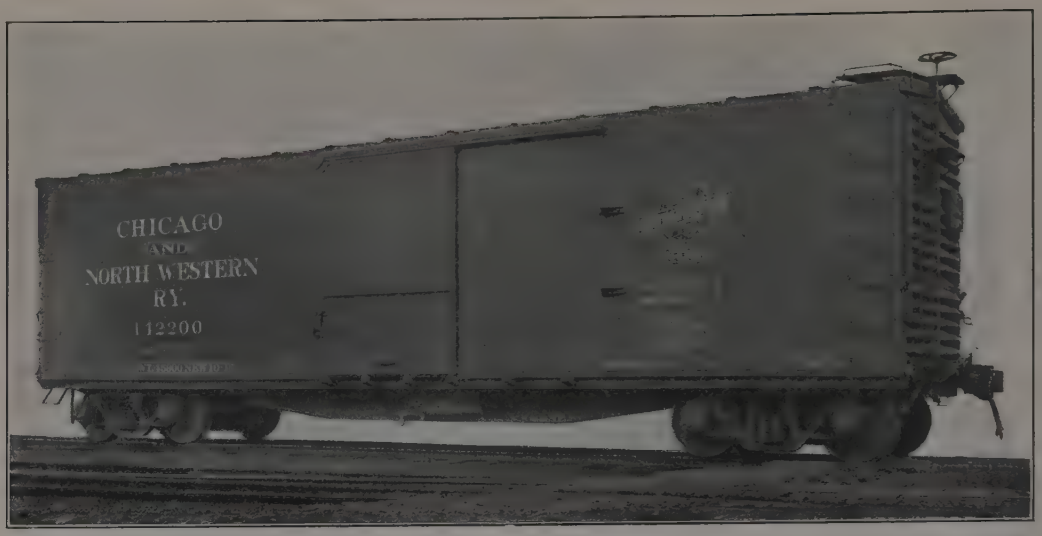


Fig. 23—U. S. R. A. Standard Steel-Frame Double Sheathed 40-Ton Box Car. Assigned to the Chicago and North Western. Builder, American Car & Foundry Company.
(*See also Figs.* 24-25.)

PRINCIPAL DIMENSIONS OF U. S. R. A. STANDARD DOUBLE SHEATHED BOX CAR SHOWN IN FIG. 23

Length, Inside	40 ft. 6 in.	Height from Rail to top of Car at Eaves	12 ft. 10⅞ in.
Width, Inside	8 ft. 6 in.	Height from Rail to top of Brake Mask	14 ft. 1¾ in.
Height, Inside	9 ft.	Height from Rail to top of Running Board	13 ft. 6⅞ in.
Length, Over Striking Plates	42 ft. 1½ in.	Distance Center to Center of Trucks	31 ft. 1½ in.
Width Over Eaves	9 ft. 4 in.	Height from Rail to Center of Coupler	2 ft. 10½ in.
Width Over All	10 ft. 2½ in.	Height from Rail to Bottom of Center Sill	2 ft. 4½ in.

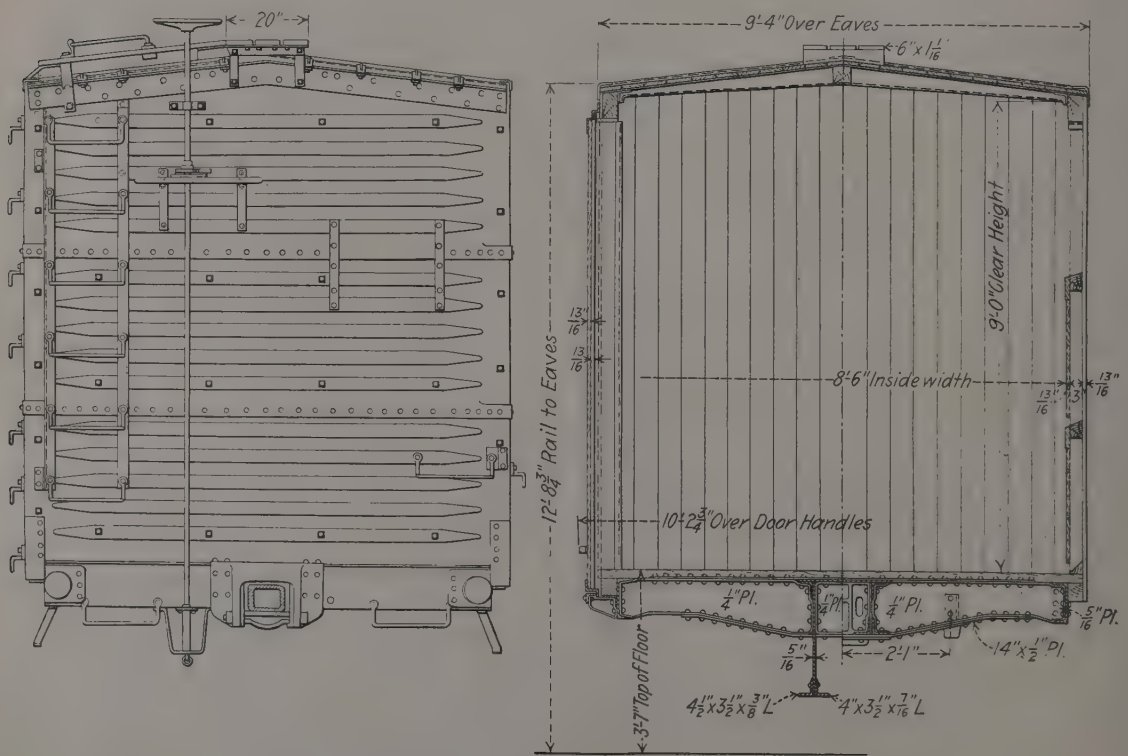


Fig. 24—Cross-Section and End of Double Sheathed 40-Ton Box Car Shown in Figs. 23 and 25.

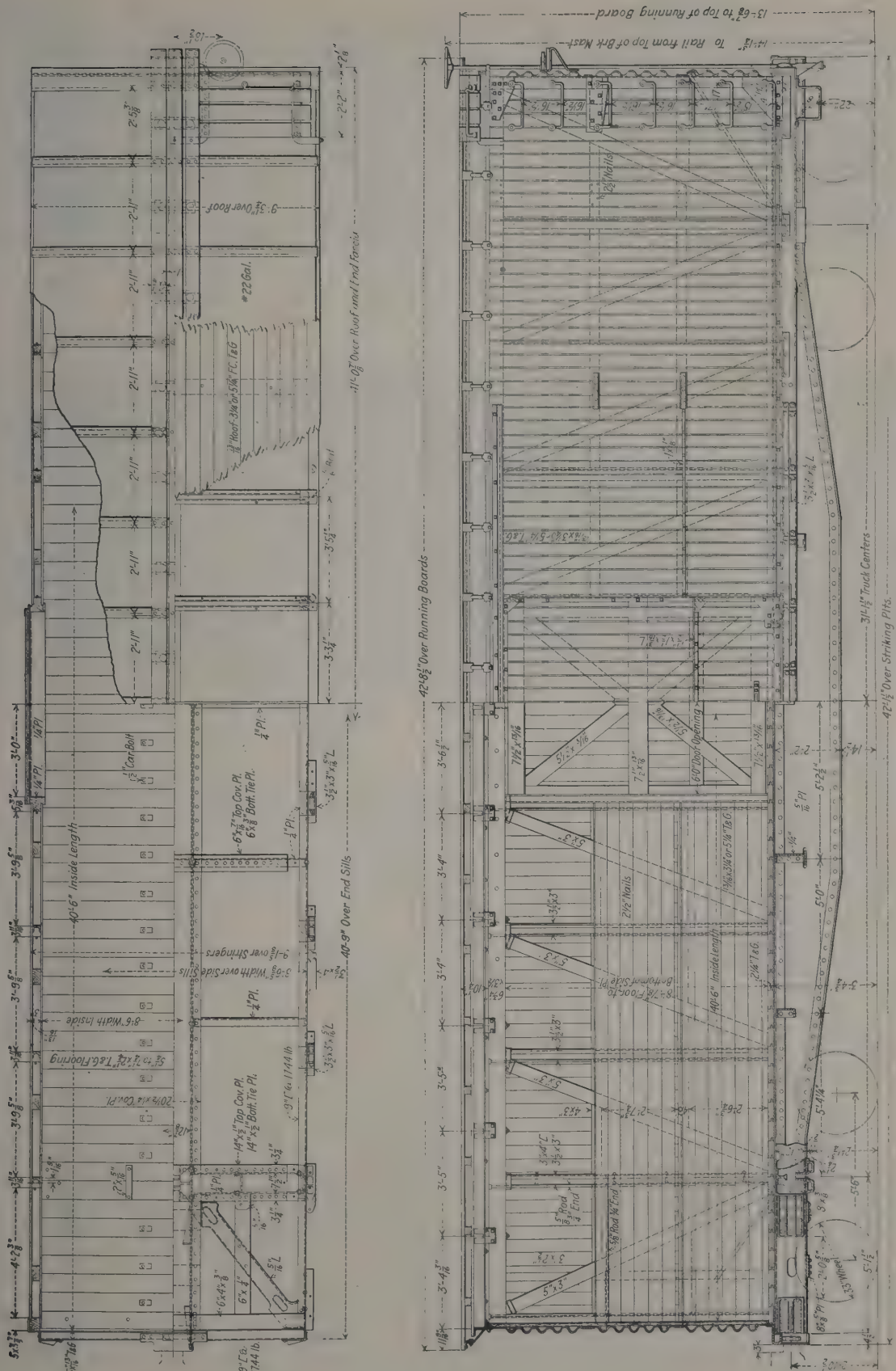


Fig. 25—U. S. R. A. Standard Steel Frame 40-Ton Double Sheathed Box Car.
(See also Figs. 23-24.)

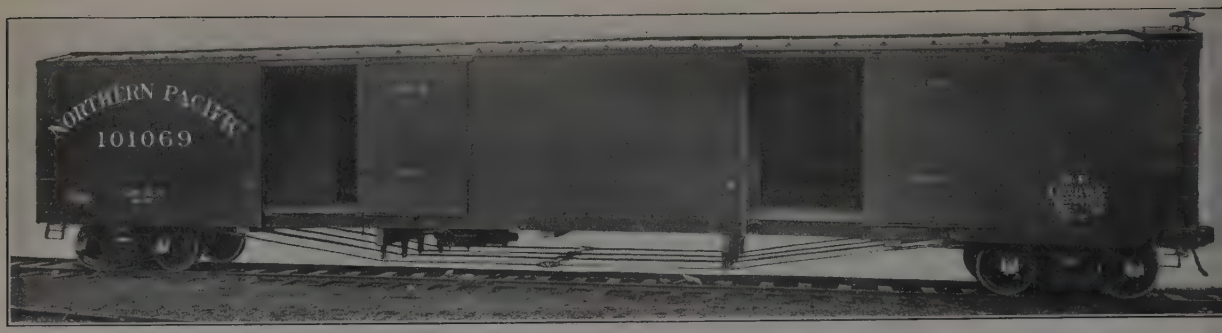


Fig. 26—Long Wooden 40-Ton, 4,036 cu. ft., Capacity Box Car for Collecting L. C. L. Freight from Team Tracks. Inside Length, 59 ft. 4⅞ in.; Light Weight, 43,500 lb. Builder, Northern Pacific Railway.

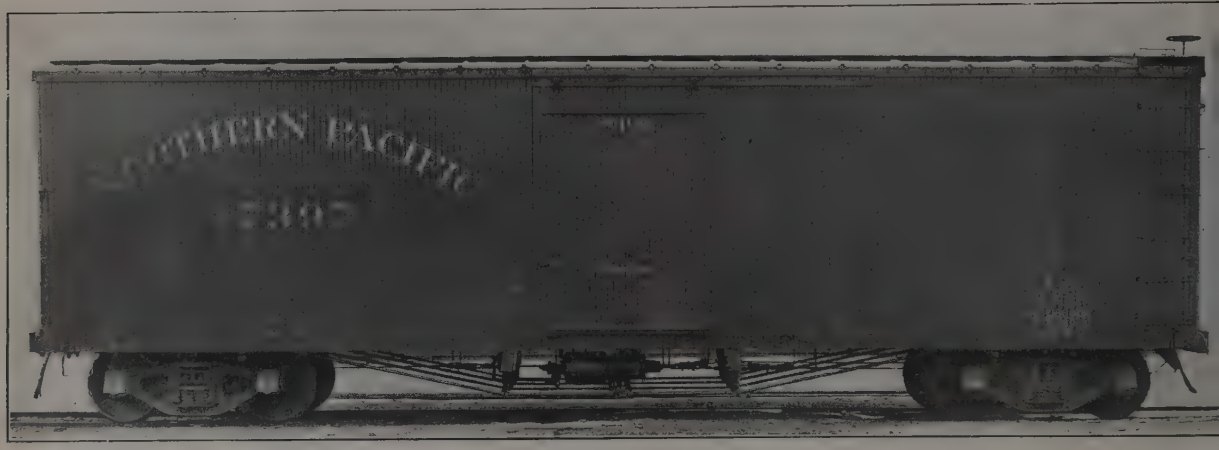


Fig. 27.—Wooden 40-Ton Capacity Box Car with Steel Center Sills and End Posts. Builder, Northern Pacific Railway.

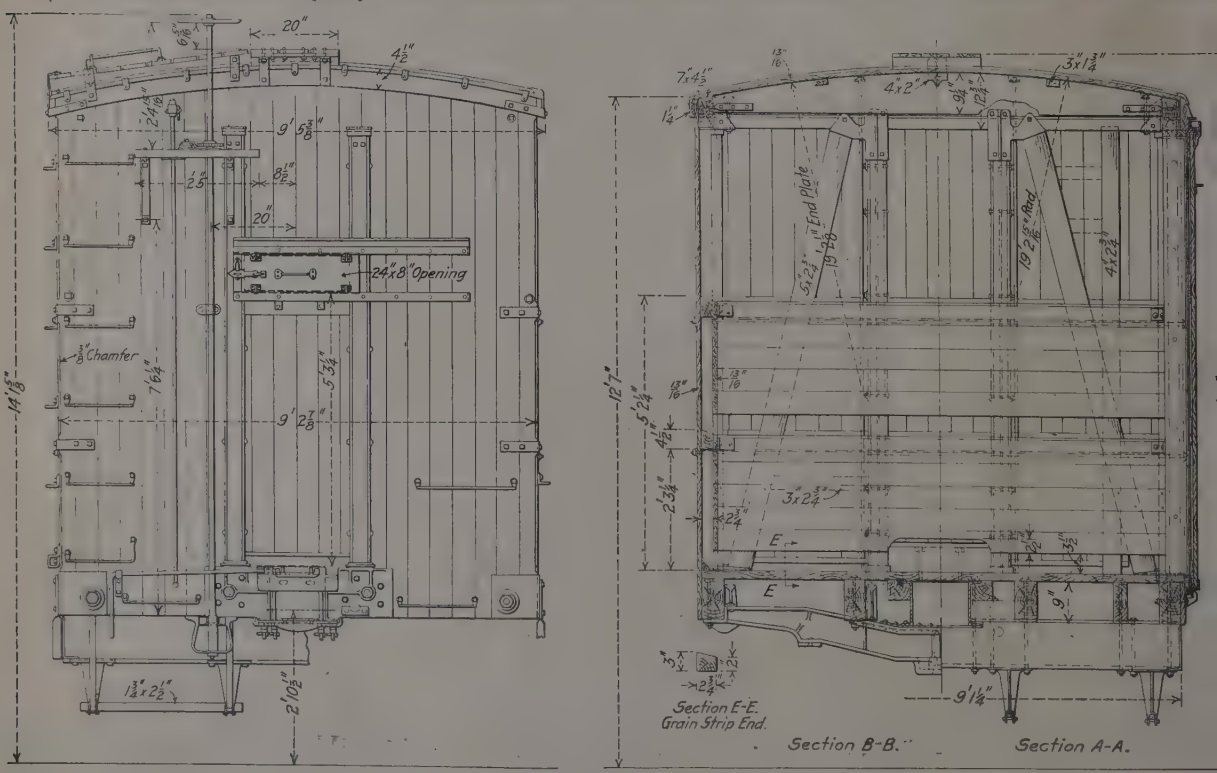


Fig. 28—End Elevation and Cross Sections of Northern Pacific Box Car Shown in Figs. 27 and 29.

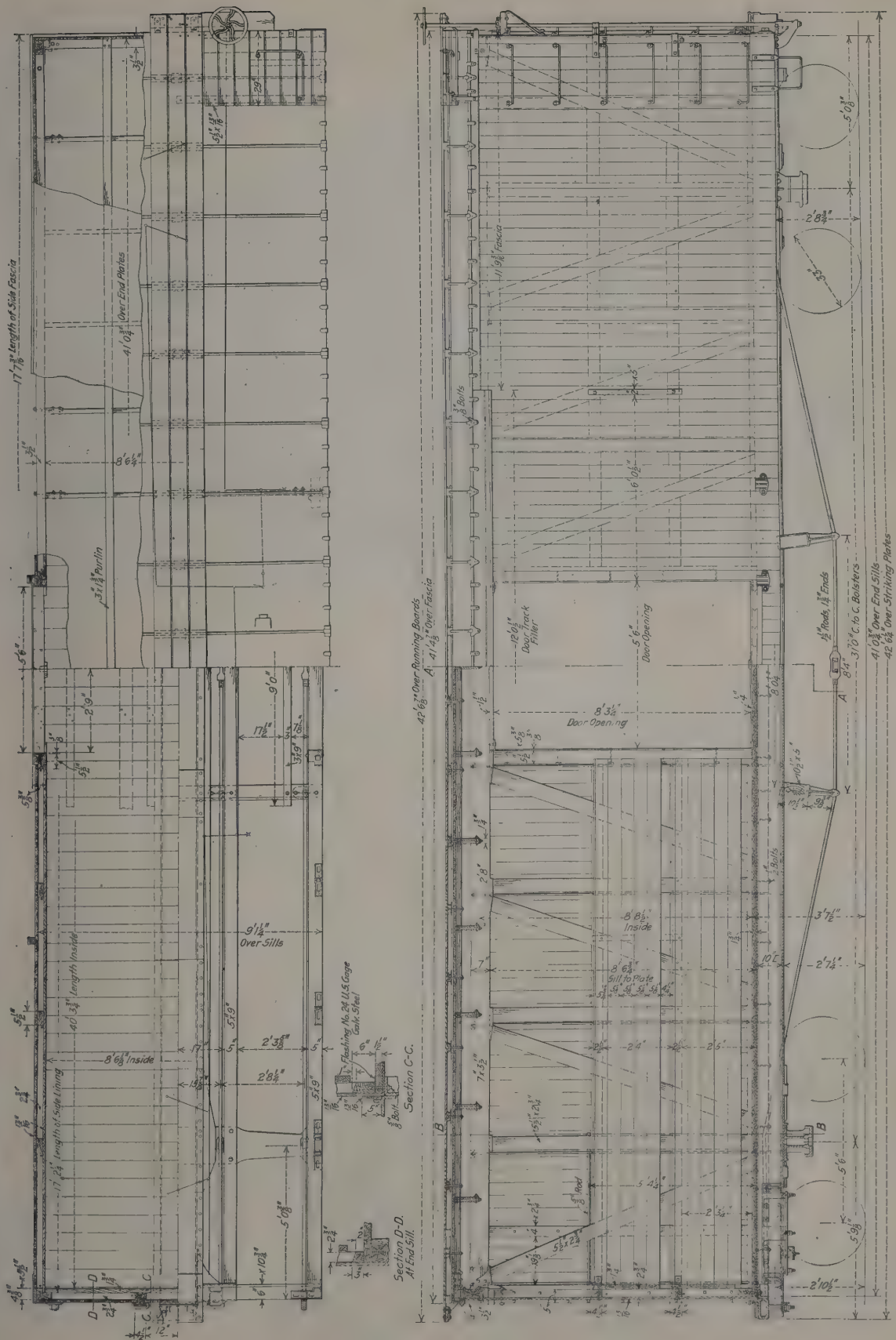


Fig. 29—Side Elevation and Plan of Northern Pacific Box Car Shown in Figs. 27-28.

Fig. 30—Steel Frame Grain Car Showing Hopper Door in Closed Position. Weight, 48,000 lb.; Inside Length, 40 ft. 6 in.; Inside Width, 8 ft. 6 in. Inside Height, 9 ft. Builder, The National Steel Car Corporation.

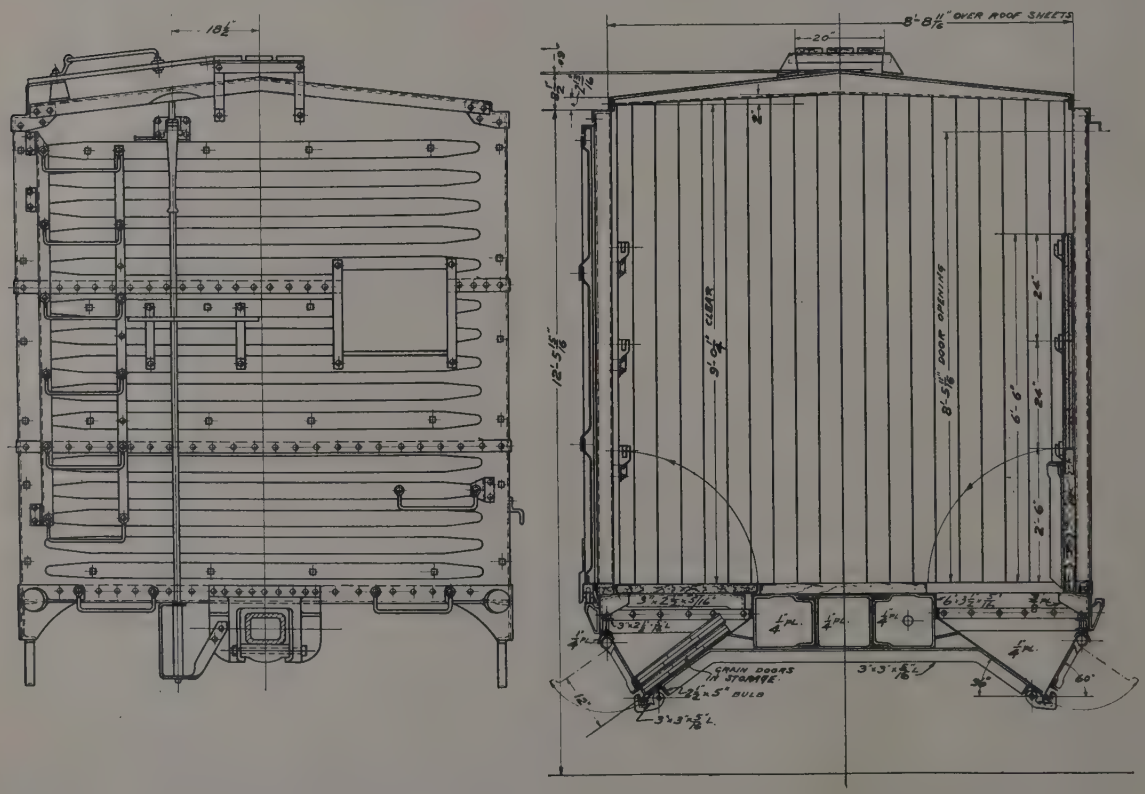


Fig. 31—End Elevation and Cross Section of All-Steel 50-Ton Capacity Grain and Merchandise Car Shown in Figs. 32-34.

Enterprise Grain and Merchandise Car

A satisfactory convertible grain or merchandise car has long been a subject of discussion and many efforts have been made to build a car that will be entirely practical for the combined services.

The Enterprise Railway Equipment Company's design shown in Fig. 32 meets the conditions of a general merchandise car and provides by the addition of a few extra parts a car conveniently convertible for the grain service.

At each side of the car adjacent the side doors there are two movable floor sections hinged at the outer sides of the car. These floor sections, when raised to their vertical position, form the bottom grain doors and are held in place by small turn-bolts. The doors, being about four feet high, provide the car at all times with better than sixty percent of the grain doors required. The remaining, or upper grain doors may be standard grain doors, either attached by hinges to the bottom doors or unattached as desired. In either event, provision is made below the car floor for their storage. Horizontal sub-floors made of steel plates extend in width from the side to the center sill of the car and in length from diaphragm to diaphragm, a distance slightly greater than the side door opening of the car. These steel sub-floors add greatly to the strength of the car body and the slight increased cost would therefore be fully compensated.

In each sub-floor there is an outlet valve, the opening of which is usually about nine inches square. It is provided with a small door which when closed is made to be perfectly seal-tight. This door is supported by a small latch held in place by a dog and provision is made in the door and latch for the application of a car seal.

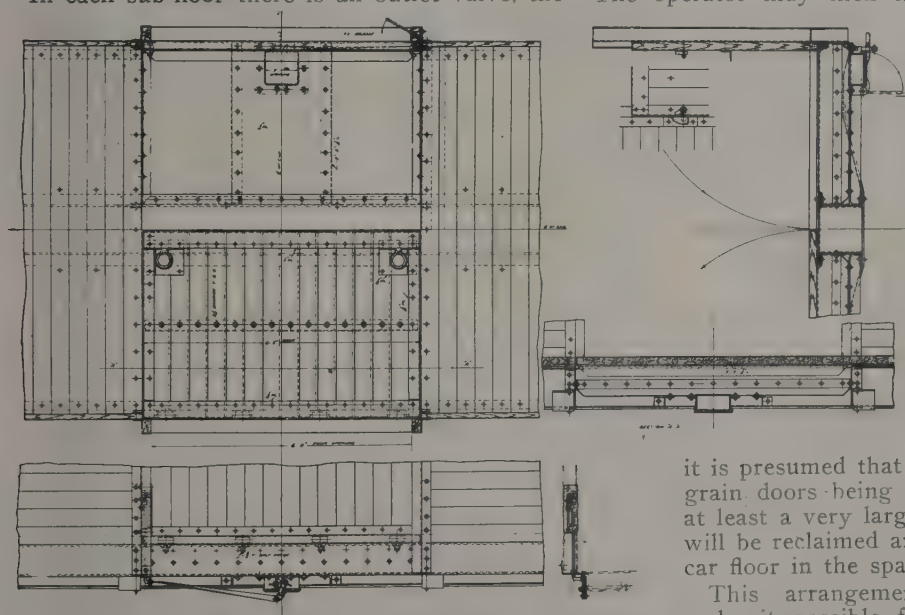


Fig. 32—Grain Door Arrangement for Convertible Grain or Merchandise Car

To provide further security, particularly against pilfering the car, there is attached to the door latch a longitudinal rod connected to and cooperating with a vertical rod in the side post of the car door to which is attached at the top a suitable drop handle.

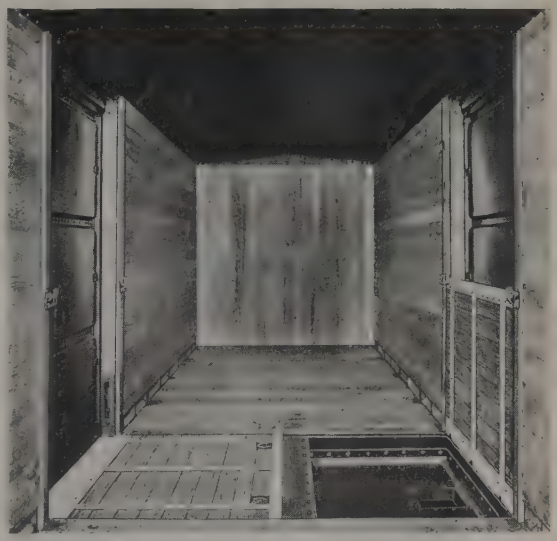


Fig. 33—Interior View of Grain Car

To unload a car of grain the side door of the car is opened, the car seal on the grain discharge door at the bottom broken and the small dog removed out of engagement with the door latch. The operator may then take the drop handle located in the side post of the car, elevate it to a horizontal position and by an inward movement release the grain outlet door at the bottom. The car will be relieved of sufficient grain so that the operator may gain entrance by removing the top grain doors. This is conveniently accomplished without destroying any of these members and it is presumed that in the event of loose grain doors being used at the top that at least a very large percentage of them will be reclaimed and stored beneath the car floor in the space provided.

This arrangement should therefore make it possible for the railroad companies to eliminate nearly all of the expense which they now have to bear in coopering cars for the grain service and the heavy loss of the grain doors used.

Fig. 33 shows an interior view of such a car including all of the parts above described excepting the upper grain doors; the storage space for them, however, is shown in the illustration.

For other products and branch offices, see classified and alphabetical indexes.

ENTERPRISE RAILWAY EQUIPMENT CO., CHICAGO, ILL.

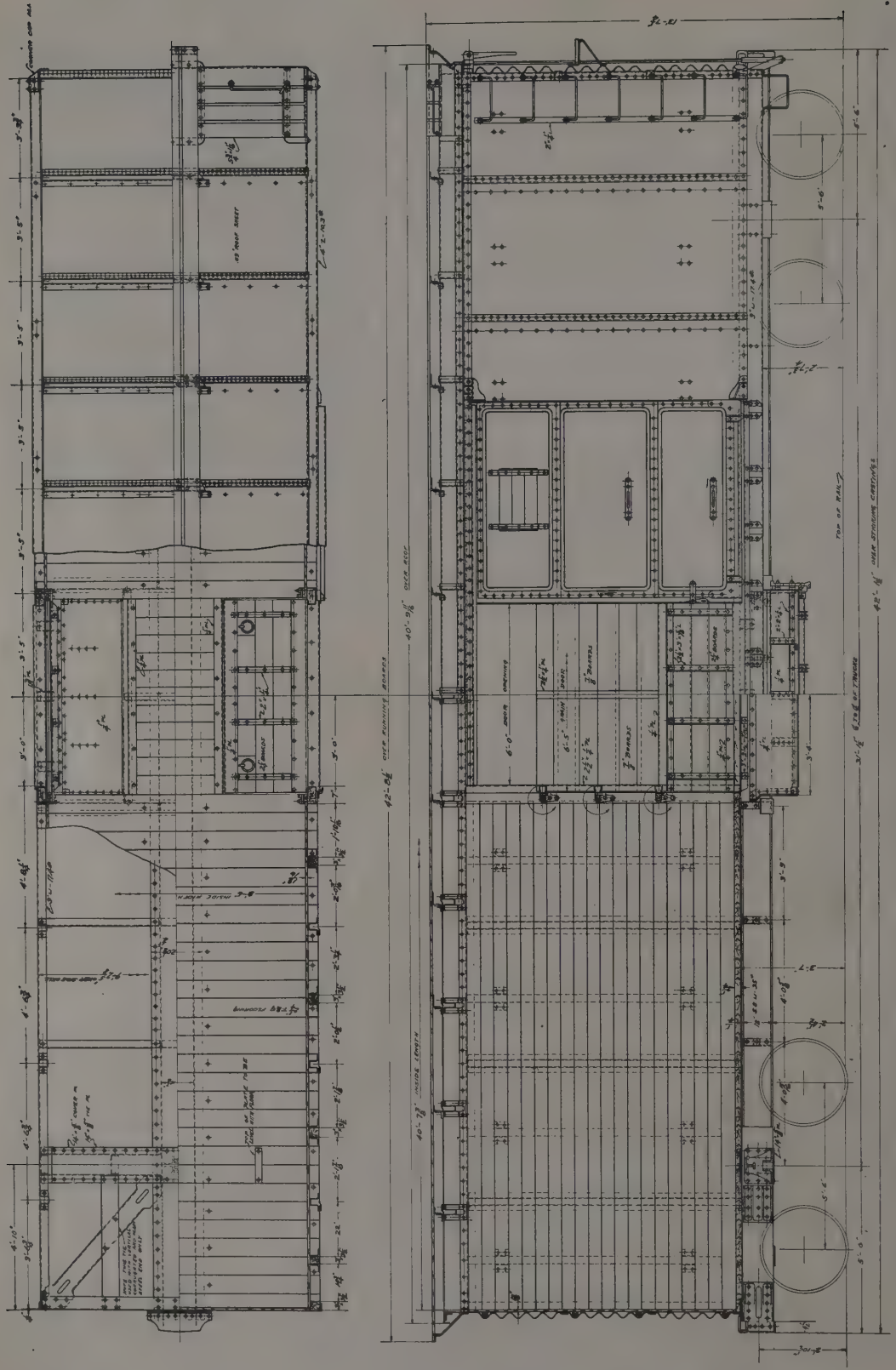


Fig. 34—All-Steel 50-Ton Capacity Grain and Merchandise Car. U. S. R. A. Design. "Enterprise" Grain Doors and Hopper Discharge. Designer, Enterprise Railway Equipment Company.
(*See also Fig. 31 and Page 121.*)

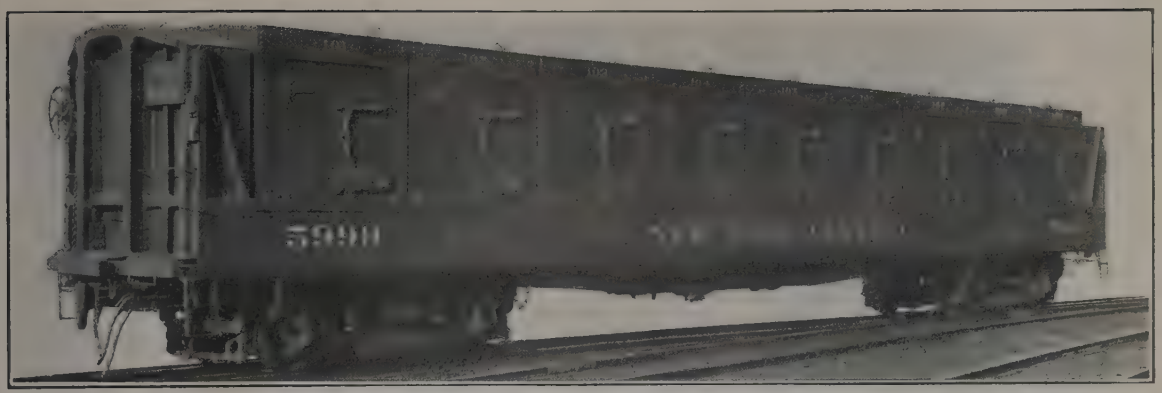


Fig. 35—New York Central Container Car Designed for Handling Express Matter, Equipped with Passenger Trucks and Buffers and with Air, Steam and Signal Line for Passenger Train Operation. Builder, The Merchants Despatch Transportation Company.

Fig. 36—New York Central Car Loaded with Two Small and Two Large Containers for Freight Service. Builder, The Merchants Despatch Transportation Company.

Fig. 37—Trinity Freight Units, Bulk Freight Type, in Position Locked on Standard Unit System Flat Car. River and Rail Transportation Company.

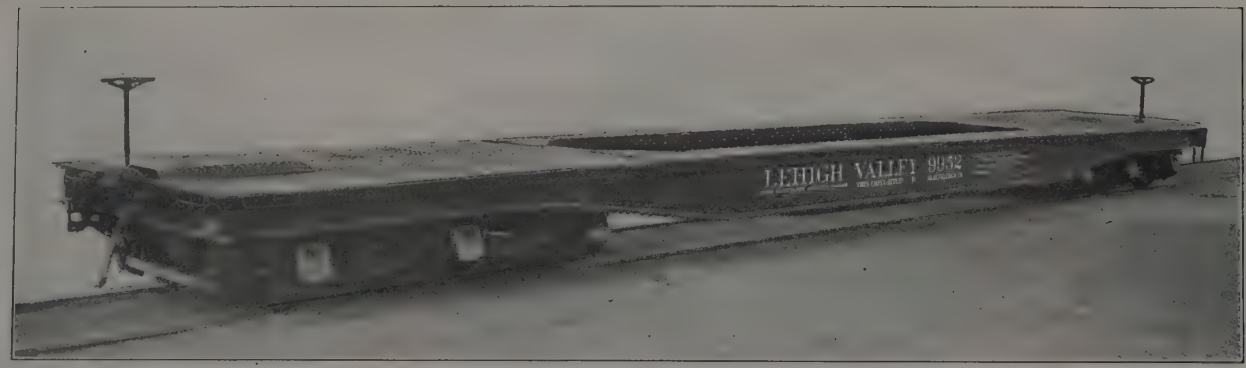


Fig. 38—All-Steel 110-Ton Capaciy Flat Well-Hole Car. Weight, 91,900 lb.; Length of Platform, 55 ft. 7 in.; Width of Platform, 9 ft. 10 in.; Height, Rail to Top of Platform, 3 ft. 2 in.; Well Opening, 26 ft. 2 in. by 6 ft. 1 in. Builder, Lehigh Valley Railroad.

(See also Fig. 39.)

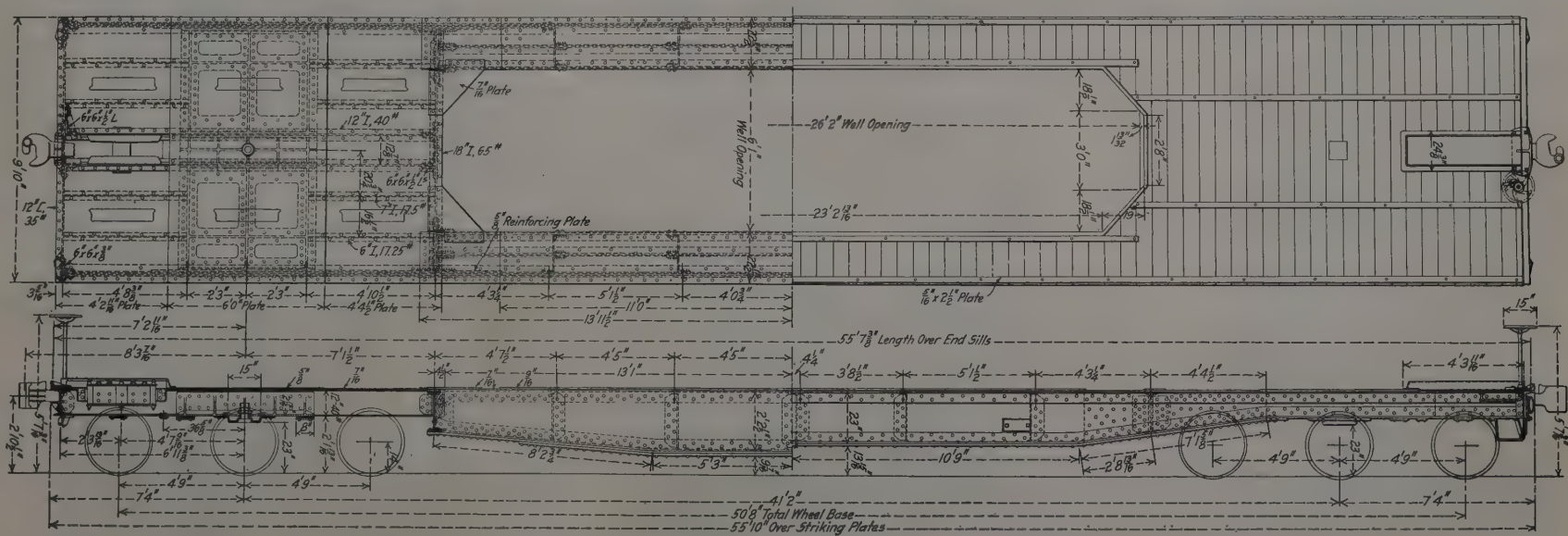


Fig. 39—Lehigh Valley Steel Frame 110-Ton Capacity Well-Hole Car Shown in Fig. 38.

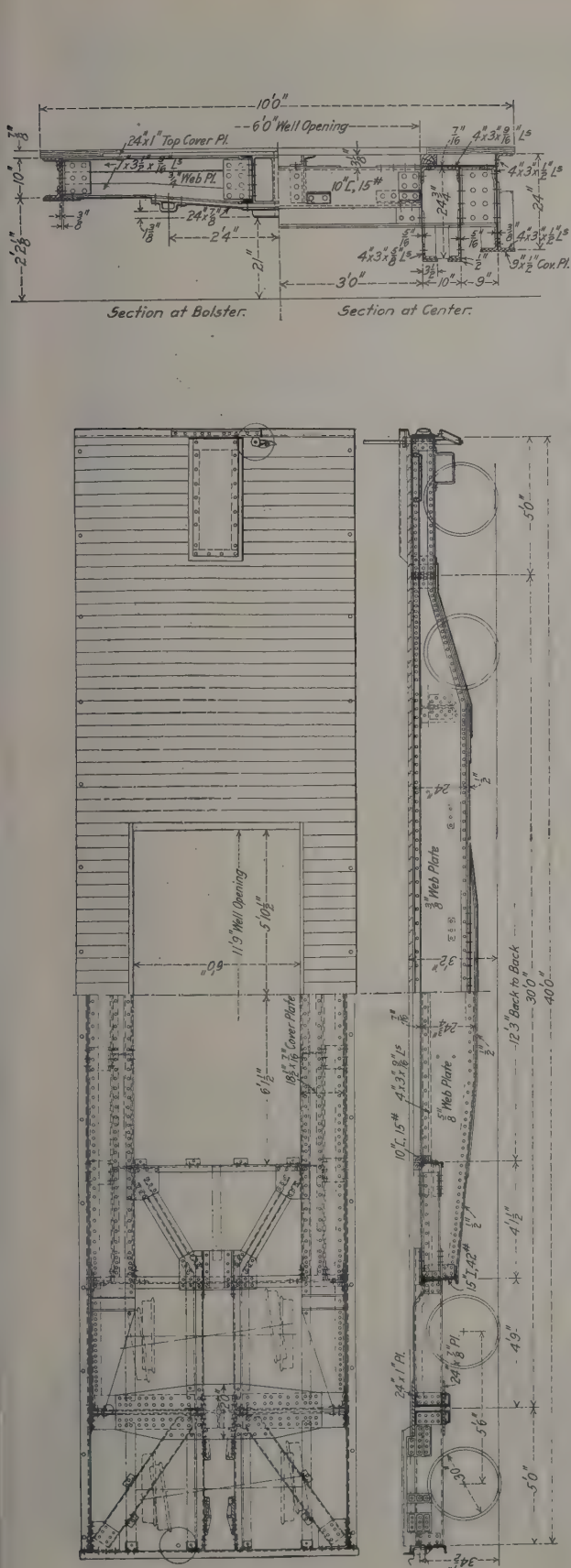


Fig. 40.—Erie Railroad Steel Frame 75-Ton Capacity Well-Hole Car. Builder: American Car & Foundry Company.

Fig. 41—Pittsburgh & Lake Erie Steel Frame 100-Ton Capacity Flat Car.

Flat Car Parts.

1 *Center Sill*
2 *Side Sill*
3 *Floor Stringer*
4 *Body Bolster*
5 *Center Plate*
6 *Cross Bearer*
7 *Stringer Support or Floor Beam*
8 *End Sill*
9 *Push Pole Pocket*
10 *Side Stake Pocket*
11 *Dead Wood or Buffer Block*
12 *Floor*
13 *Center Sill Cover Plate*
14 *Floor Nailing Strip*

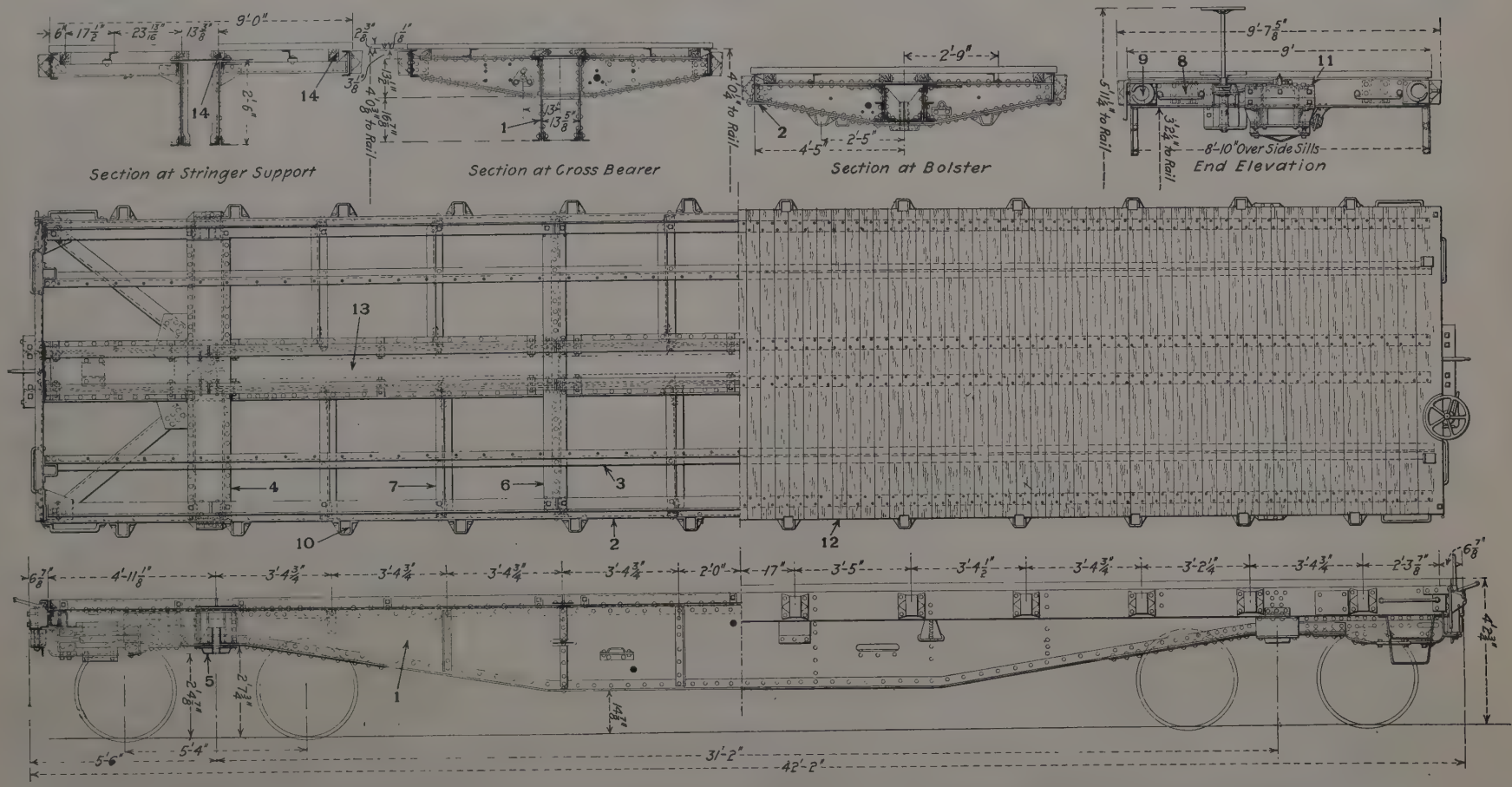


Fig. 42—Canadian Pacific Steel Frame 40-Ton Capacity Flat Car Shown in Fig. 43. Builder; Canadian Car & Foundry Company.

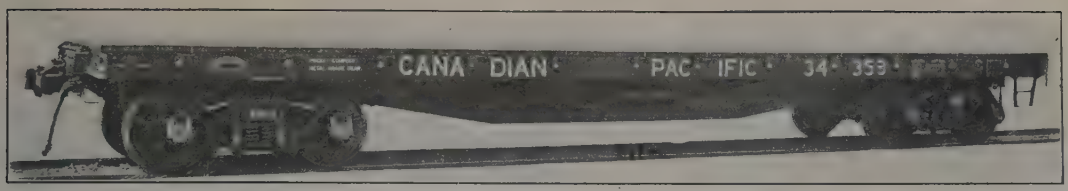


Fig. 43—Steel Frame 40-Ton Capacity Flat Car. Weight, 33,100 lb.; Length of Platform, 41 ft. 6 in.; Width of Platform, 9 ft. Builder, Canadian Car & Foundry Company.
(*See also Fig.* 42.)

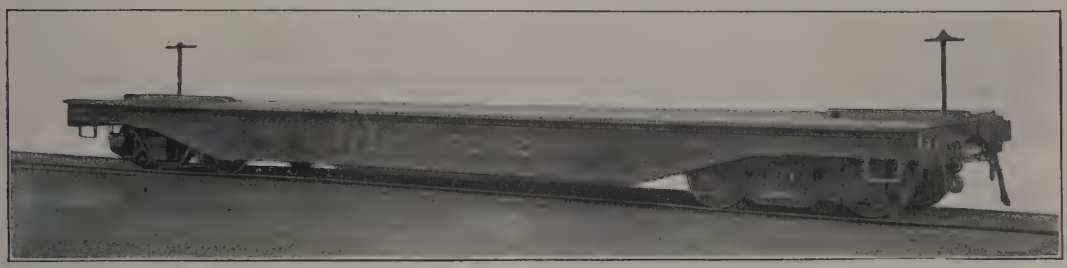


Fig. 44—Steel Underframe 50-Ton Capacity Flat Car. Weight, 33,800 lb.; Length, 36 ft.; Width, 8 ft. 11 in. Builder, American Car & Foundry Company.

Fig. 45—Steel Frame 50-Ton Capacity Flat Car. Weight, 39,500 lb.; Length of Platform, 40 ft.; Height. Rail to Top of Platform, 4 ft. Builder, Pressed Steel Car Company.

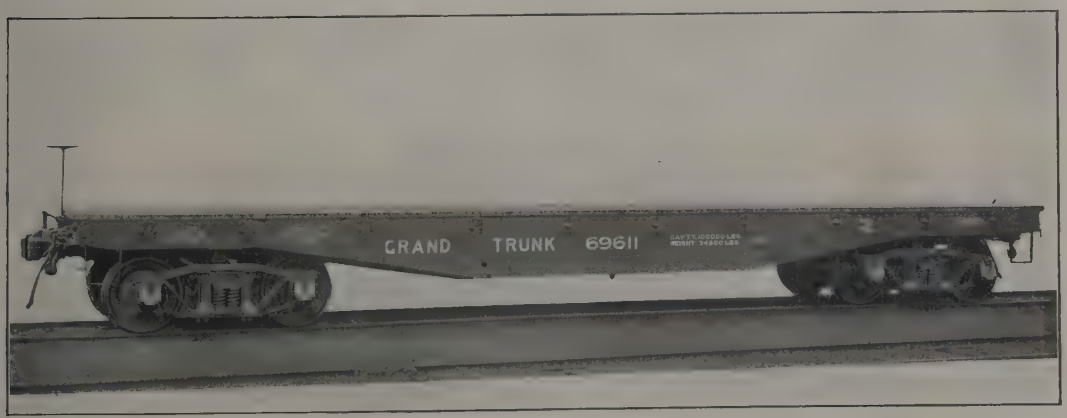


Fig. 46—Steel Frame 50-Ton Capacity Flat Car. Weight, 34,600 lb.; Length of Platform, 40 ft. 6 in.; Width of Platform, 9 ft. Builder, Western Steel Car & Foundry Company.

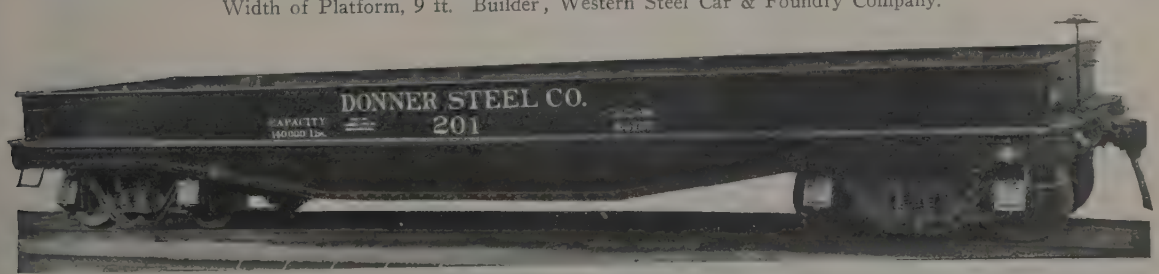


Fig. 47—All-Steel, 70-Ton Rail Floor Car for Hot Metal Service, with Low Sides. Weight, 54,000 lb. Builder, Cambria Steel Company.

Fig. 48—All-Steel 70-Ton Rail Floor Flat Car for Hot Metal Service. Weight, 46,400 lb.
Builder; Cambria Steel Company

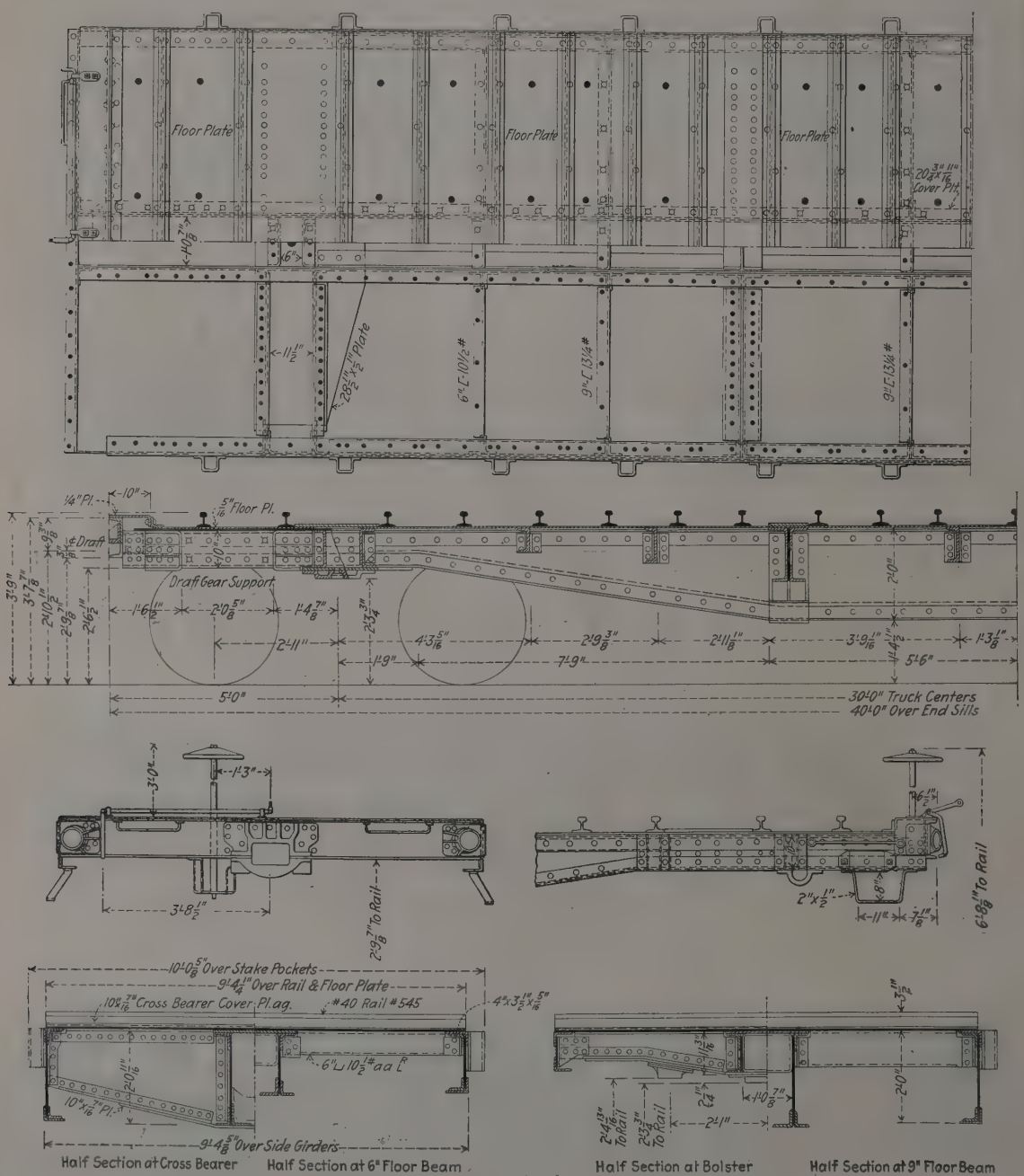


Fig. 49—Plan, Elevations, and Sections of All-Steel 70-Ton Rail Floor Flat Car Shown in Fig. 48.
Builder; Cambria Steel Company.

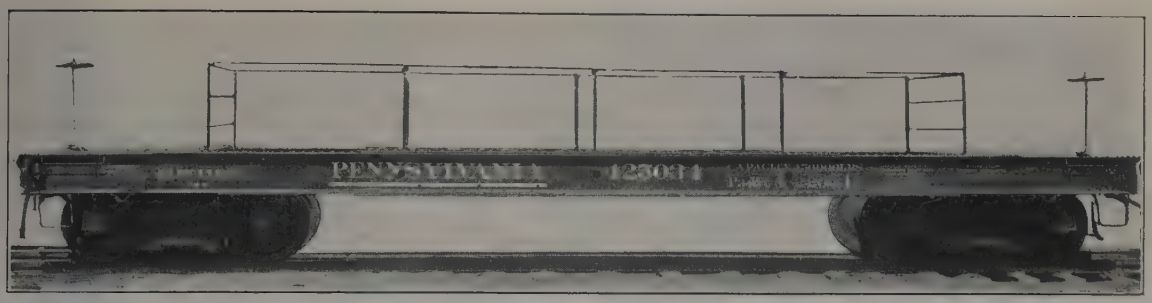


Fig. 50—All-Steel 75-Ton Capacity Well-Hole Car. Length, 38 ft.; Width, 10 ft. Pennsylvania Railroad.

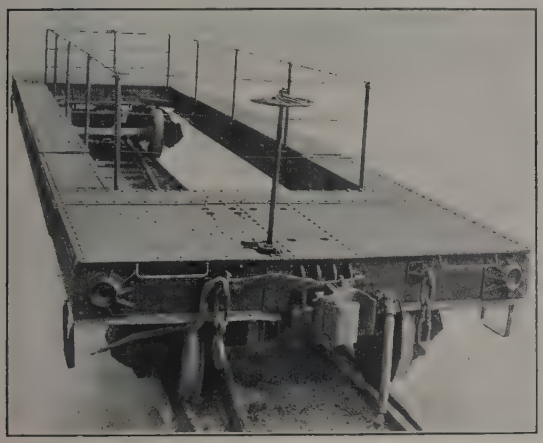


Fig. 51—Plan View of Well-Hole Car in Fig. 50.

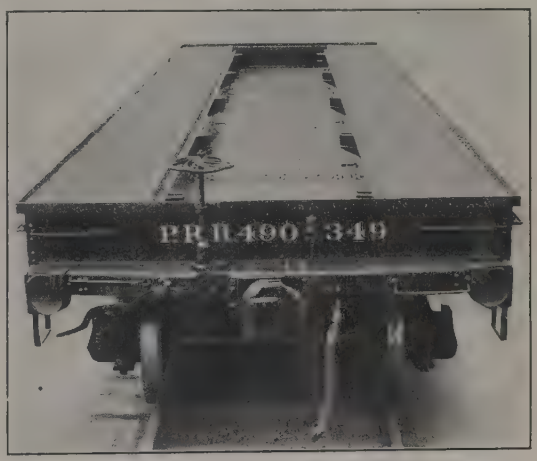


Fig. 52—End View of Car Shown in Fig 53.

Fig. 53—All-Steel 40-Ton Capacity Truck Car with Pockets in Side for Wreck Equipment. Weight 38,800 lb.; Length, 40 ft. 0 in.; Width, 10 ft. 0 in. Pennsylvania Railroad.

Fig. 54—Steel Underframe 50-Ton Capacity Flat Car. Weight, 33,800 lb.; Length, 36 ft.; Width, 8 ft. 11 in. Builder, American Car & Foundry Company.

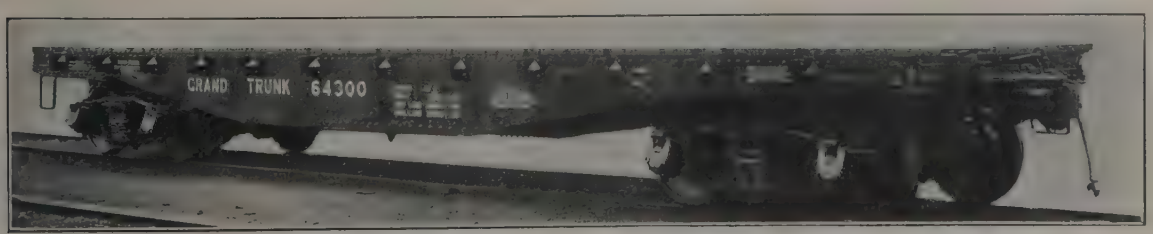


Fig. 55—Steel Underframe 50-Ton Capacity Flat Cars. Weight, 36,700 lb.; Length, 41 ft. 1¾ in.; Width, 8 ft. 10 in. Builder, National Steel Car Corporation, Limited.

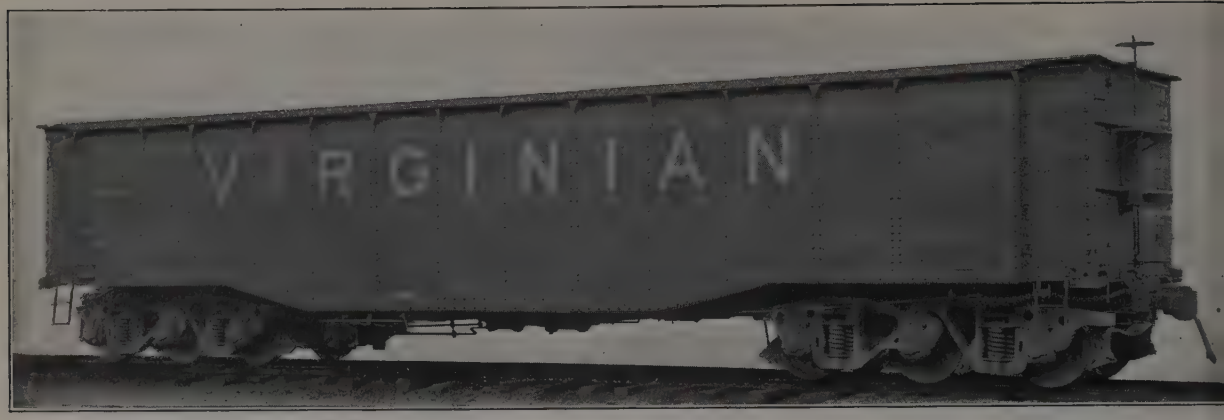


Fig. 56— All-Steel 120-Ton Capacity Flat Bottom Gondola Car. Builder, Pressed Steel Car Company.

(*See also Figs.* 57-59.)

PRINCIPAL DIMENSIONS AND WEIGHTS OF VIRGINIAN 120-TON GONDOLA COAL CARS, CLASSES G-3 AND G-4

Length over striking plates	50 ft. 8¾ in.
Truck centers	36 ft. 10¾ in.
Truck wheel base	8 ft. 8 in.
Height from rail to top of car side	11 ft. 0 in.
Inside length	49 ft. 6 in.
Inside width	10 ft. 2¾ in.
Outside width	10 ft. 3¼ in.
Cubical capacity—level full	3,850 cu. ft.
Cubical capacity—30 deg. heap	600 cu. ft.
Cubical capacity—including heap	4,450 cu. ft.
Weight of car body	{ G-3 Cars—41,600 lb. { G-4 Cars—43,200 lb.
Weight of two trucks	{ G-3 Cars—37,200 lb. { G-4 Cars—35,700 lb.
Weight of empty car	{ G-3 Cars—78,800 lb. { G-4 Cars—78,900 lb.
Total weight, loaded with 200,000 lb	{ G-3 Cars—278,800 lb. { G-4 Cars—279,900 lb.
Revenue load	240,000 lb.
Per cent revenue load of total weight	Approx. 75.3 per cent

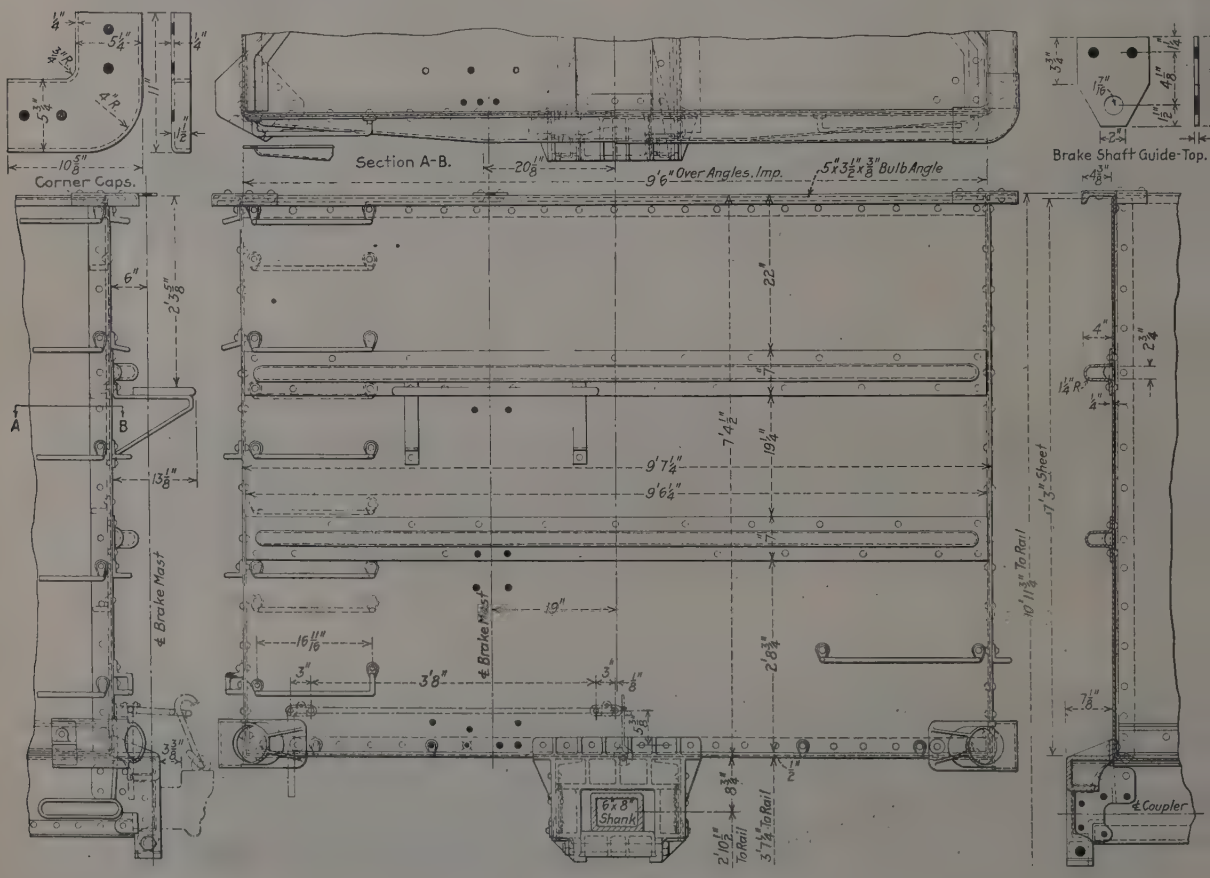


Fig. 57—End of Virginian All-Steel 120-Ton Capacity Gondola Coal Car.

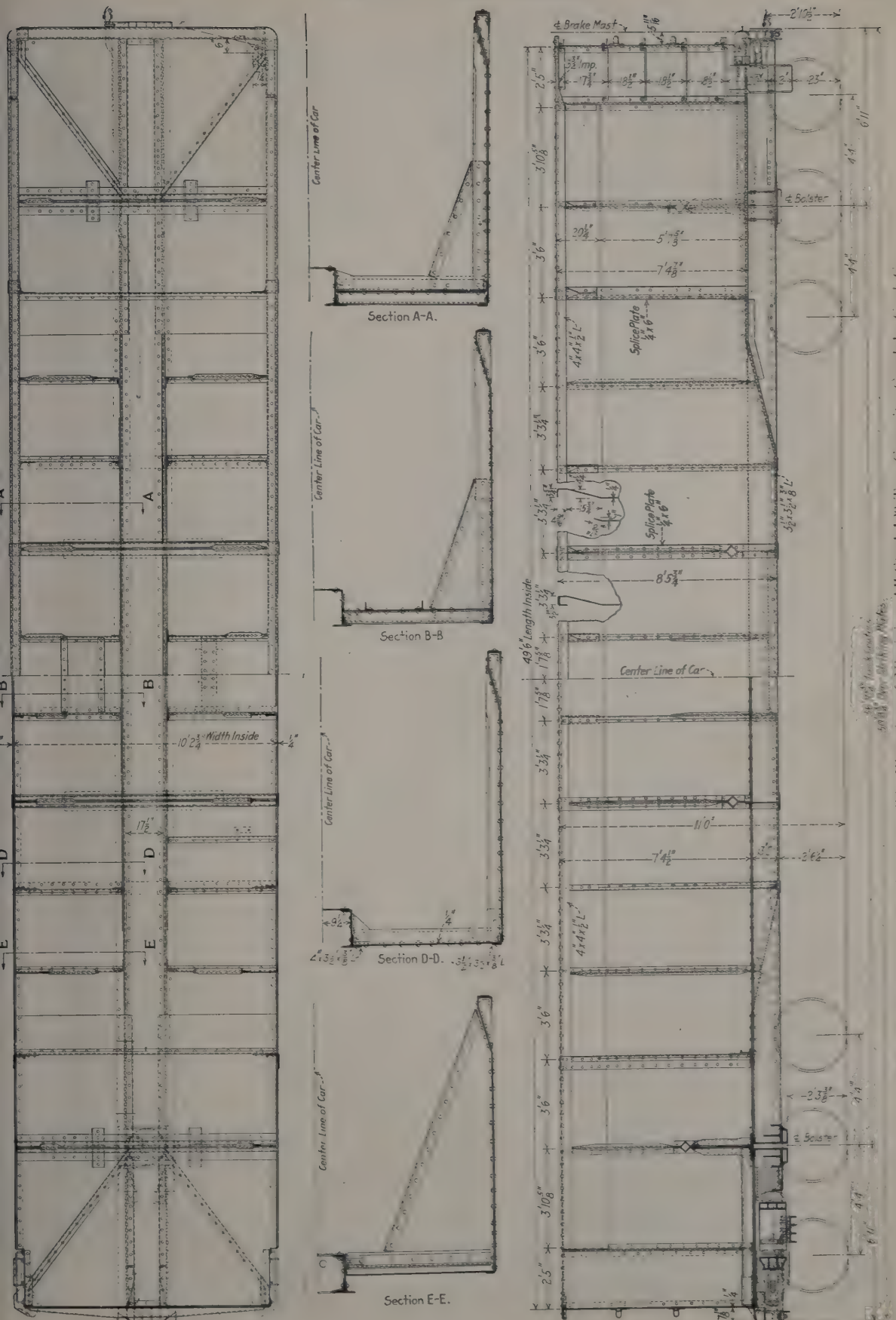


Fig. 58—Plan, Cross Sections and Side Elevation of Virginian All Steel 120-Ton Capacity Gondola Coal Car.
(See also Figs. 56, 57 and 59.)

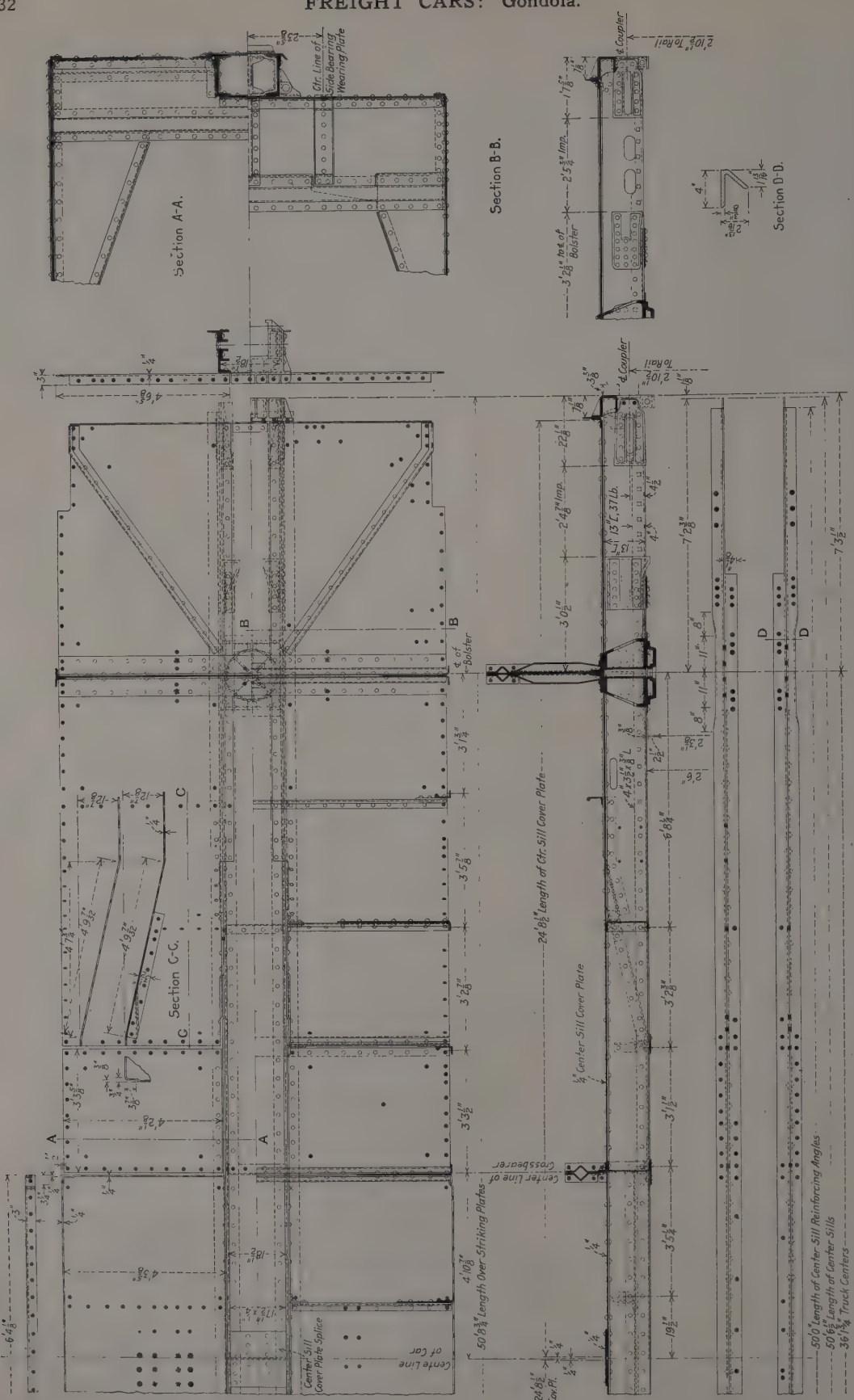

Section A-A.
Ctr. Line of Side Bearing Wearing Plate
Section B-B.
℄ Coupler
2'10⅝" To Rail
Section D-D.
℄ of Bolster
Section C-C.
Center Sill Cover Plate Splice
Center Line of Car
Center Line of Crossbearer
24'6½" Length of Ctr. Sill Cover Plate
¼" Center Sill Cover Plate
50'8¾" Length Over Striking Plates
50'0" Length of Center Sill Reinforcing Angles
50'6½" Length of Center Sills
36'1¾" Truck Centers

Fig. 59—Steel Underframe for Virginian All-Steel 120-Ton Capacity Gondola Coal Car Shown in Figs. 56-58.

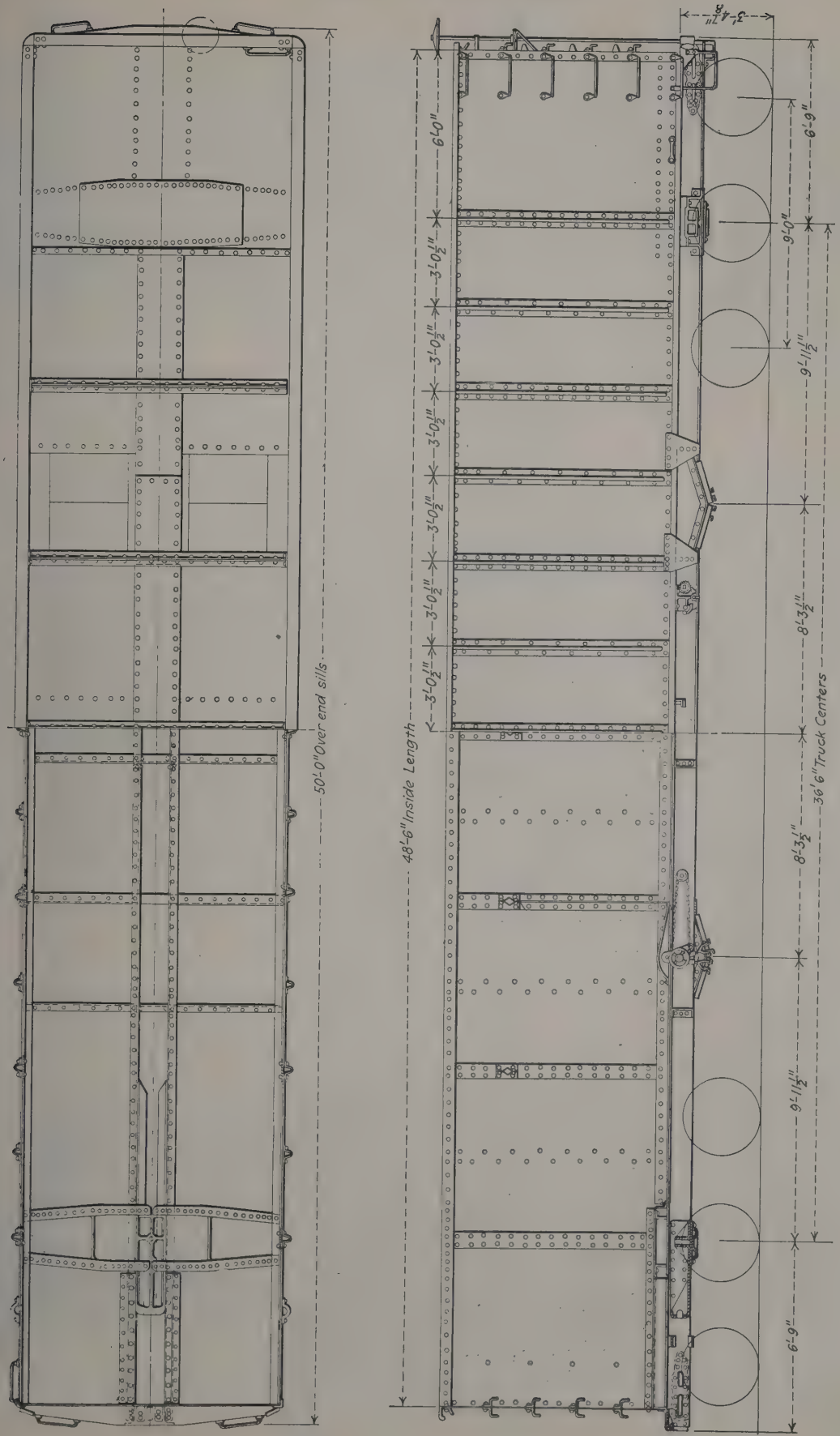


Fig. 60—Plan and Elevation of the Pennsylvania Railroad 110-Ton Gondola Coal Car Shown in Fig. 61.

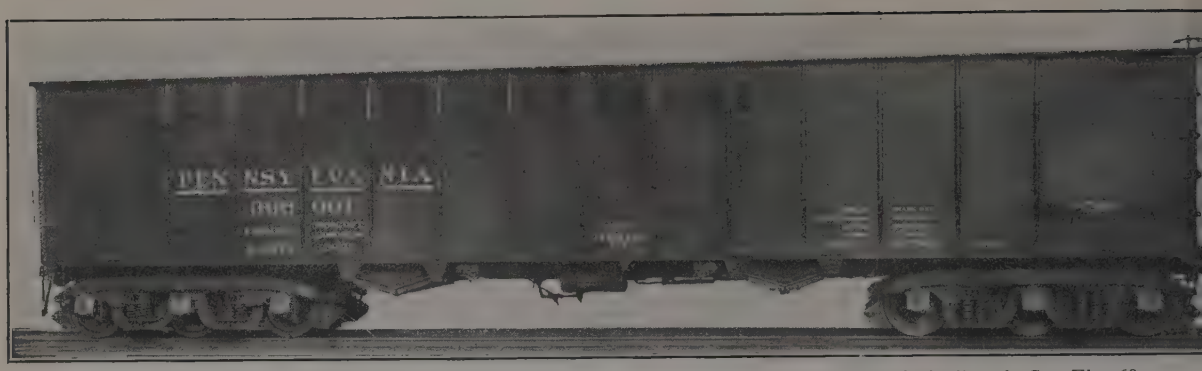


Fig. 61—All-Steel 110-Ton Capacity Gondola Coal Car. Built by the Pennsylvania Railroad. See Fig. 60.

Light weight	74,600 lb.
Length over end sills	50 ft. 0 in.
Length inside	48 ft. 6 in.
Distance from center to center of trucks	36 ft. 6 in.
Width over all	10 ft. 2 in.
Width inside	9 ft. 4⅞ in.
Height above rail	11 ft. 6 in.
Height inside	8 ft. 1¼ in.
Truck wheel base	9 ft. 0 in.
Truck journals	6 in. by 11 in.
Truck weight	17,200 lb.
Capacity, level full, 3.660 cu. ft; heaped	340 c. ft.

Fig. 62—All-Steel 100-Ton Capacity Flat Bottom Gondola Coal Car. Built by the Norfolk & Western.

Length over striking plates	43 ft. 9 in.
Height from rail to top of car side	11 ft. 0 in.
Inside length	42 ft. 7 in.
Inside width	9 ft. 6 in.
Outside width	10 ft. 1¼ in.
Cubical capacity—level full	3,122.5 cu. ft.
Revenue load	200,000 lb.
Weight of car body	29,020 lb.
Weight of empty car	53,500 lb.
Total weight, loaded with 200,000 lb.	253,500 lb.
Per cent revenue load of total weight	78.88 per cent
Rail load per pair of wheels	42,250 lb.

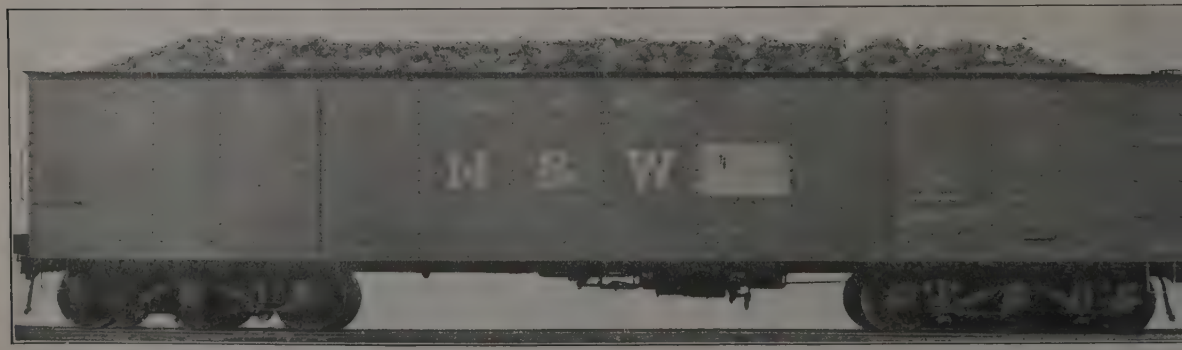


Fig. 63— All-Steel 90-Ton Capacity Gondola Car with Drop-Bottom Doors. Weight, 65,200 lb.; Inside Length, 45 ft. 6 in.; Inside Width, 9 ft. 6 in.; Inside Height, 6 ft. 6 in. Builder, Norfolk & Western Railway.

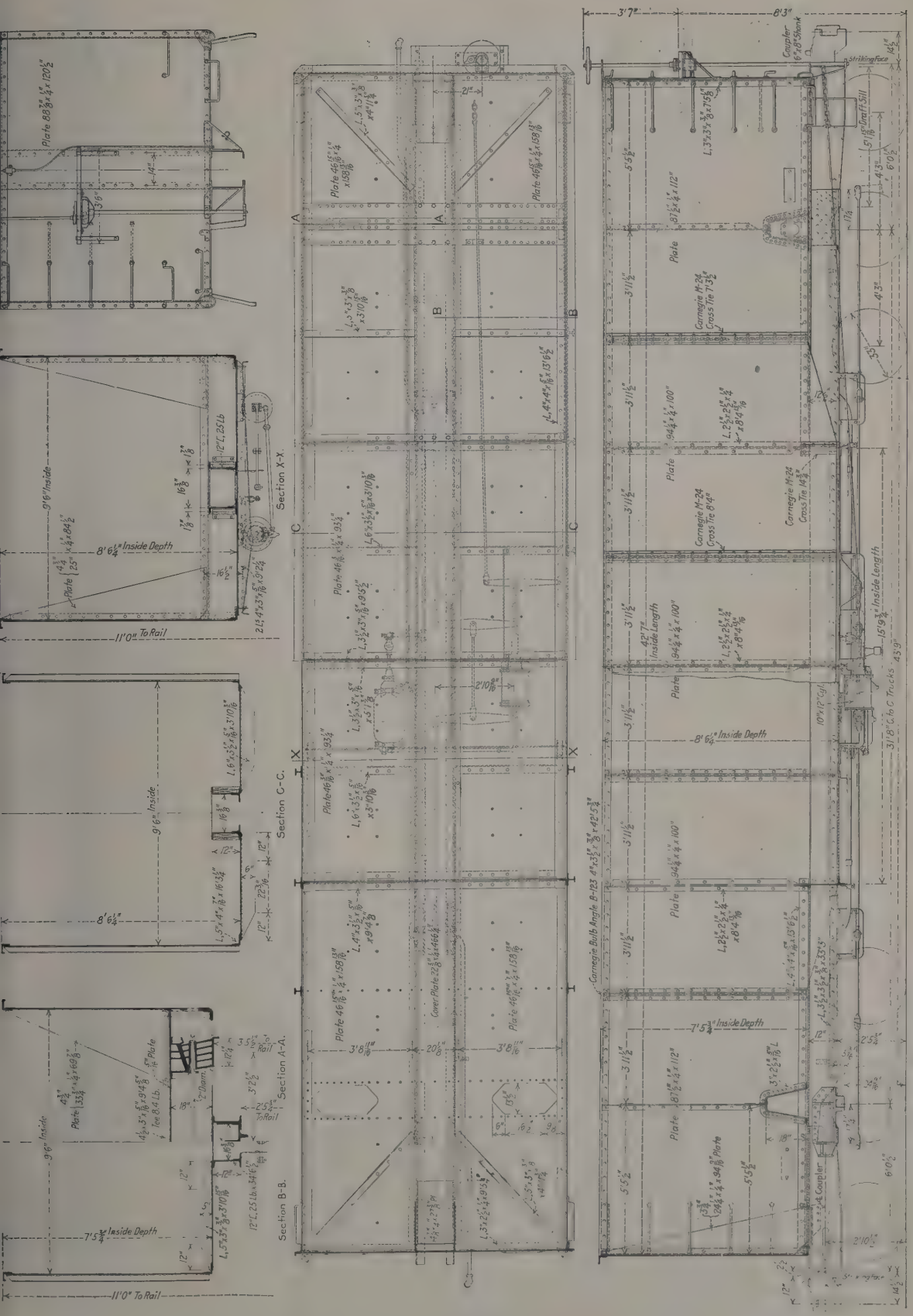
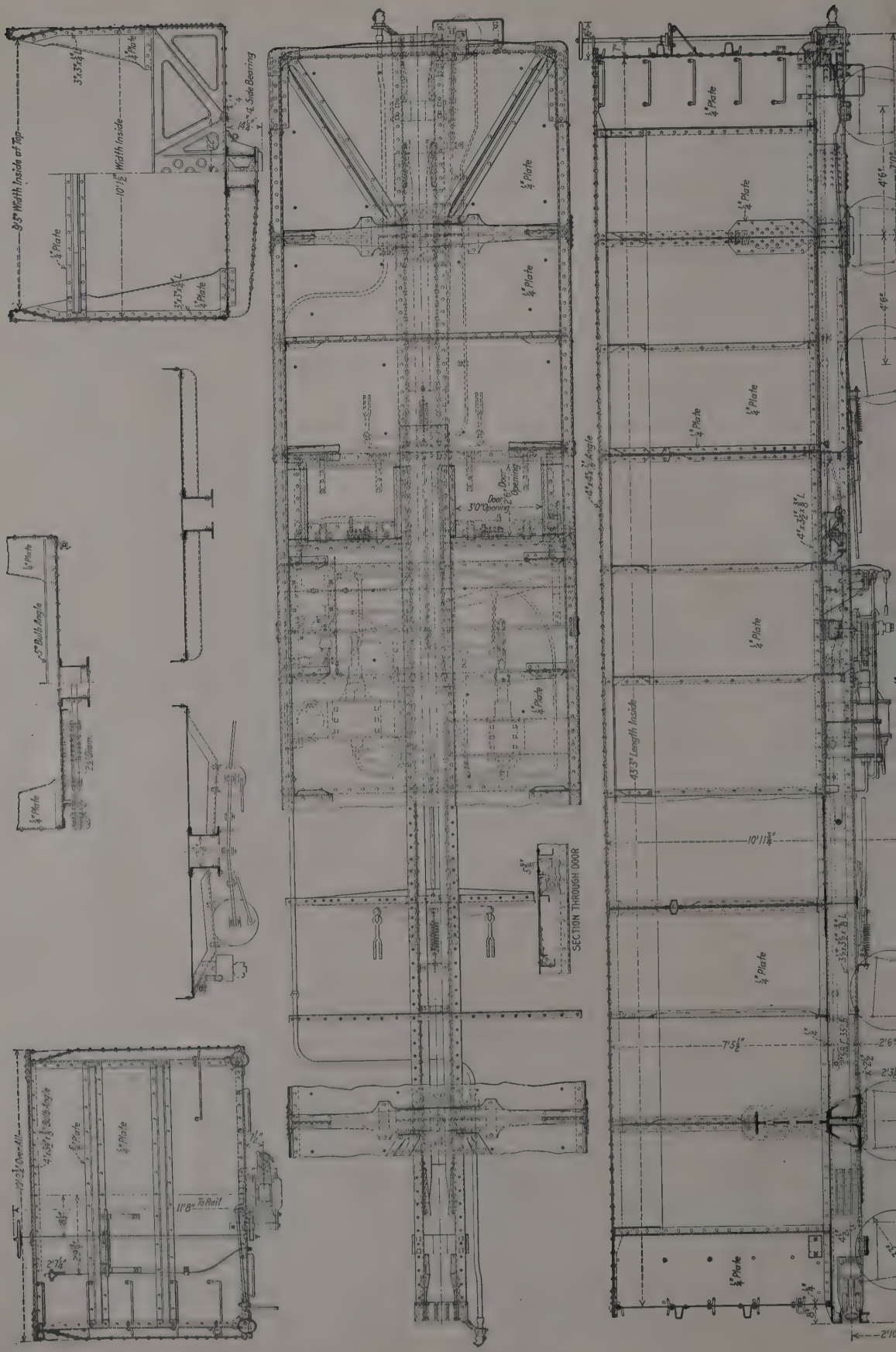


Fig. 64—Plan, Cross Sections and Side and End Elevations of Norfolk & Western All-Steel 100-Ton Capacity Gondola Coal Car.
(See also Fig. 62.)


8'5" Width Inside of Top
10'1½" Width Inside
14½" c. to c. Side Bearing
¼" Plate
3'3¾" x 3'3¾" x ½" L
Door Opening
3'0" Door Opening
41'4½" x ½" Angle
41'3½" x 3½" x ½" L
43'3" Length Inside
10'11¾"
7'5½"
SECTION THROUGH DOOR
3½" Ball Angle
2'2" Diam.
10'3½" Over All
4"x3½"x⅜" Angle
11'8" To Rail

All-Steel Construction

The coal traffic constitutes a very large proportion of all railway traffic, both in relation to tonnage and to gross revenue. The operating characteristics of the traffic are also such as to demand of the cars used in this branch of service the utmost in ruggedness and durability and, at the same time, these qualities must be obtained at a first cost which is restricted by certain well-defined limits.

The side sheets, which are ¼ in. steel plates, are pressed in at the top and are further reinforced there by a 4 in. x 4 in. x 7/16 in. angle and at the bottom by a 4 in. x 3½ in. x ⅜ in. angle.

The center sills are made up of two 12-in. 35-lb. channels, set with the flanges facing outward and reinforced at the bottom by 3½ in. x 3½ in. x ⅜ in. angles extending between the draft gears, and at the top by the ¼ in. floor plates.

The brake equipment consists of empty and load brakes, having a 4-in. "take-up" cylinder. a 10-in. cylinder for use when the car is empty, and an additional 16-in. cylinder for use when the car is loaded.

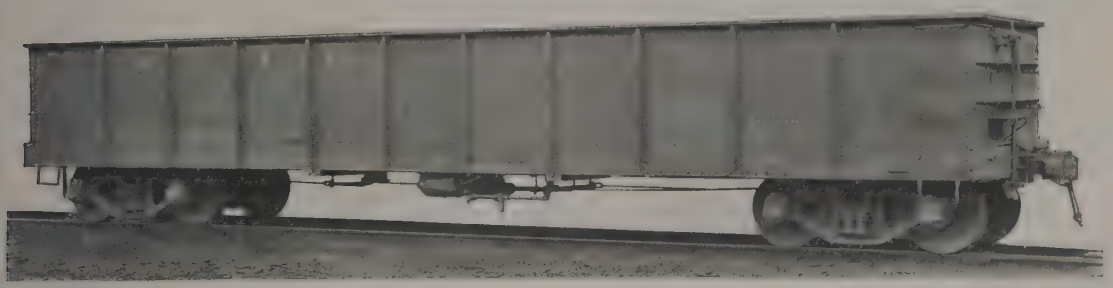


Fig. 66—All-Steel Gondola of 50 Tons Capacity, Built by the Standard Steel Car Company

The utmost skill and refinement of design is required on the part of the builders in order to obtain maximum strength with a minimum of weight and the construction of coal cars has therefore been characterized by constant improvement. The former limit of 50 tons capacity having been passed, cars of 100 tons capacity are now in extensive use. The organization and equipment of the Standard Steel Car Company has kept pace with this development, and this company today is in a position completely to design and build steel gondola cars of all capacities.

Steel coal cars built by the Standard Steel Car Company for the Wheeling & Lake Erie are representative of a type in common use. These cars weigh 42,600 lb. and have a capacity of 100,000 lb. or 1,688 cu. ft.

The ability of the Standard Steel Car Company to design and build the heaviest types of steel coal cars has been proved by the recent completion for the Chesapeake & Ohio, of an order of 500 cars, having a capacity of 100 tons each.

TABLE I—WEIGHTS AND CAPACITIES OF 100-TON GONDOLAS

Capacity, stencil'd	182.000 lb.	Weight of two trucks	27,200 lb.
Capacity, heaped 30 degrees	200,000 lb.	Weight of empty car	68,300 lb.
Cubic capacity level	3,212 cu. ft.	Weight loaded	268,000 lb.
Cubic capacity, heaped 30 degrees	3,703 cu. ft.	Per cent revenue load of total weight	74.6 per cent
Estimated density of load	54 lb. per cu. ft.	Rail load per axle, loaded car	44,717 lb.
Coupled length	47 ft. 1 in.	Weight loaded per foot coupled length	5,695 lb.
Weight of car body	41,100 lb.		

The problems solved in connection with the design of these cars are typical of the capacity and resources of the Standard Steel Car Company. Not only are these resources available for the construction of high capacity cars but also for the solution of all problems relating to the design of steel coal cars for any service.

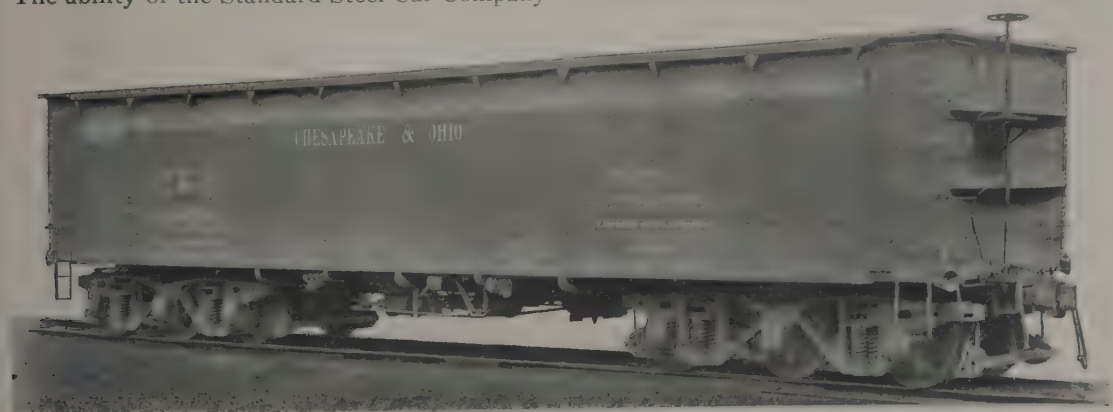


Fig. 67—All-Steel Gondola of 100 Tons Capacity Built by the Standard Steel Car Company

For other products and branch offices, see classified and alphabetical indexes.

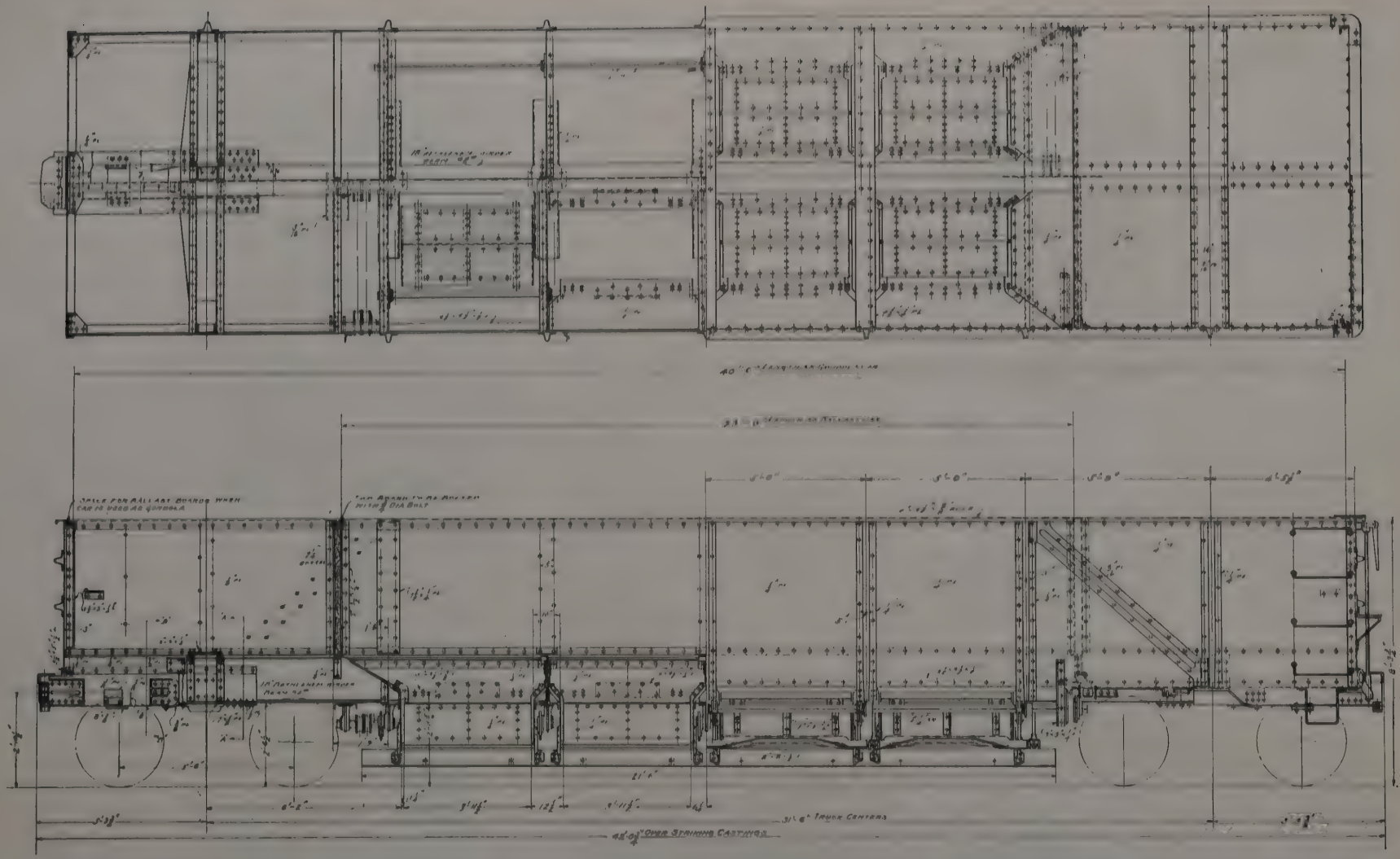


Fig. 68—All Steel 50-Ton Capacity Ballast and Coal Car. Center and Side Discharge. As Concentrated Load Ballast Car, Cubic Capacity, 1206 cu. ft. Level or 1424 cu. ft. with 12 in. Average Heap. As Coal Car, Cubic Capacity, 1896 cu. ft. Level or 2276 cu. ft. with 12 in. Average Heap. Designer; Enterprise Railway Equipment Company.

(*See also Fig. 69 and Pages* 144-145.)

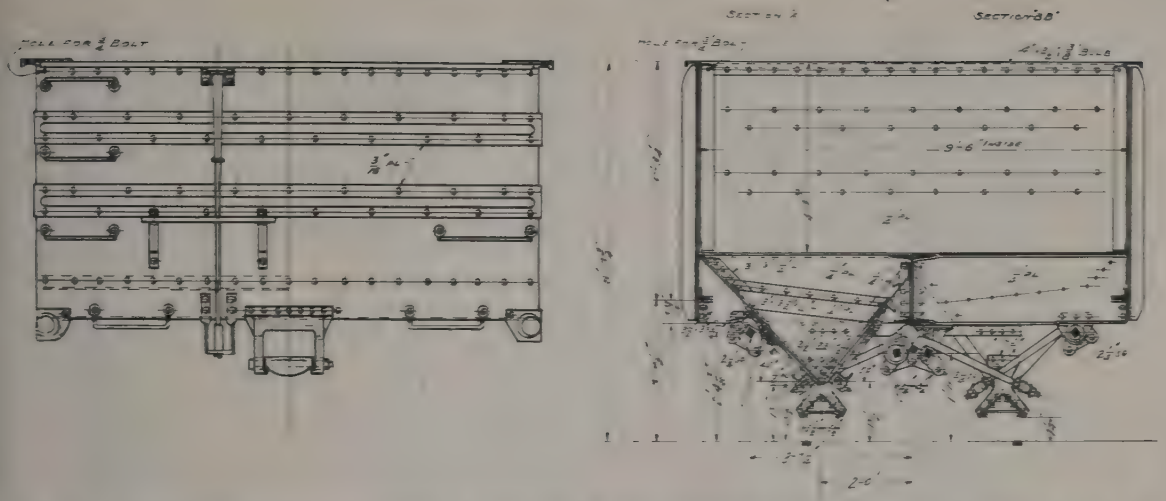


Fig. 69—End Elevation and Cross Section of All-Steel 50-Ton Capacity Ballast and Coal Car Shown in Fig. 68.

Fig. 70—All-Steel 50-Ton Capacity General Service Gondola Car. Builders: Pressed Steel Car Company.

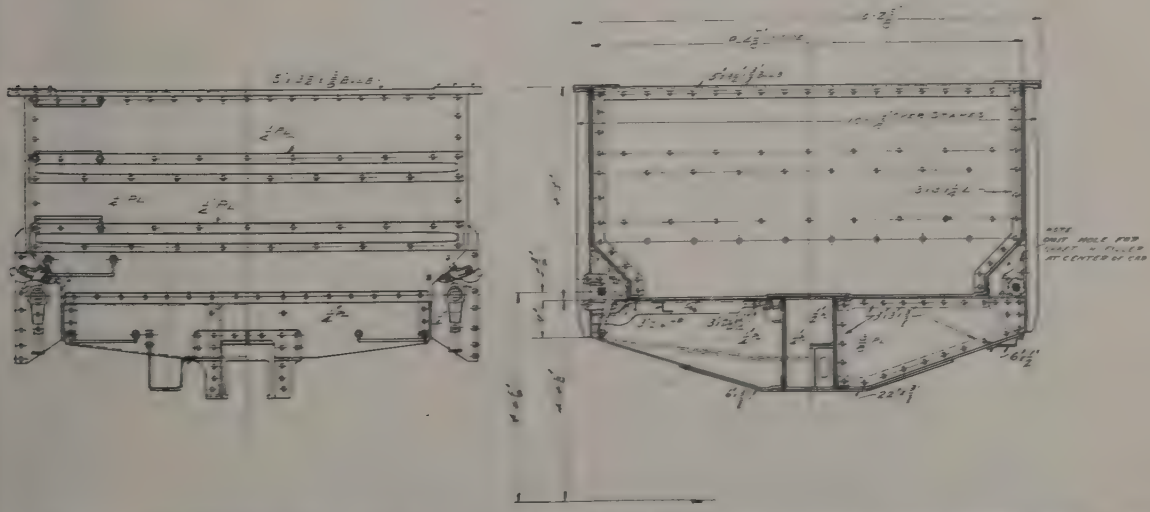


Fig. 71—End Elevation and Cross Section of All-Steel 50-Ton Capacity General Service Gondola Car Shown in Fig. 72

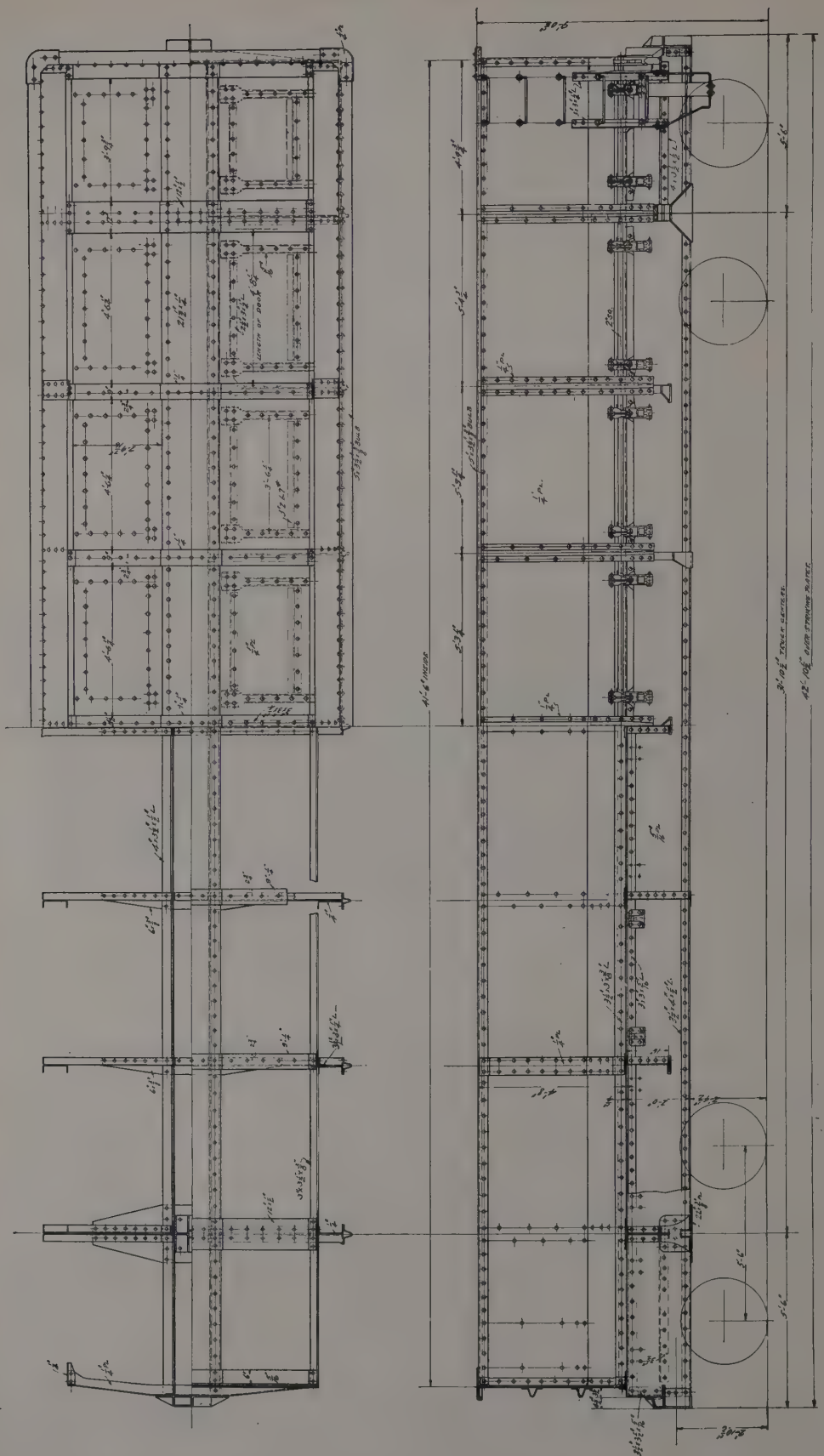


Fig. 72—All-Steel 50-Ton Capacity General Service Gondola Car. Cubic Capacity, 1769 cu. ft. Level or 2159 cu. ft. with 12 in. Average Heap.
Designer; Enterprise Railway Equipment Company.
(*See also Fig. 71 and Pages* 144-145)

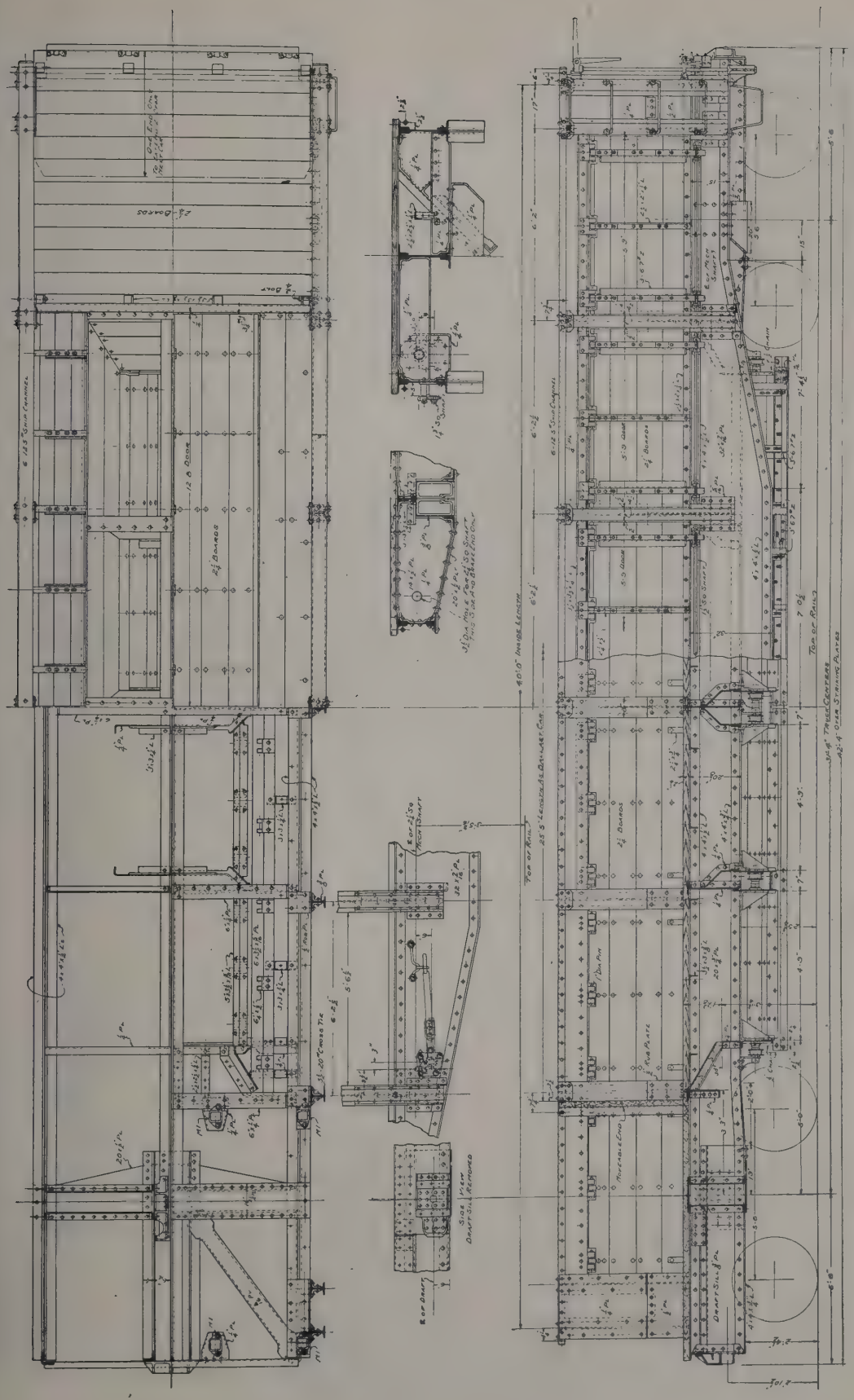


Fig. 73—Composite 50-Ton Capacity Convertible Ballast Distributing. Plow or Gondola Car. As Concentrated Load Ballast Car, Cubic Capacity, 980 cu. ft. Level or 1203 cu. ft. with 12 in. Average Heap. As Plow or Gondola Car, Cubic Capacity, 1400 cu. ft. Level or 1750 cu. ft. with 12 in. Average Heap. Designer; Enterprise Railway Equipment Company.

(*See also Fig. 74 and Pages* 144-145.)

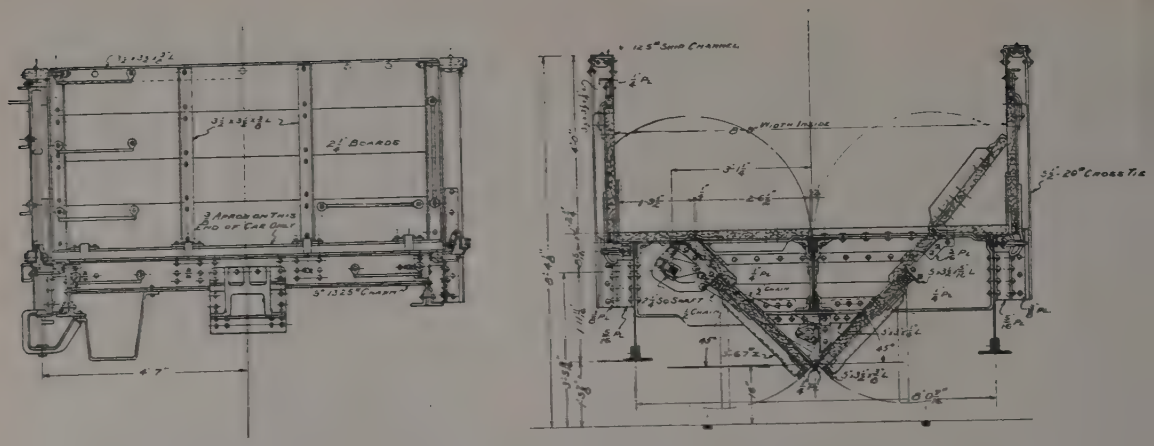


Fig. 74—End Elevation and Cross Section of Composite 50-Ton Capacity Convertible Ballast Distributing or Plow or Gondola Car Shown in Fig. 73.

Fig. 75—Composite 50-Ton Capacity Drop-Bottom Gondola Car. Weight, 41,600 lb.; Inside Length, 41 ft. 9 in.; Inside Width, 9 ft. 2½ in.; Inside Height, 4 ft. 5½ in.; Capacity Level Full, 1,714 cu. ft.
Builder; Western Steel Car & Foundry Company.

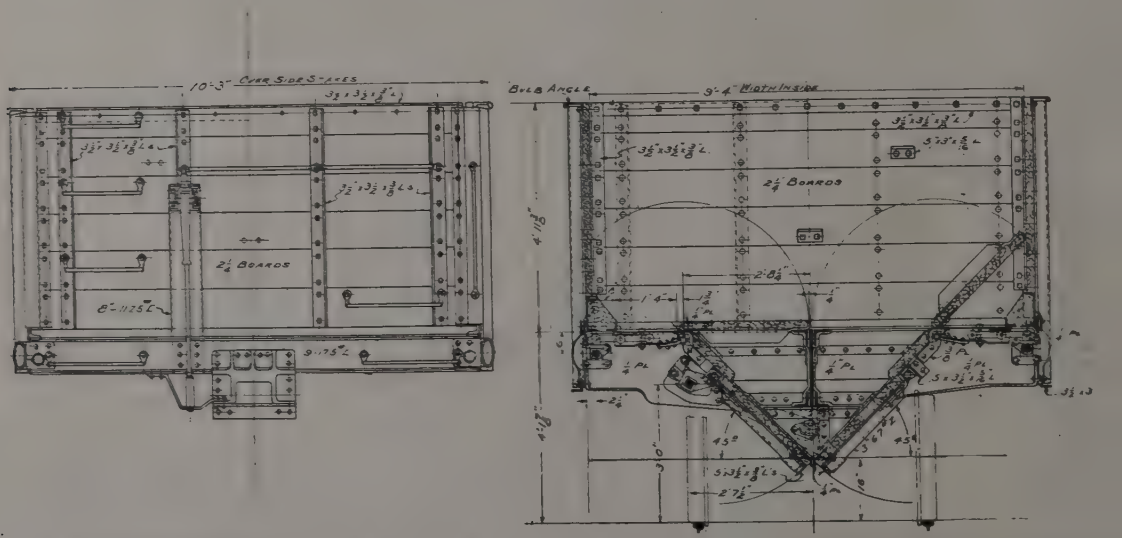


Fig. 76—End Elevation and Cross Section of Composite 50-Ton Capacity Convertible Ballast Distributing, or Side Discharge Gondola Car Shown in Fig. 77.

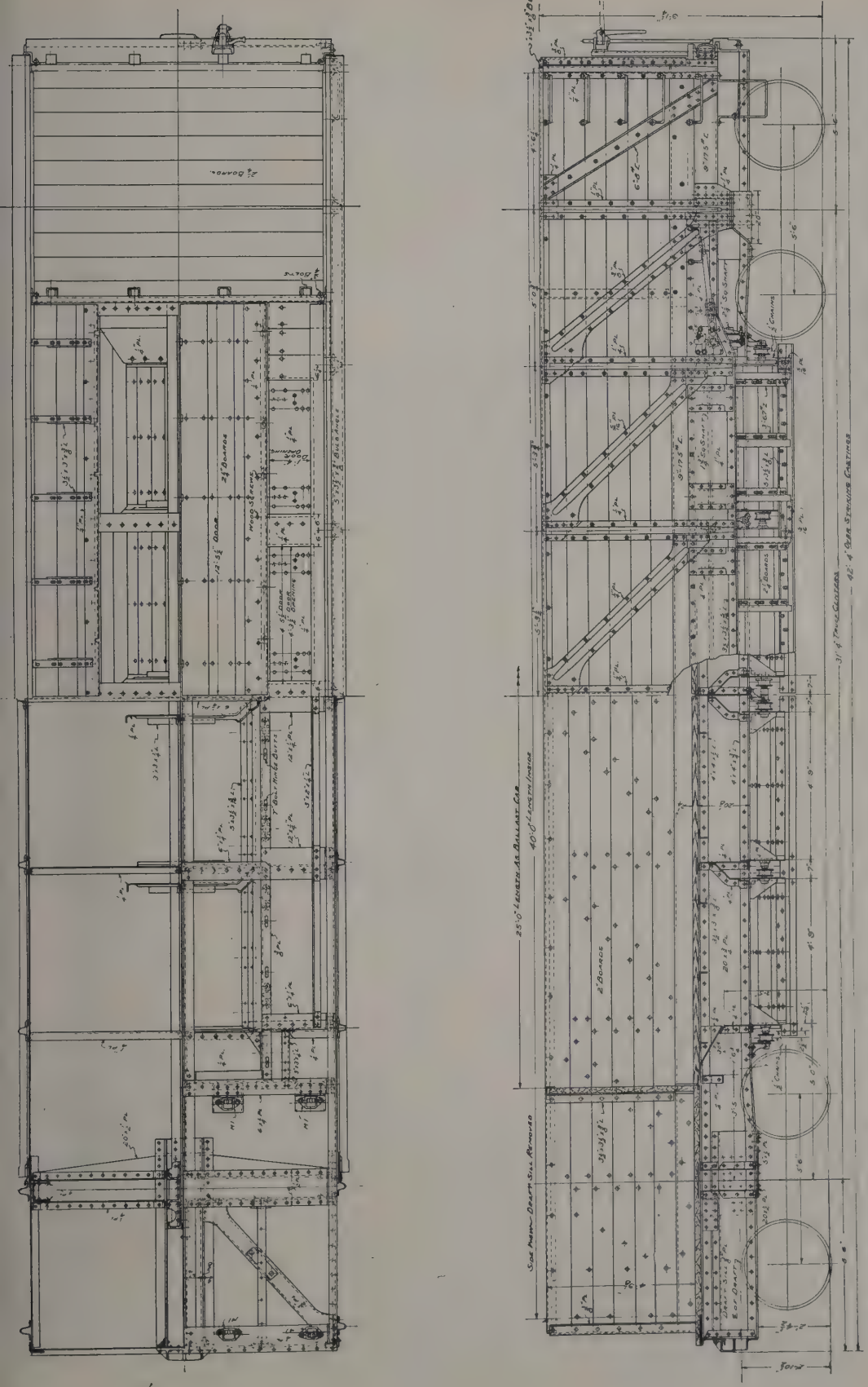


Fig. 77—Composite 50-Ton Capacity Convertible Ballast Distributing or Side Discharge Gondola Car. As Concentrated Load Ballast Car, Cubic Capacity, 1121 cu. ft. Level or 1354 cu. ft. with 12 in. Average Heap. As Gondola Car, 1770 cu. ft. Level or 2143 cu. ft. with 12 in. Average Heap.
Designer; Enterprise Railway Equipment Company.
(See also Fig. 76 and Pages 144-145.)

Enterprise General Service Ballast and Gondola Cars

Among the many special types of freight cars developed by the Enterprise Railway Equipment Company are General Service and Ballast cars. A tentative design is available from this company to accommodate whatever the conditions may demand, or a new plan incorporating the ideas of the users will be prepared if desired.

The name "General Service Car" immediately presents to mind a car suitable for many purposes and of the flat bottom gondola type. It is usually about 40 ft. in length, and has 16 doors in the bottom arranged to be lowered in sets of 4, discharging the load on both sides of the track.

78. In this design the mechanism is located at the side of the car above the floor line; the advantage of such a location is that the mechanism lies out of the way of the discharging load, and the offset in the side of the car, with filler plates between the side and stakes, adds greatly to the strength of the car and insures against bulging sides.

The mechanism consists of square operating shafts with square hub links thereon, around which wind steel links flexibly riveted together.

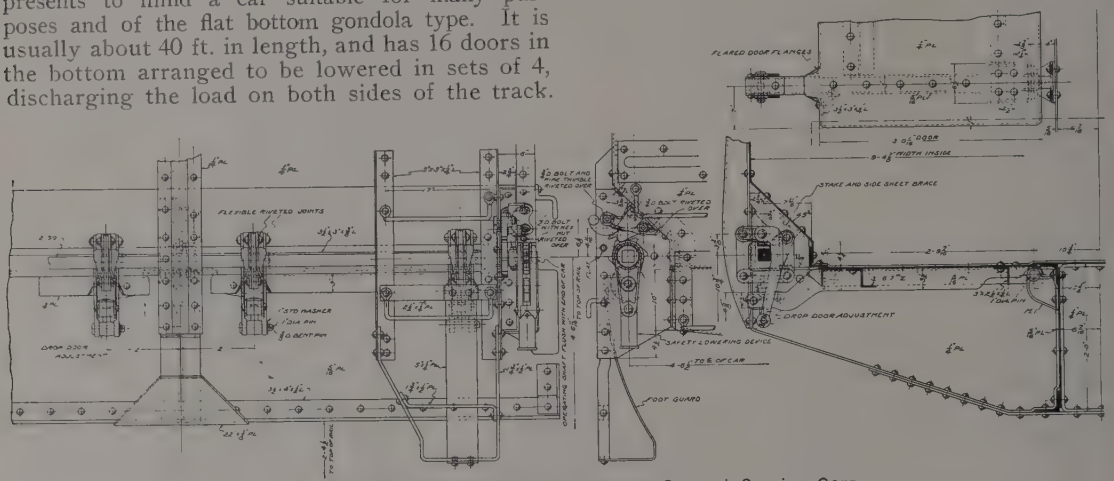


Fig. 78—Door Operating Mechanism for General Service Cars

Figs. 72 and 82 show respectively an all-steel and a composite design, both of which incorporate parts very generally accepted as essential to insure reasonable durability. It will be noted that the floors of these cars are sufficiently high to obtain proper door openings.

When in a closed position they form very positive locks for the car doors, to which they are attached by adustable eyebolts, so that perfectly tight closing doors may be obtained. These links are sufficiently strong to support the doors in their locked position without the need of door stops on the diaphragms of the car and it is claimed that the shocks incident to the opening of the doors are better distributed to the car body when received directly by the operating shaft and thereby transmitted to the whole car framing.

To insure safety and convenience of operation, a safety socket handle is provided at the end of each operating shaft; this handle does not project beyond the end of the car, where it would be a constant inconvenience and danger to the train crew.

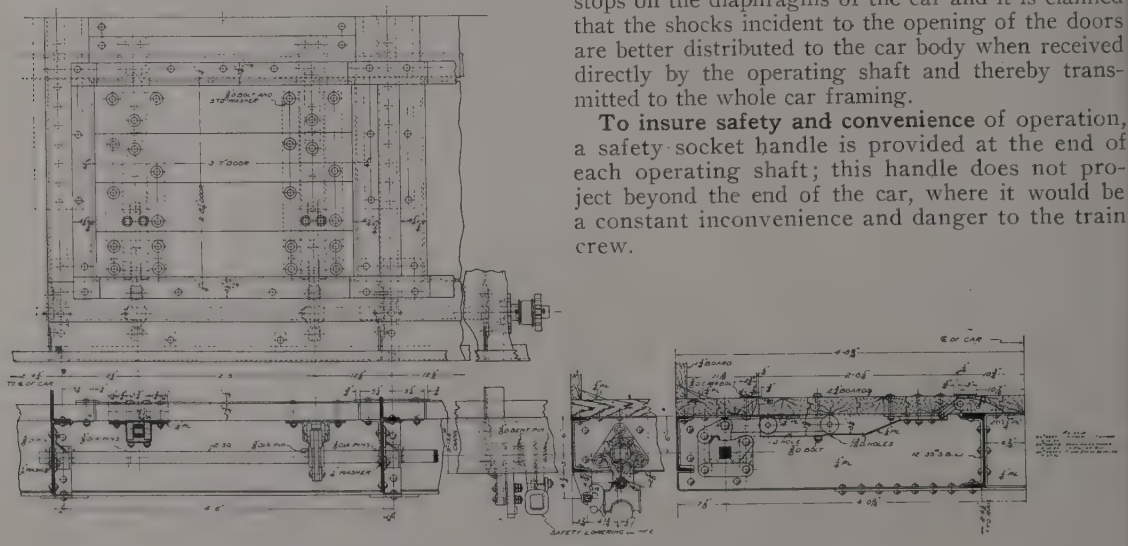


Fig. 79—Door Operating Mechanism for Gondola Cars

A method of applying door operating mechanism to general service cars, showing more particularly that portion near the end, is shown in Fig.

For gondola cars having doors only between the trucks the floor does not need to be as high above the rails as is required for the general serv-

Enterprise General Service Ballast and Gondola Cars *Cont'd.*

ice car. Fig 79 illustrates a door plan for such a car with the door operating mechanism located below the car floor. The mechanism is very similar to that described above and includes the safety lowering device illustrated in Fig. 80.

Latch Equipment for drop doors is another

Fig. 80—Safety Lowering Device

product of this Company. These latches are serviceable for small doors which may be conveniently handled by a single operator. Such a door is illustrated in Fig. 81 together with two "Ingoldsby" Latches which securely support the closed door.

Ballast cars are subjected to such severe usage that it is necessary to have a very substantial well built car. The several cars shown in Figs. 68, 73 and 77 are designed to meet such requirements and have been provided with strong sides, continuous cross tie members and continuous center sill construction. Fig. 68 illustrates an all-steel car which may be arranged to operate either as a concentrated load, 100 percent-discharge ballast car, or as a 40 ft. gondola, suitable for hauling coal and other commodities. The arrangement of this car is such that the load may be discharged either to the center of the track or to both sides. The center doors are arranged for graduating the discharge so that ballast may be released in small quantities from a moving car and thus distributed along the roadbed.

The design of the convertible car, which is shown in Fig. 73, is such that a concentrated load of ballast may be distributed to the immediate center of the track in such quantities as desired by the operator, or it may be arranged as a flat floor gondola car suitable for carrying coal or for other purposes in which a fair proportion of the load may be dumped to the sides of the track. Fig. 77 is also a convertible car, which, in addition to the ballast features above mentioned, is suitable for plow service and has, therefore, vertically hinged doors arranged in the sides of the car so that the material may be plowed from the car body to either side of the track.

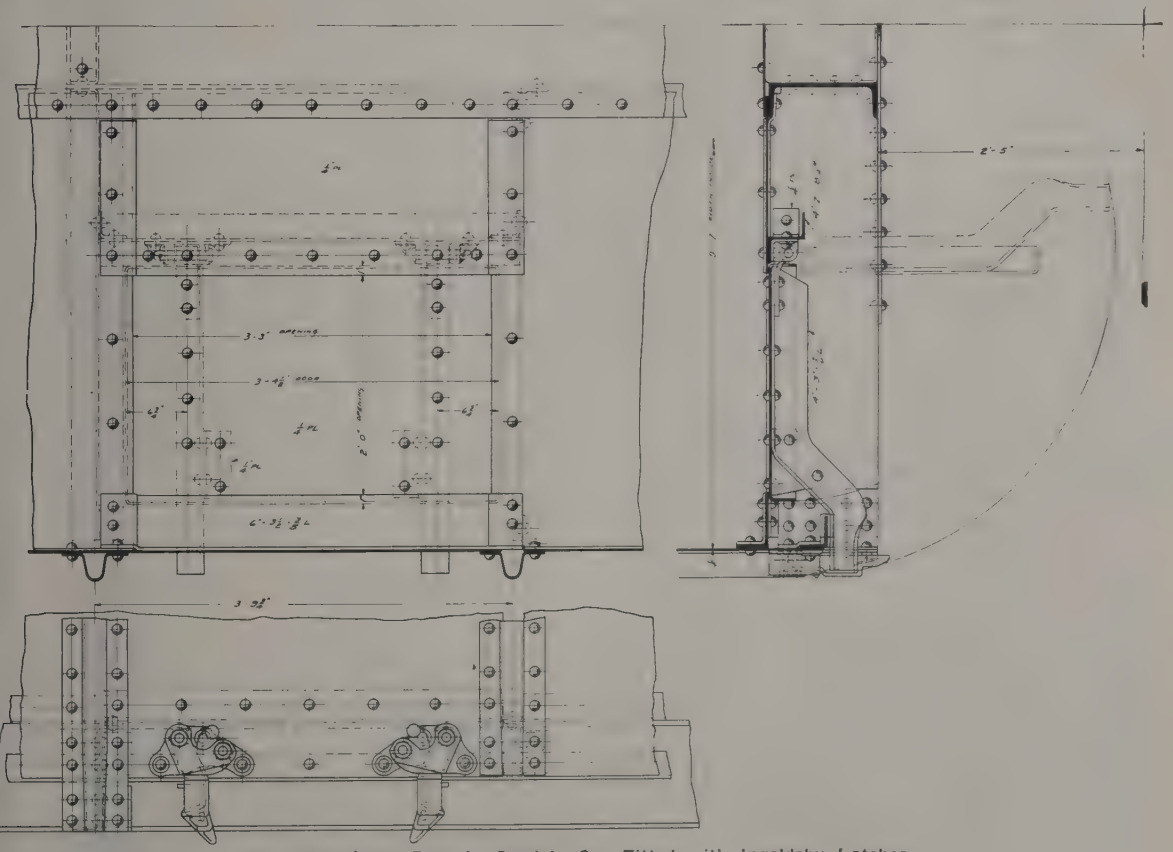


Fig. 81—Bottom Door in Gondola Car Fitted with Ingoldsby Latches

For other products and branch offices, see classified and alphabetical indexes.

ENTERPRISE RAILWAY EQUIPMENT CO., CHICAGO, ILL.

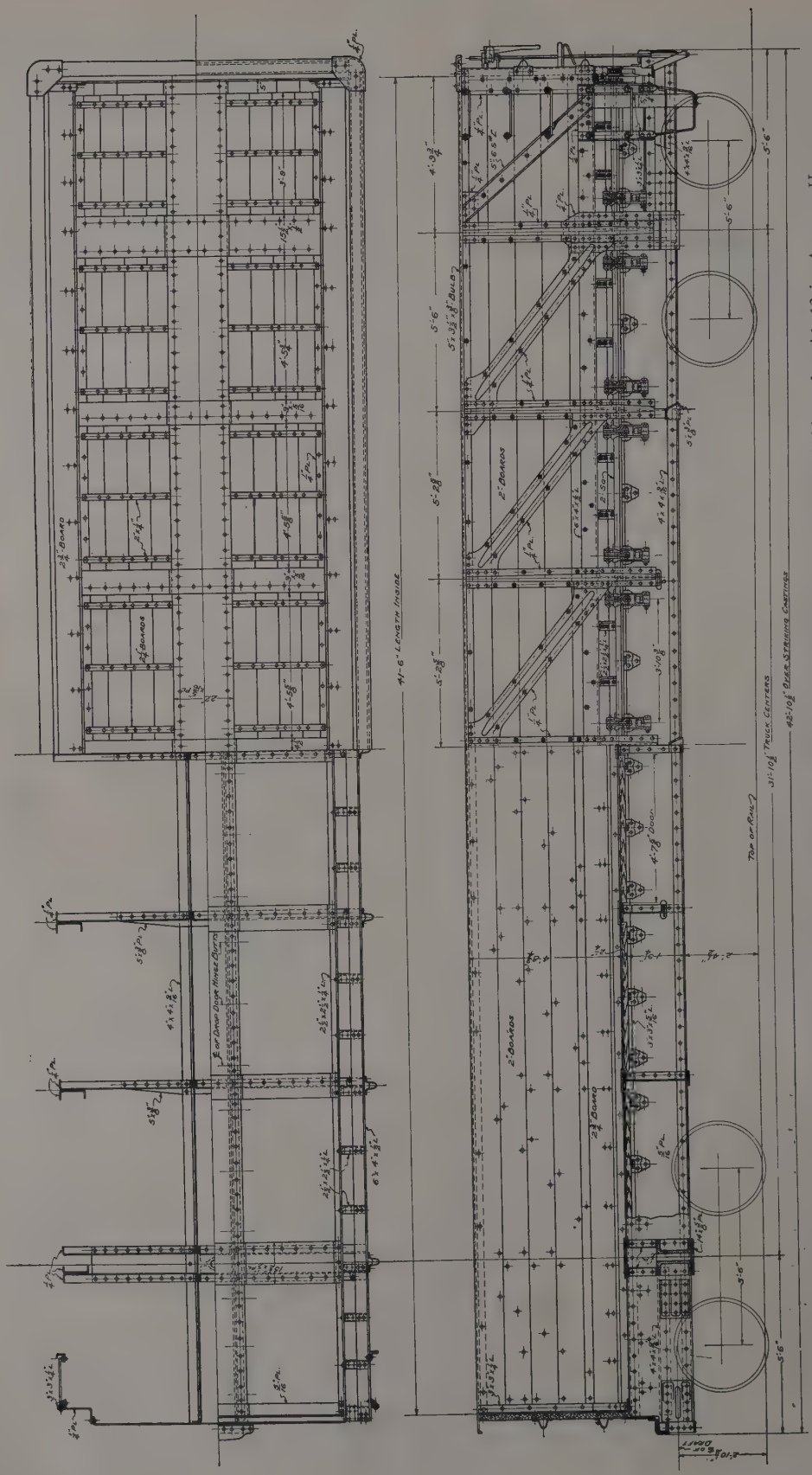


Fig. 82—Composite 50-Ton Capacity General Service Gondola Car. Cubic Capacity, 1754 cu. ft. Level or 2136 cu. ft. with 12 in. Average Heap. Designer; Enterprise Railway Equipment Company.

(*See also Fig.* 83 *and Pages* 144-145.)

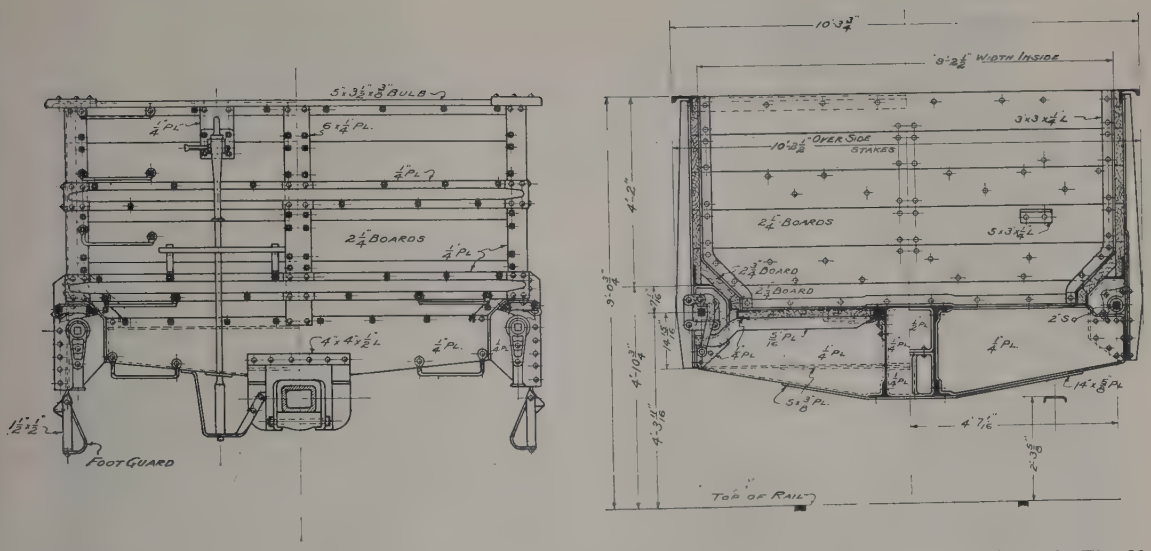


Fig. 83—End Elevation and Cross Section of Composite 50-Ton Capacity General Service Gondola Shown in Fig. 82.

Fig. 84—Steel Frame 50-Ton Capacity Drop-Door Gondola Car. Builder; General American Car Company.

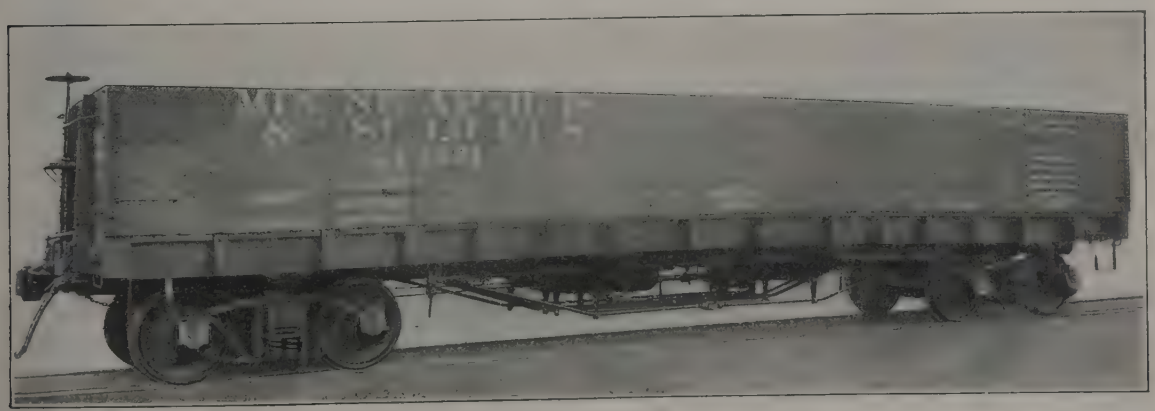


Fig. 85—Wooden Drop Door Gondola Car with Steel Center Sills: Capacity, 50 Tons; 1,494 cu. ft.; Outside Length, 40 ft. 0 in.; Inside Length, 39 ft. 7½ in. Builder; The Pullman Company—Haskell & Barker Plant.

Fig. 86—Car Shown in Fig. 88 with Drop Bottom Arranged for Use as Coal Car.

Fig. 87—Car Shown in Fig. 88, Arranged for Use as a Center Dumping Ballast Car.

Fig. 88—Steel Frame 55-Ton Capacity Convertible Gondola and Ballast Car. Weight, 44,000 lb.; Inside Length, 30 ft. or 40 ft. Car as Shown Arranged for Center Dumping of Ballast, with Ends Set In. Builder, Rodger Ballast Car Company.

(*See also Fig. 93 and Page 149.*)

Hart Convertible Car

The Hart Convertible Car has been for many years recognized standard equipment for construction, ballast and maintenance work upon American and foreign railways. With this car the work may be performed rapidly and economically, and, owing to its convertible features the car may be used as a plain, side-dumping gondola for coal or other ordinary traffic.

Since these cars were first introduced they have been constantly improved to meet the rigorous conditions of modern railroading. New types of Hart Convertible cars have been produced which, while retaining all the advantageous features of prior cars, contain many radical improvements which make them entirely satisfactory for construction, ballast and maintenance work.

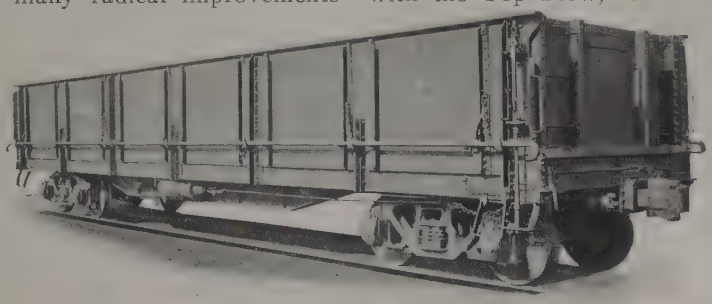


Fig. 89—Hart Convertible Car

The Improved Hart Convertible Car illustrated on this page has all the regular center and side ballasting and convertible features, with many improvements which add greatly to the ease of operation and efficiency of the car, not only in its regular work but in ordinary traffic as well.

The improvements consist of downwardly and outwardly sloping edges along the side of the floor, making possible a great increase in the side door opening without increasing the height of the car. This construction also relieves the car sides from strain during the unloading operation, making it practically impossible to break the stakes or distort the sides. The number of stakes is reduced, thus increasing the size of the doors. The side door operating mechanism is entirely new. The plow guiding and supporting features are new.

The center-dump method is the most economical and most generally used method of ballasting. By this method the material is deposited in the center of the track and spread by the Rodger Plow car attached to the rear of the ballast train; this is the method originated by the Rodger Ballast Car Company. In center-dump work the operating gear for the hopper doors of the improved car absolutely controls the flow of ballast from the hopper with a nicety never before attained. A most important point in favor of the "Center-Dump Method" is the short time in which the work can be done. In addition to its center-dump features, side dumping features are also provided in the Hart Convertible Car which permit the plowing off of material from the train with the Top Plow, for construction, filling or side ballast work. They have been greatly improved over old designs. In side-dump work the cars are subjected to extremely heavy strains owing to the character of the material necessarily used at times in construction and filling work, sometimes resulting in damages to the cars and necessitating their transfer to the repair track. When it is considered that the season for such work is short, it is expensive in more ways than one to have ballast cars on the repair track. With the improvements to the side dumping features it has been possible to reduce the possibility of damage to cars to a minimum, making it possible to keep the cars constantly in use and, therefore, eliminating the heavy expense due to time lost out of service.

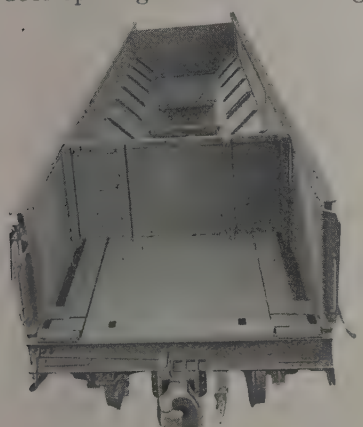


Fig. 90—As Ballast Car with Center Dump

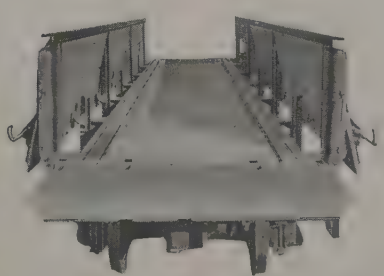


Fig. 91—As Work Car With Swinging Side Doors

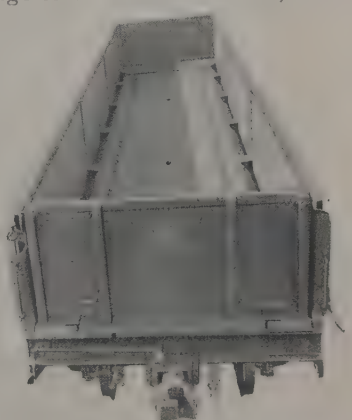


Fig. 92—As Gondola Car with Level Floor

The Hart Coal and Ballast Car—illustrated in Figs. 86-88, 93—is designed especially for use where unloading by a top plow is not necessary. It is a car which may be quickly converted into a drop-bottom side-dump gondola for coal traffic.

For other products and branch offices, see classified and alphabetical indexes.

THE RODGER BALLAST CAR CO., CHICAGO, ILL.

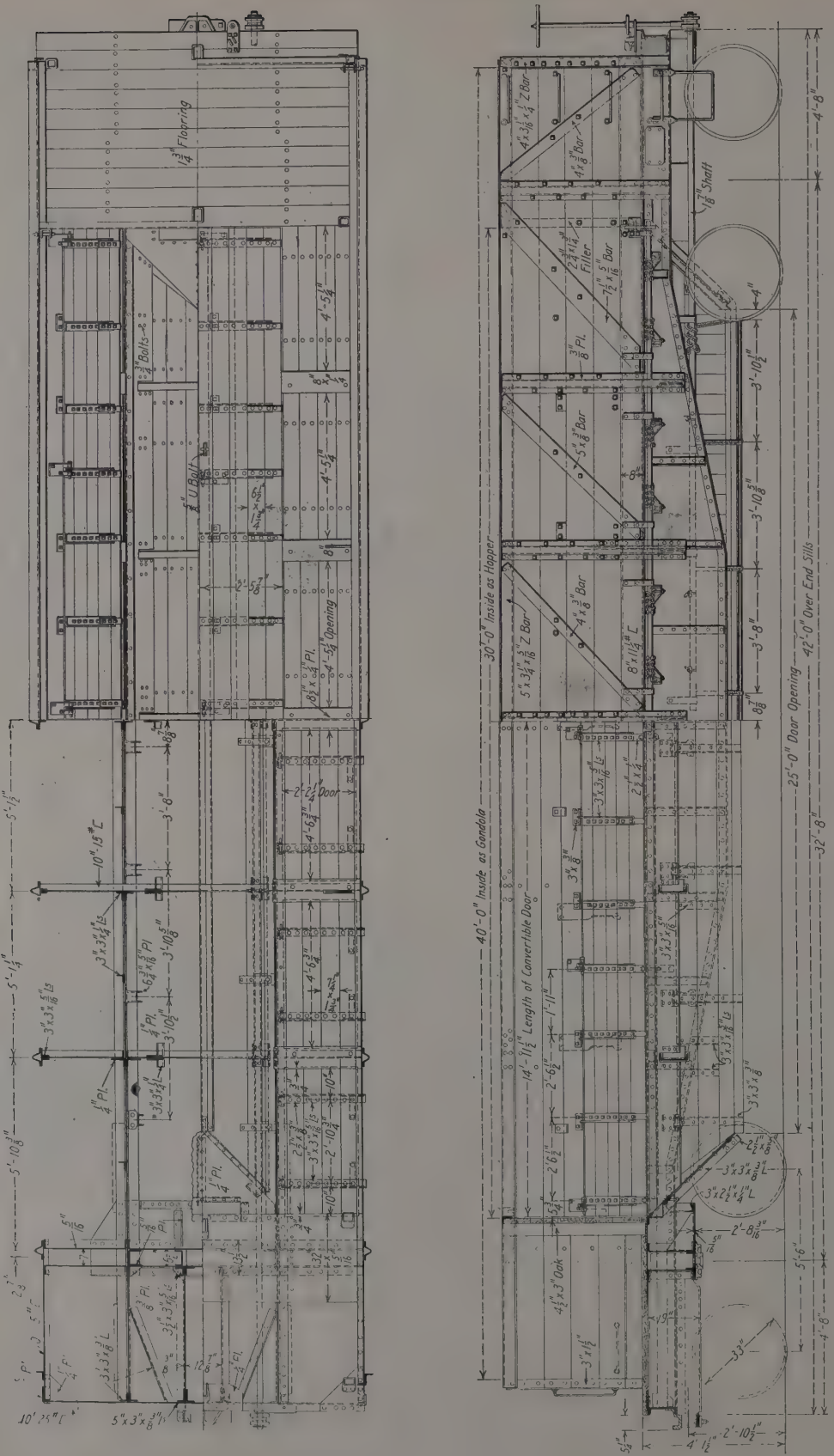


Fig. 93—Steel Underframe 50-Ton Capacity Hart Convertible Ballast and Gondola Car. Builder; Rodger Ballast Car Company.

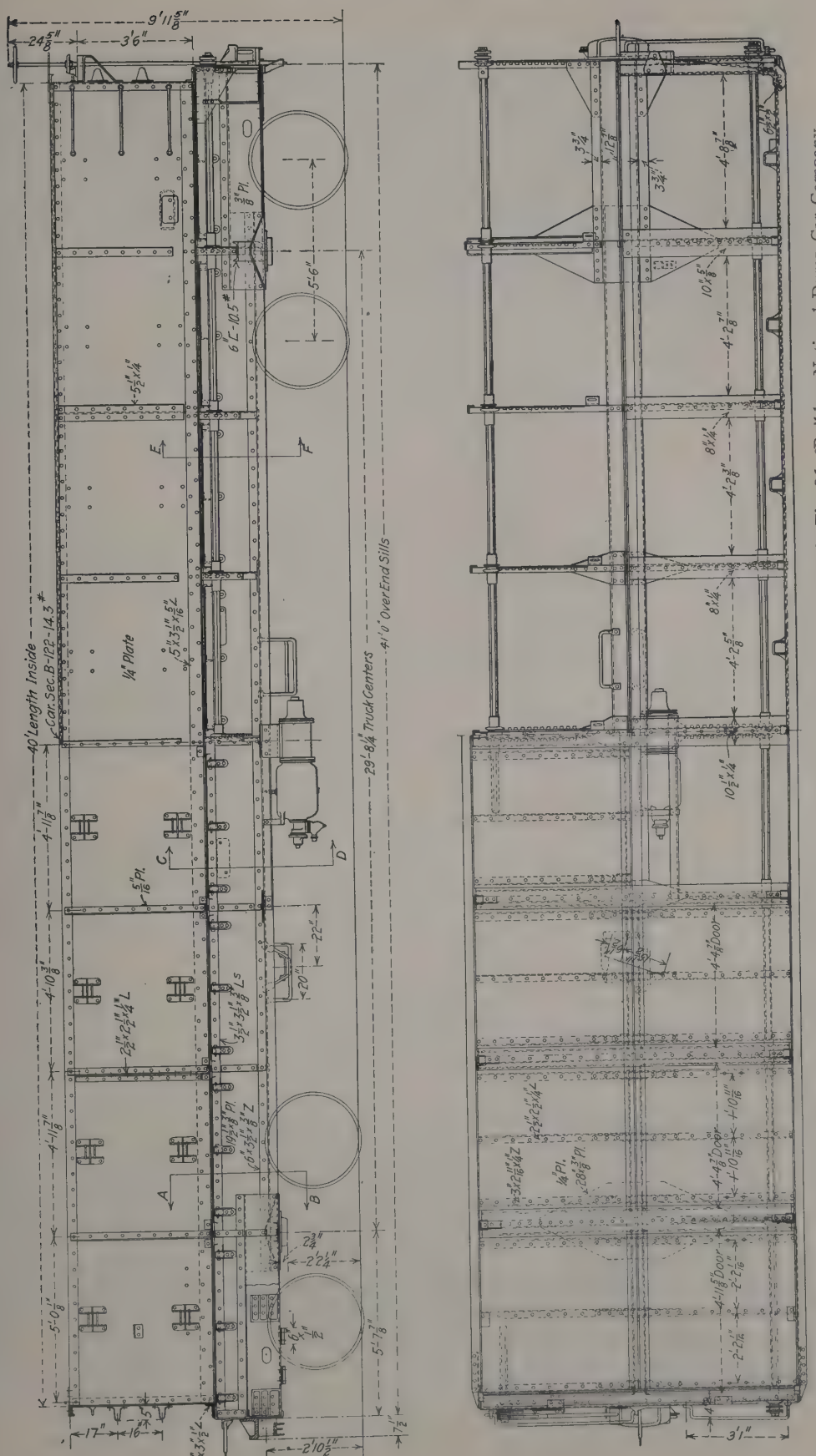


Fig. 94—Pacific Electric Railway All-Steel 50-Ton Capacity Drop Bottom Gondola Car Shown in Fig. 96. *Builder; National Dump Car Company.

Fig. 95—All-Steel 50-Ton Capacity Drop-Bottom Gondola Car. Weight, 39,300 lb.; Inside Length, 40 ft.; Inside Width, 9 ft. 6 in.; Inside Height, 4 ft. 7 in. Capacity, Level Full, Cubic Feet, 1,742. Builder; National Dump Car Company.

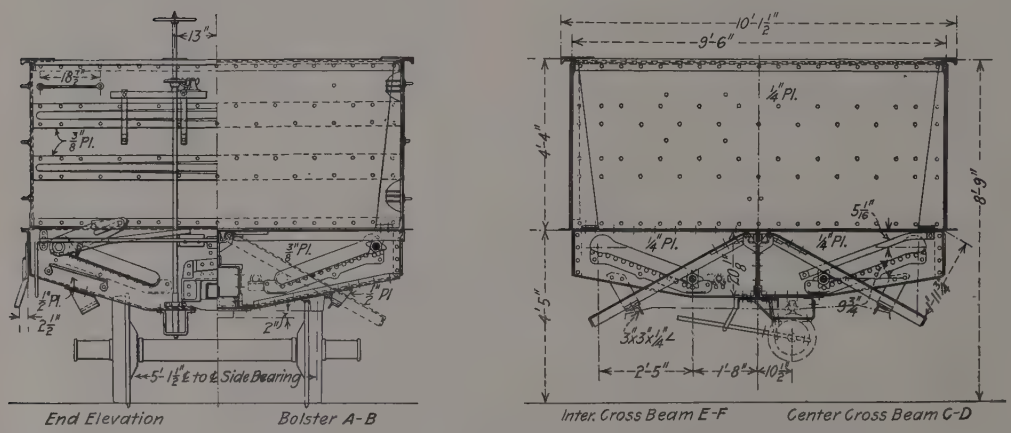


Fig. 96—End Elevation and Cross Sections of All-Steel 50-Ton Capacity Drop Bottom Gondola Car Shown in Fig. 94. Builder; National Dump Car Company.

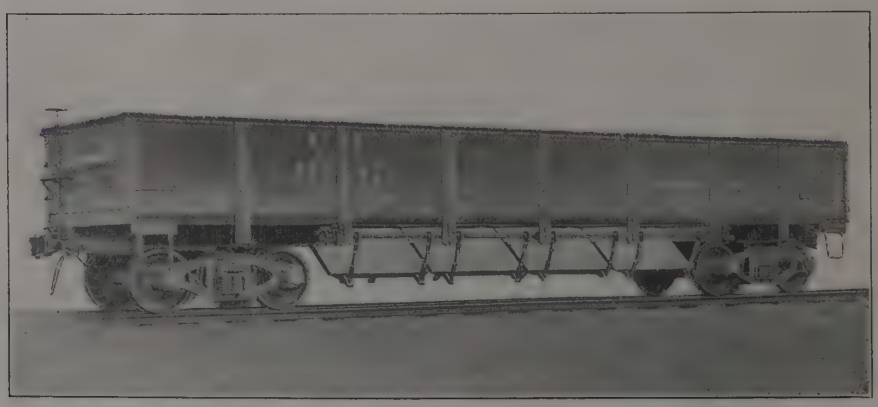


Fig. 97—All-Steel 50-Ton Capacity Drop-Bottom Gondola Car. Weight, 39,000 lb.; Inside Length, 40 ft. 4 in.; Inside Width, 9 ft. 5 in.; Inside Height, 4 ft. 6 in. Builder; The Bettendorf Company.
(*See Fig.* 98.)

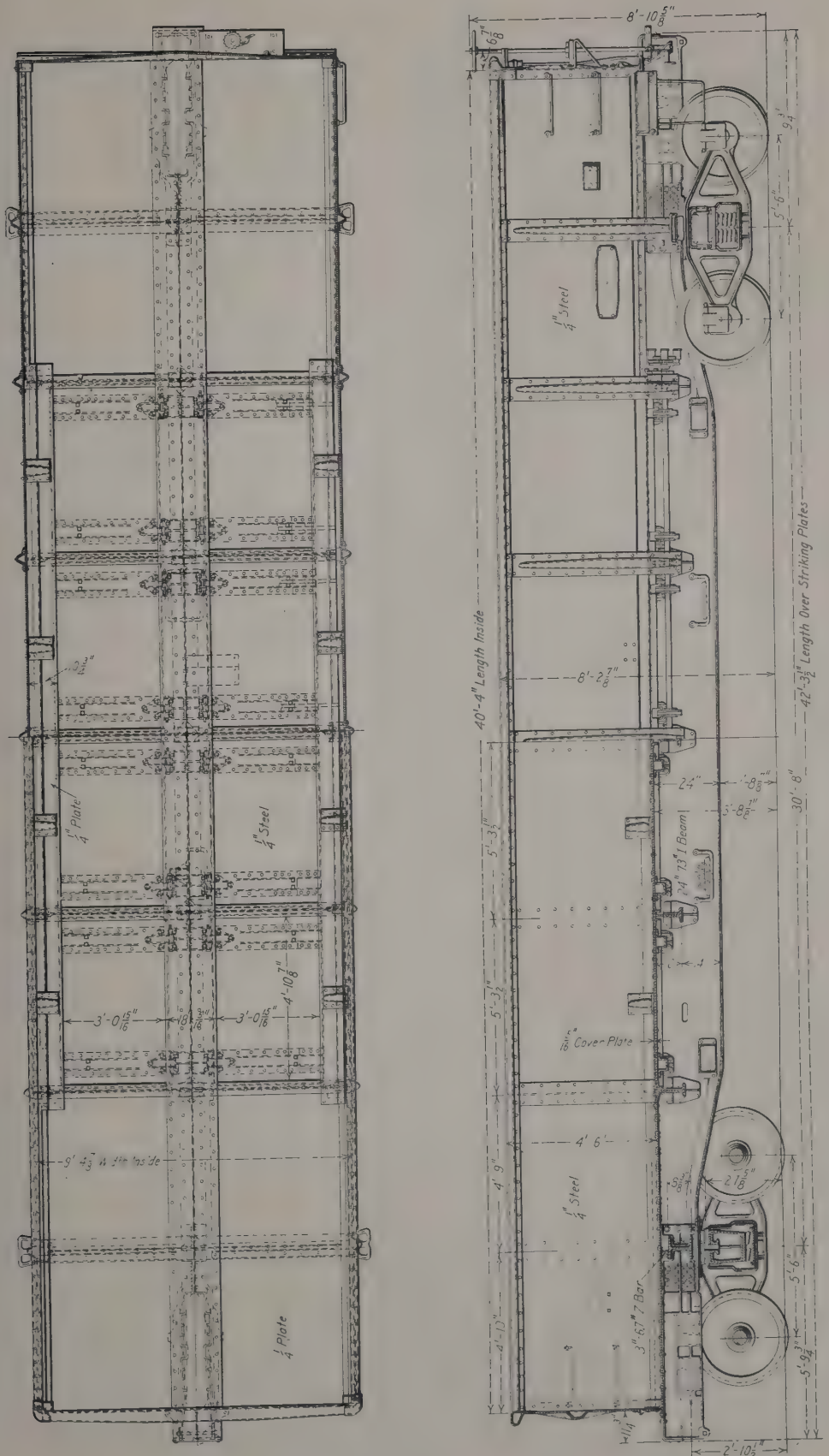


Fig. 98—Union Pacific All-Steel 50-Ton Capacity Drop Bottom Gondola Car. Builder; The Bettendorf Company.

(See also Fig. 97.)

Gondola Car Parts.

1 *Center Sill*	6 *End Stiffener*	11 *Crossbearer*	16 *Drawbar*
2 *Side Sill*	7 *Side Stake*	13 *Striking Casting*	17 *Hand Brake Shaft*
3 *End Sill*	8 *Drop Door*	14 *Center Plate*	18 *Hand Brake Step*
4 *Side Sheet*	9 *Door-Operating Gear*	15 *Draft Castings*	19 *Truck*
5 *End Sheet*	10 *Body Bolster*		

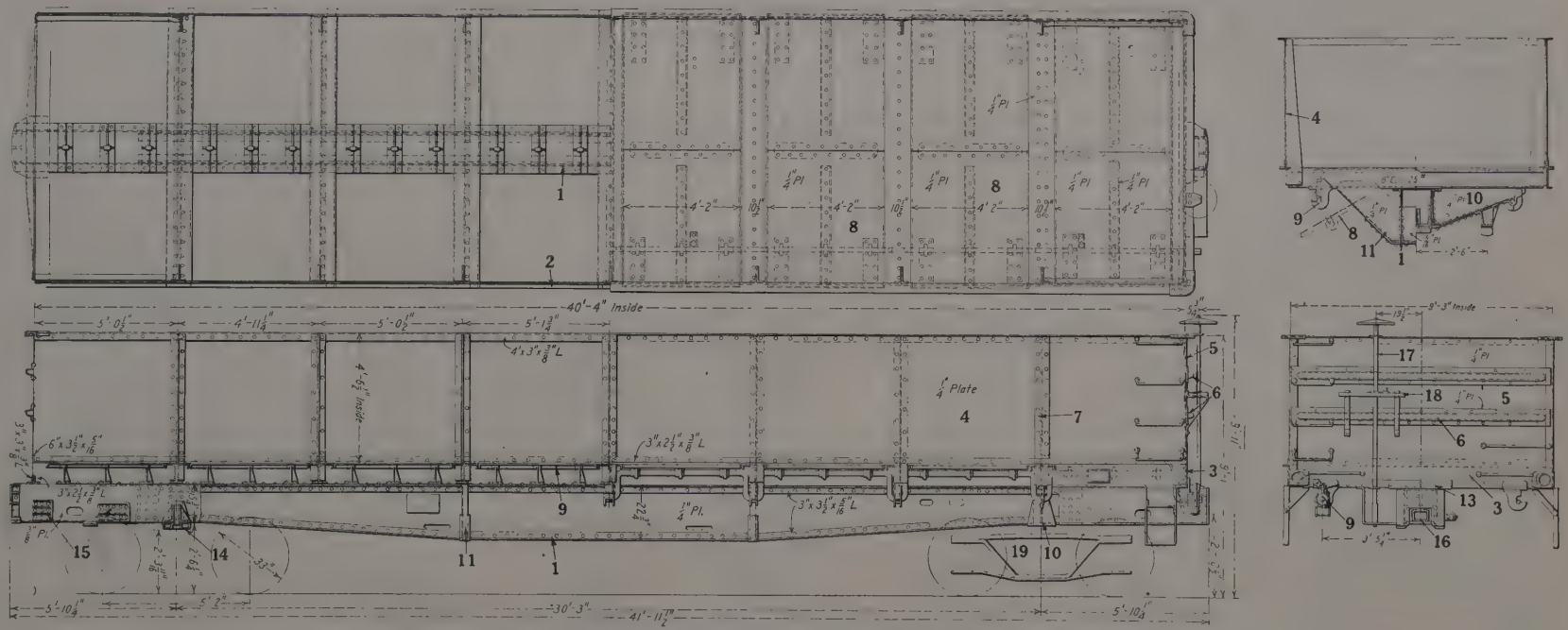


Fig. 99—Kanawha & Michigan Railway 50-Ton Capacity Drop Bottom Gondola Car. Builder, Ralston Steel Car Company.

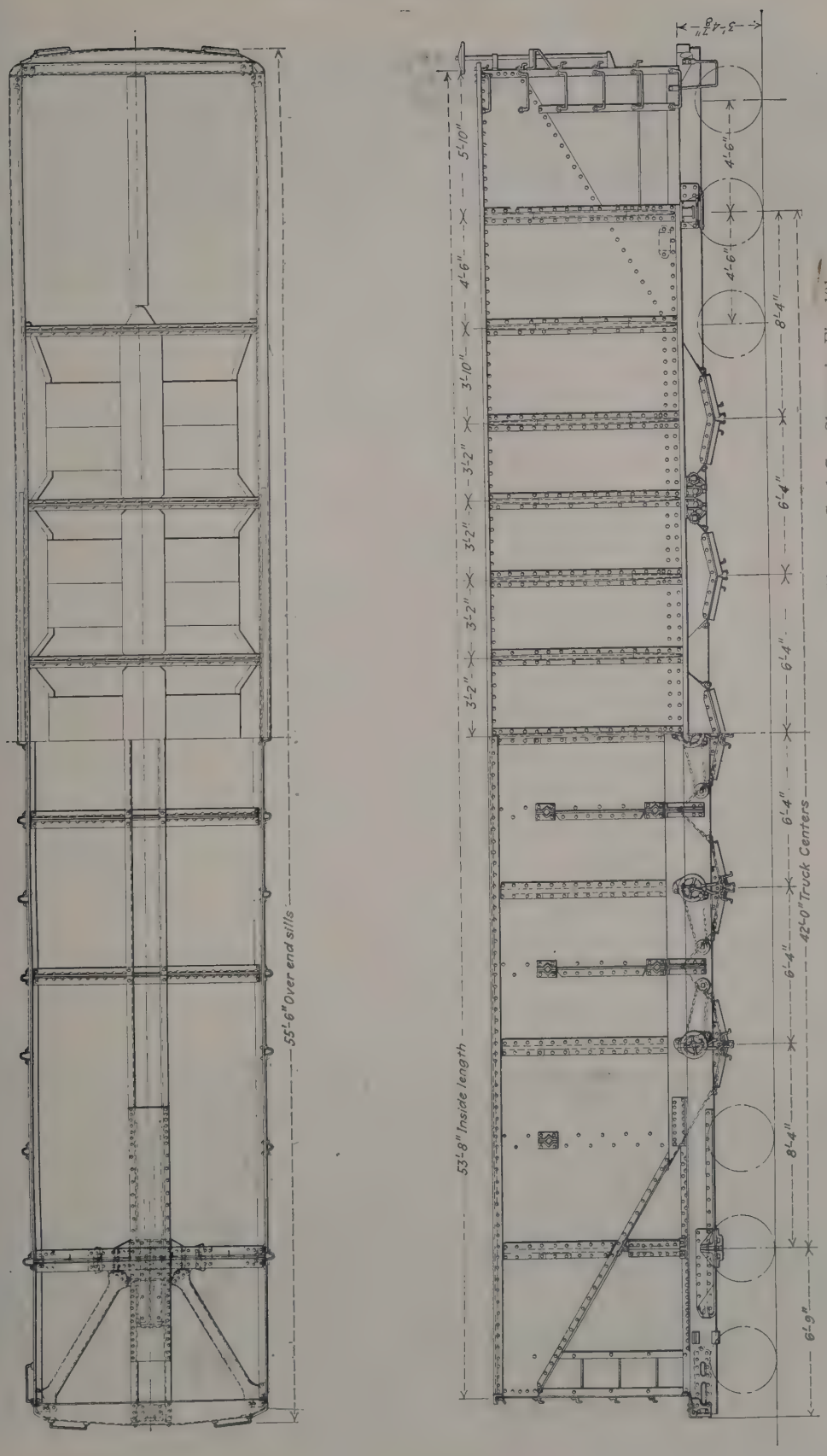


Fig. 100—Plan and Elevation of the Pennsylvania Railroad 105-Ton Hopper Coal Car Shown in Fig. 101.

Fig. 101—All-Steel 105-Ton Hopper—Quintuple Hoppers—Coal Car. Built by the Pennsylvania Railroad.
(*See also Fig.* 100.)

Light weight	83,600 lb.	Height inside	
Length over end sills	55 ft. 6 in.	Truck wheel base	9 ft. 0 in.
Length inside	53 ft. 8 in.	Truck journals	6 in. by 11 in.
Distance from center to center of trucks	42 ft. 0 in.	Truck weight	17,200 lb.
Width over all	10 ft. 2 in.	Marked capacity	210,000 lb.
Width inside	9 ft. 4⅞ in.	Capacity, level full	3,500 cu. ft.
Height above rail	11 ft. 6 in.	Additional contents, heaped	375 cu. ft.

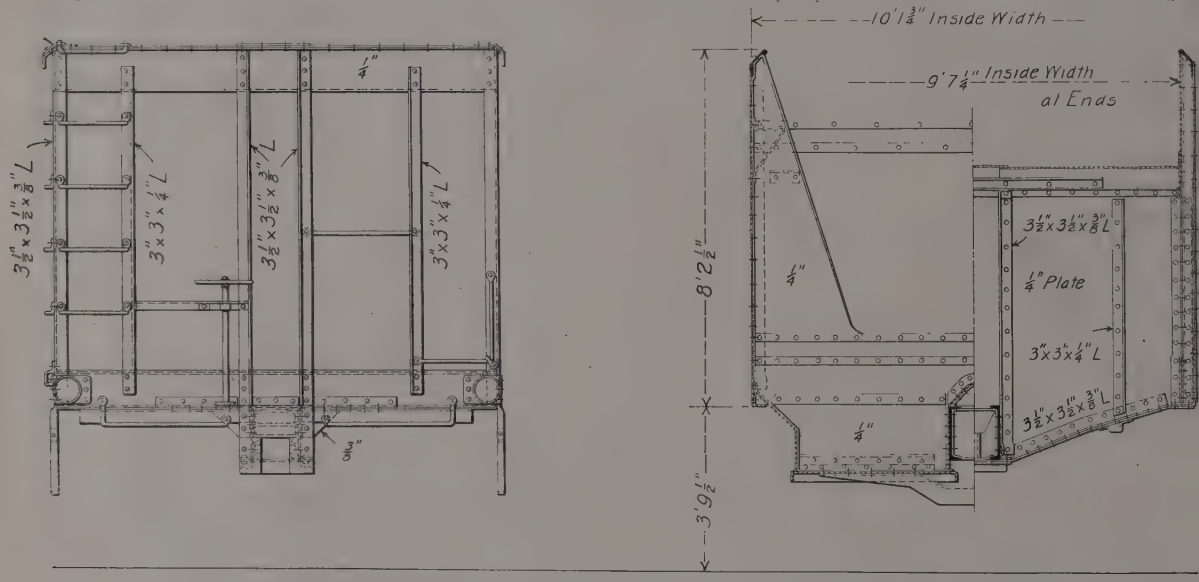


Fig. 102—End Elevation and Cross Sections, 100-Ton Hopper Car Shown in Figs. 103-104.

Fig. 103—All-Steel 100-Ton Capacity Hopper Car. Weight, 75,300 lb.; Inside Length, 46 ft. 4 in.; Inside Width, 10 ft. 1¾ in. Builder; Pressed Steel Car Company.
(*See Figs.* 102-104.)

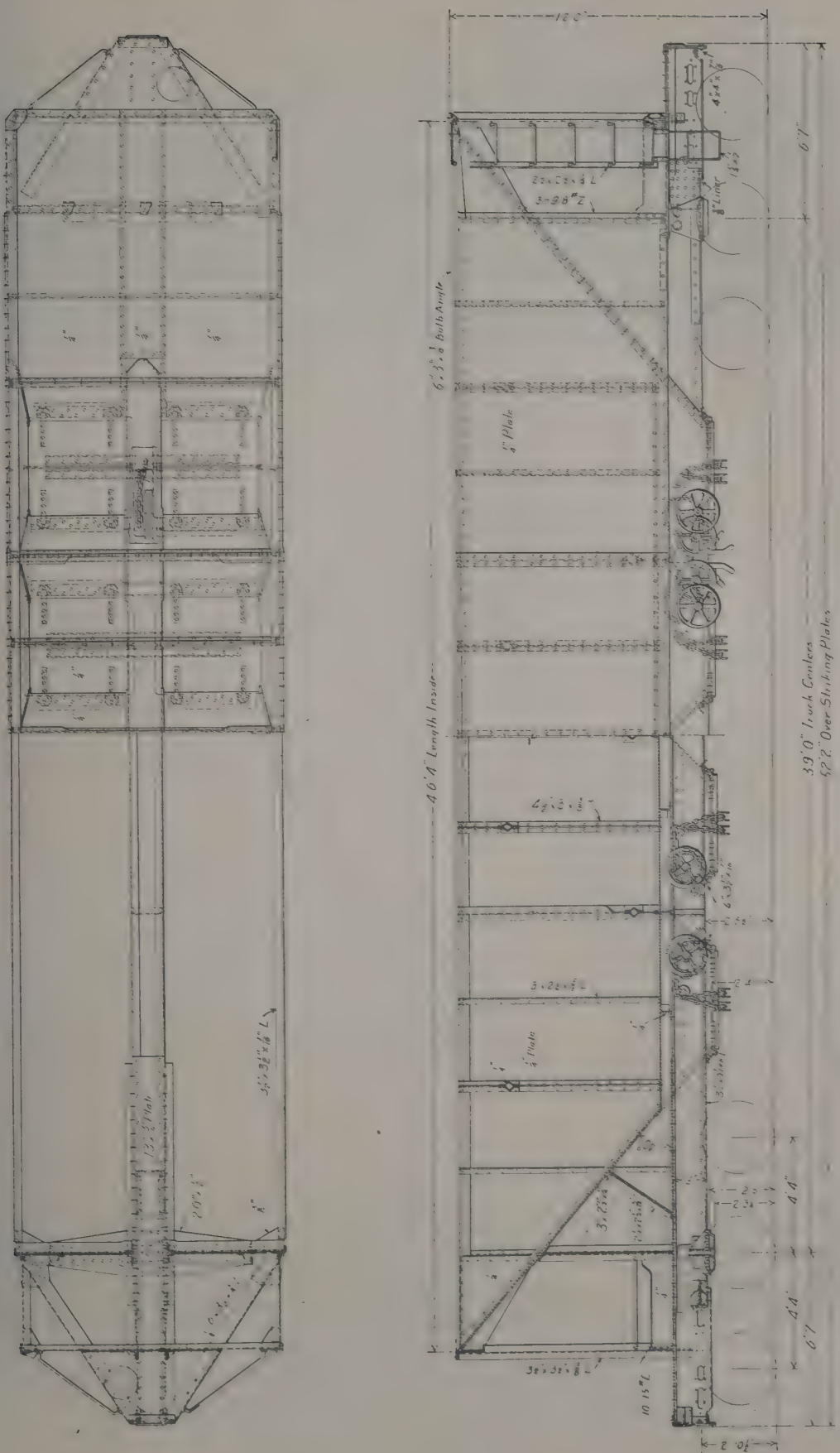


Fig. 104—Plan and Elevation, 100 Ton Hopper Car. Shown in Figs. 102 103.

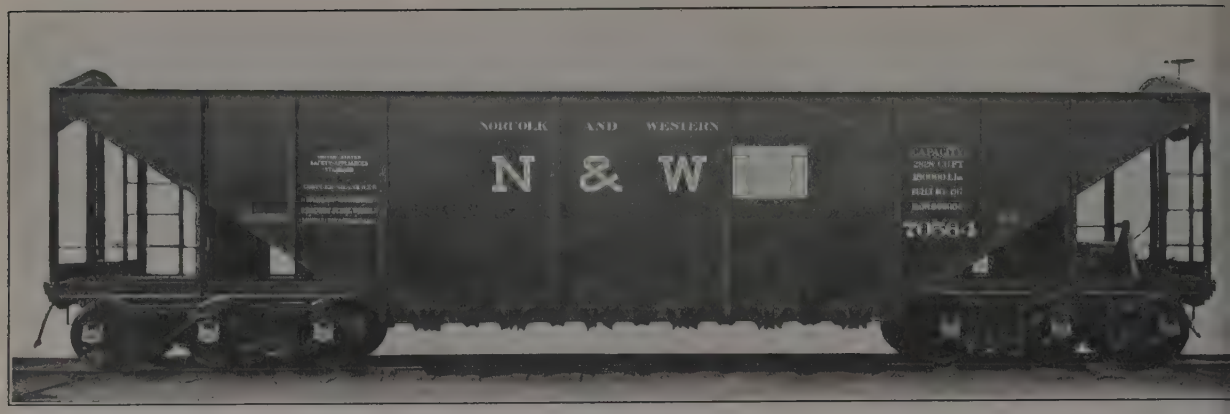


Fig. 105—All-Steel 100-Ton Capacity Hopper Car. Weight, 60,000 lb.; Inside Width, 9 ft. 6 in. Norfolk & Western Railway.

(*See also Figs.* 106-108.)

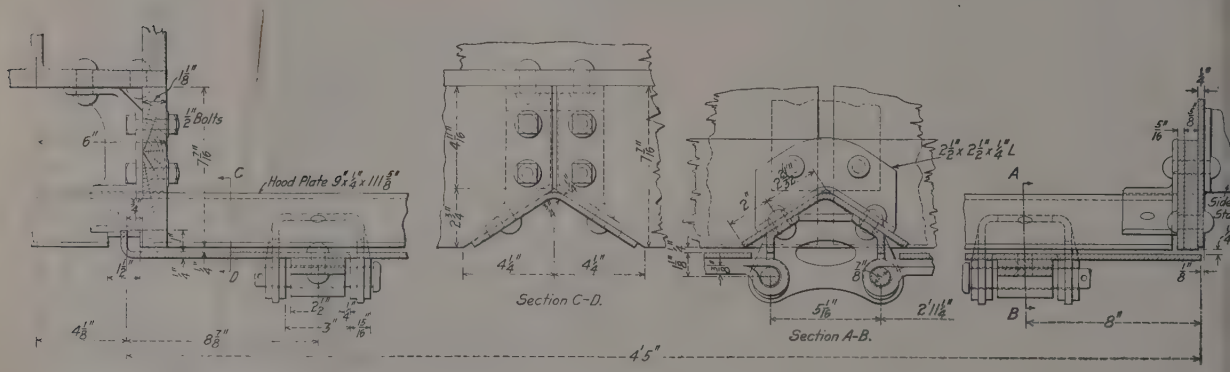


Fig. 106—Details of Door Construction, 100-Ton Hopper Car Shown in Fig. 105.

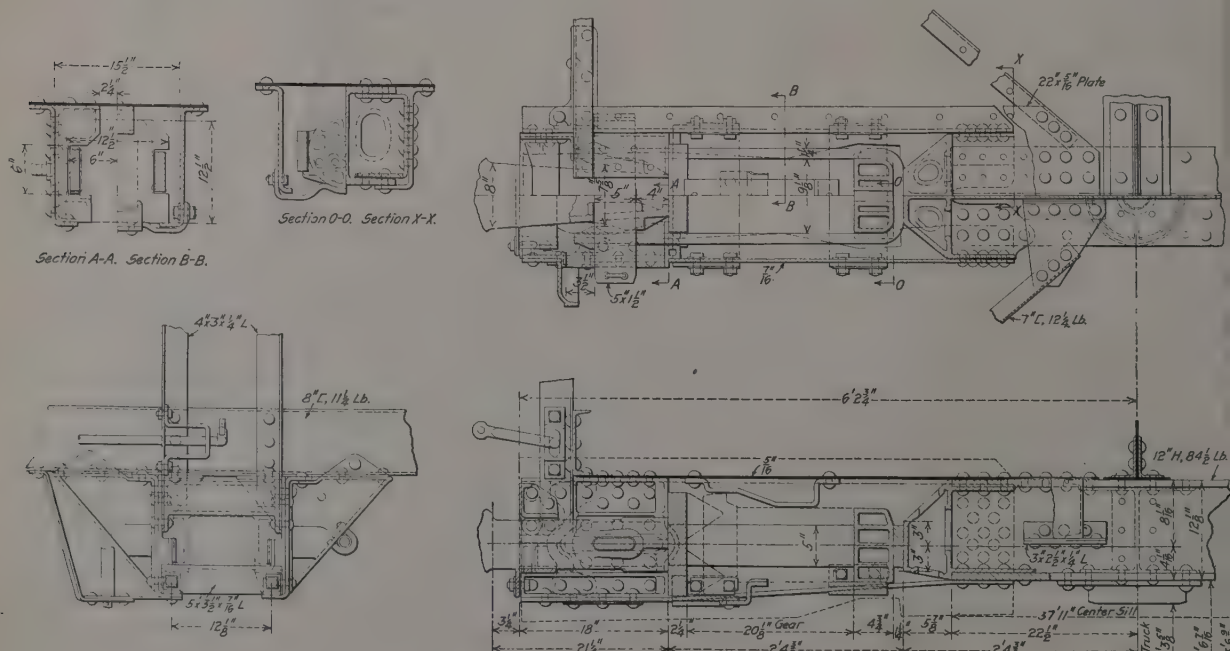
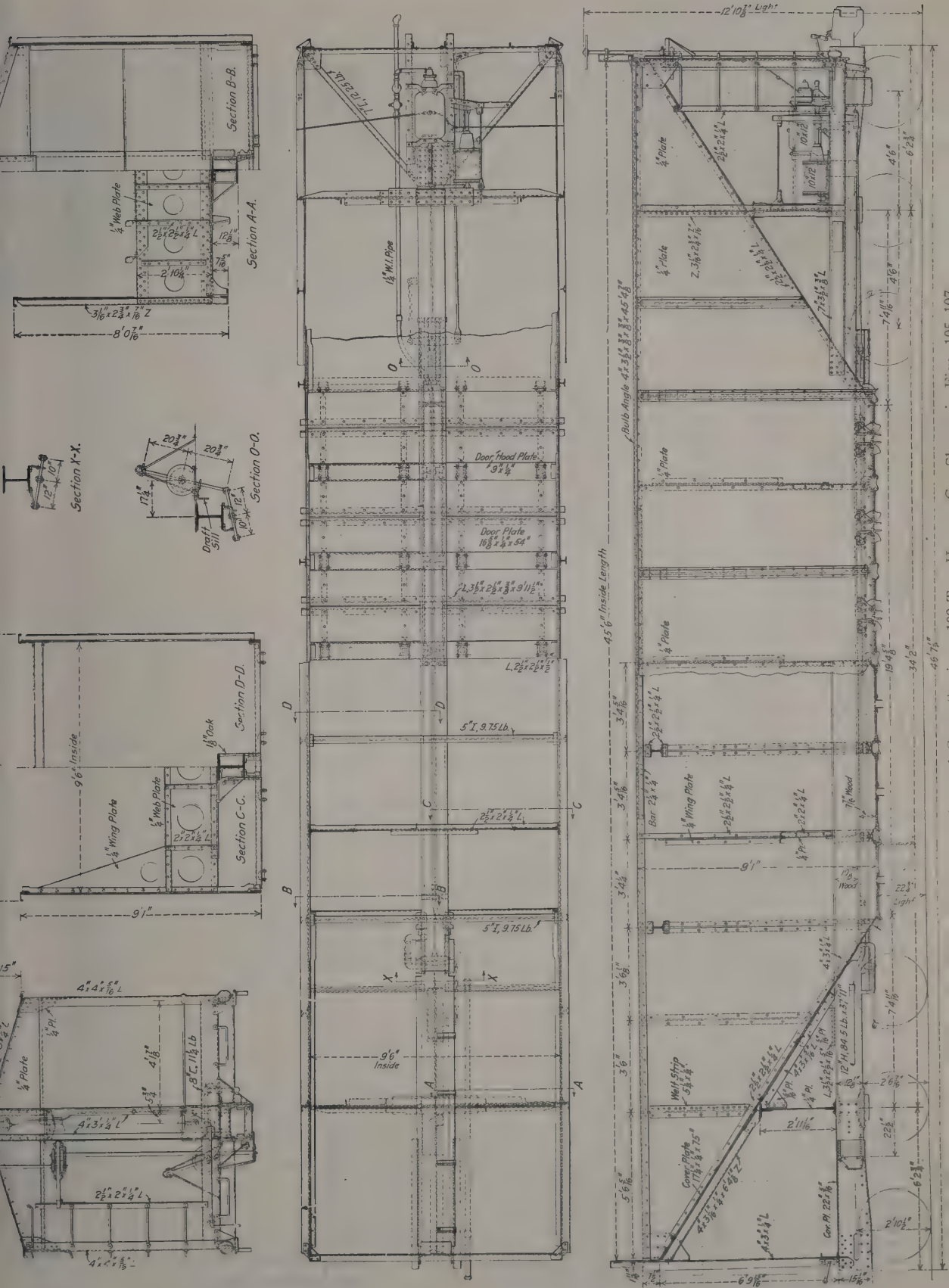


Fig. 107—Details of Draft Gear and Draft Sill Construction, 100-Ton Hopper Car Shown in Fig. 105.


Section B-B.
Section A-A.
Section X-X.
Section O-O.
Section D-D
Section C-C.
Draft Sill
Door Hood Plate
Door Plate
Wing Plate
Web Plate
Oak
Wood
Inside
Light
Bolt Angle
Cover Plate
Cor. Pl.
Wall Strip
Bar
Plate

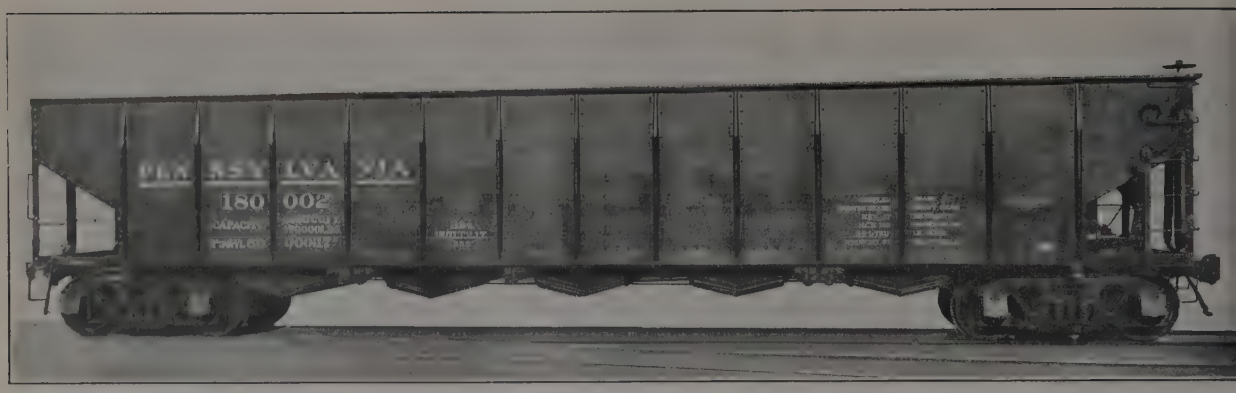


Fig. 109—All-Steel 85-Ton, 3,228 cu. ft. Capacity, Quintuple Hopper Car. Weight, 60,000 lb.; Inside Length, 46 ft. 6 in.; Inside Width, 9 ft. 4⅞ in. Builder; Pennsylvania Railroad.
(*See also Figs.* 110-112.)

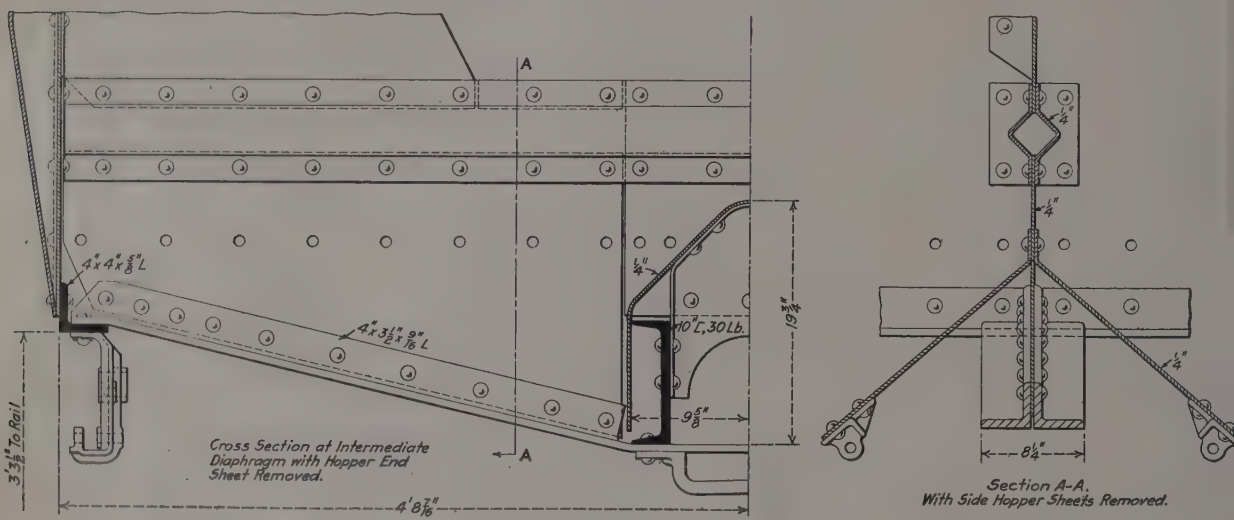


Fig. 110—Section Through Intermediate Diaphragm of Hopper Car Shown in Fig. 109.

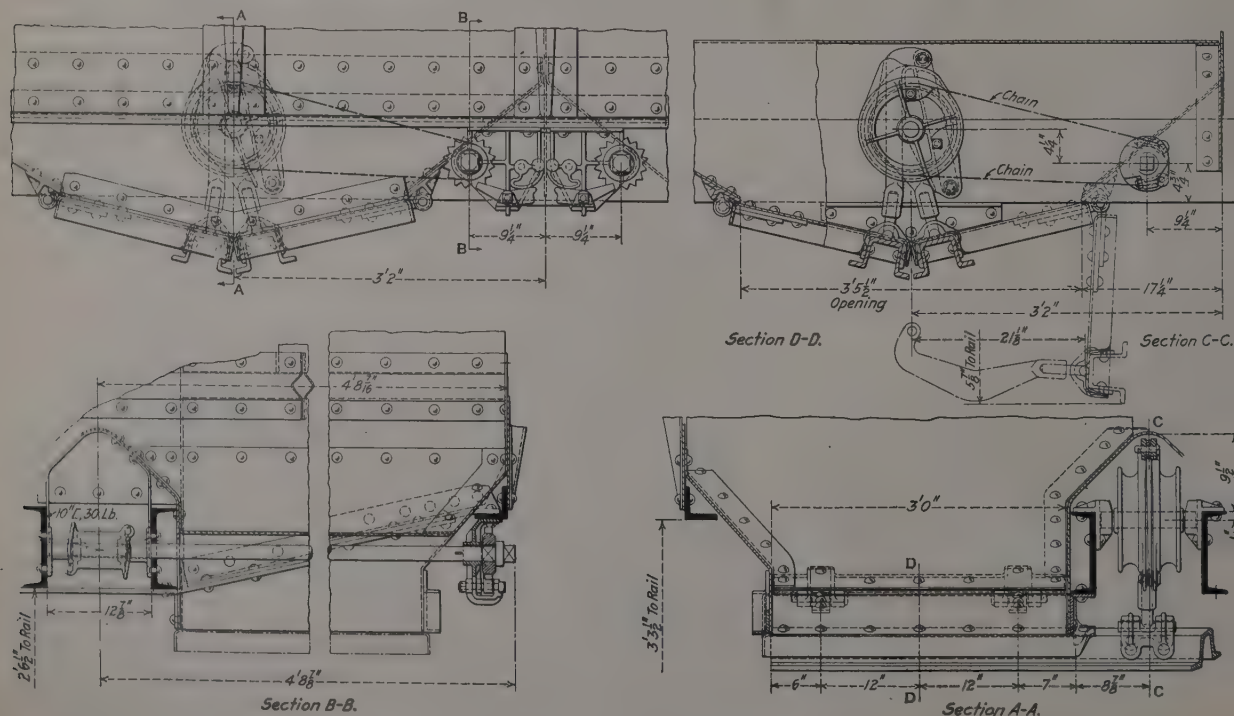


Fig. 111—Arrangement of Drop Doors for Hopper Car Shown in Fig. 109.

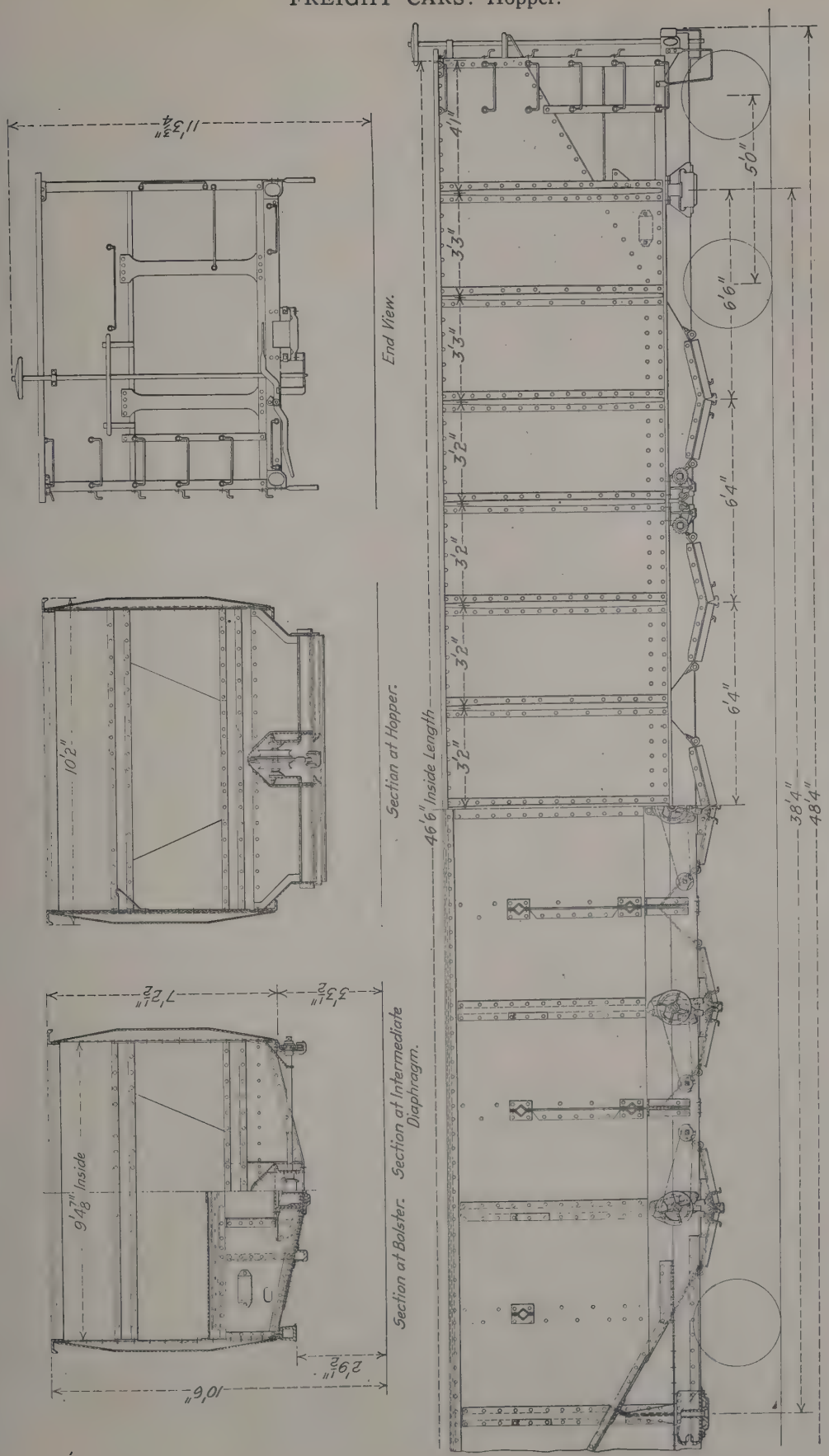


Fig. 112—Elevation, Cross Sections and End View 85-Ton Hopper Car Shown in Figs. 109-111.

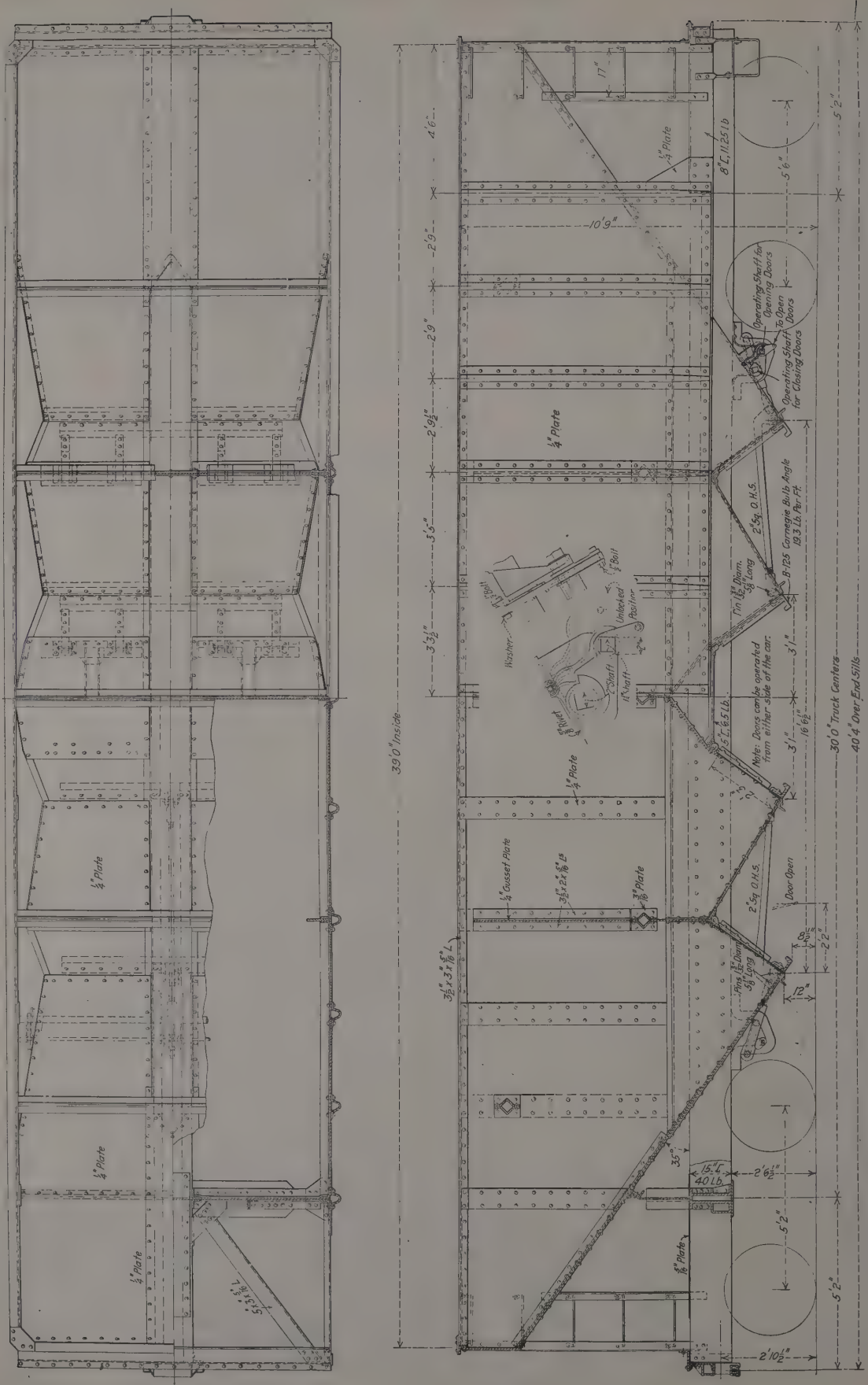


Fig. 113—Hillman 70-Ton Tandem Hopper Car. Insert Shows Hopper Door Operating and Locking Device. National Railway Appliance Company.

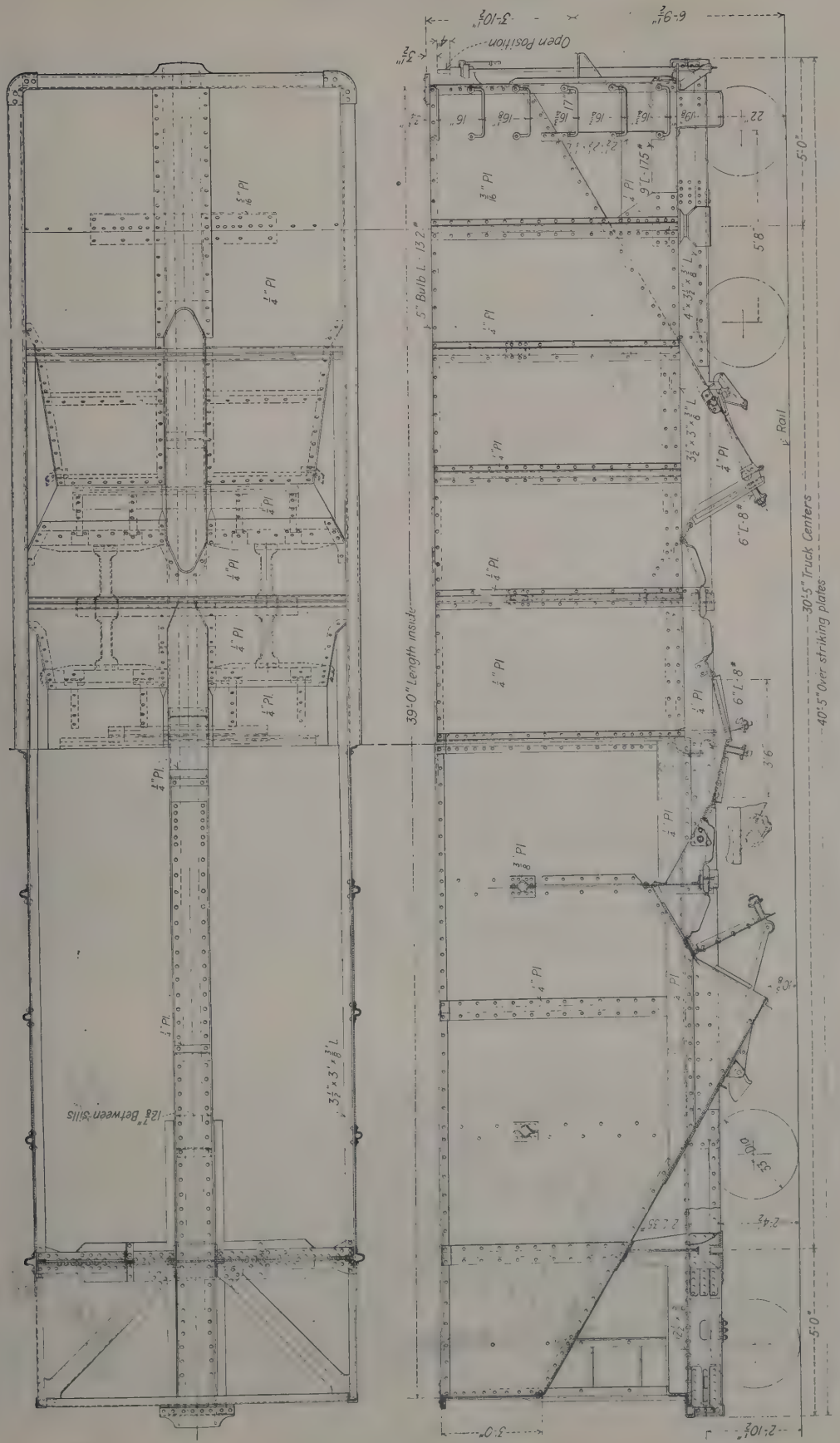


Fig. 114—Standard All-Steel 70-Ton Hopper Car as Designed by the United States Railroad Administration, (*See also Fig.* 115.)

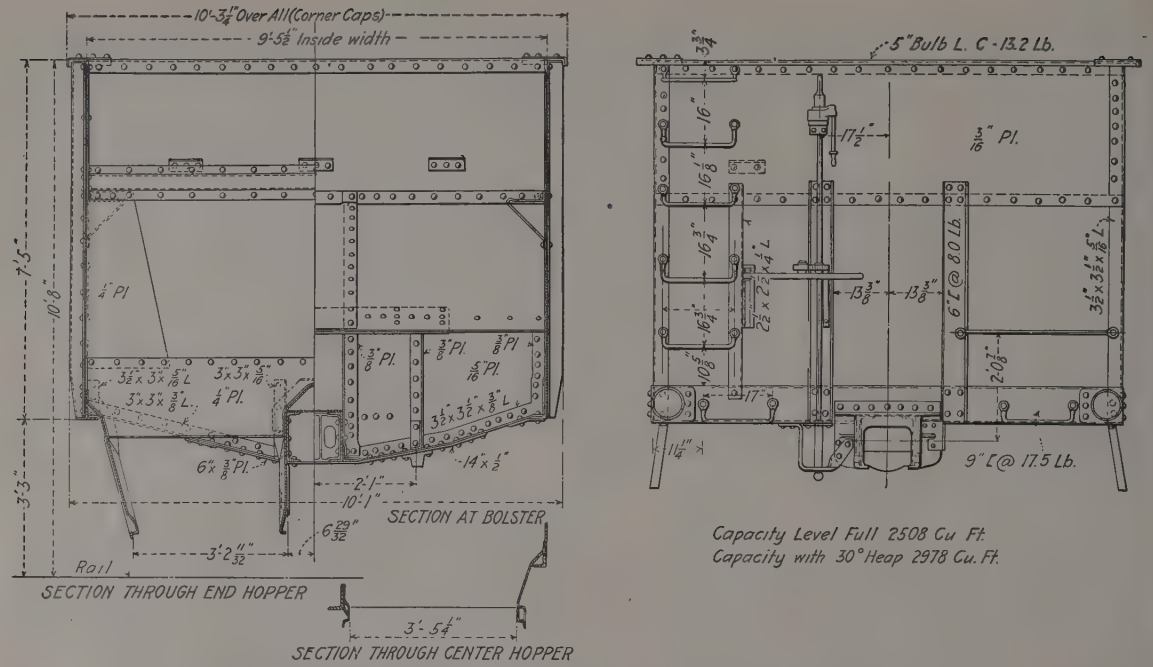


Fig. 115—Cross-Section and End of 70-Ton Hopper Car Shown in Fig. 114.

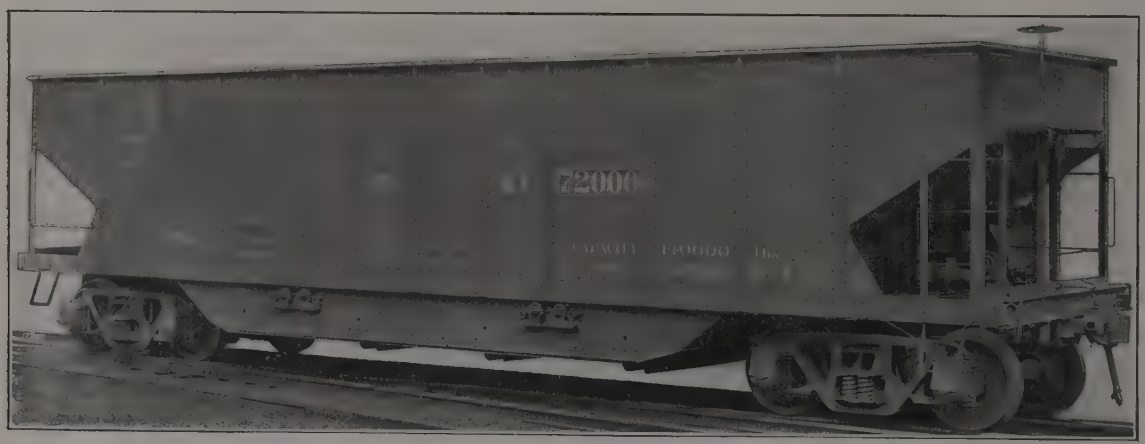


Fig. 116—All-Steel 70-Ton Capacity Quadruple Hopper Car. Builder; Standard Steel Car Company.

Fig. 117—Standard All-Steel 55-Ton Hopper Car as Designed by the United States Railroad Administration.

(*See also Fig.* 118.)

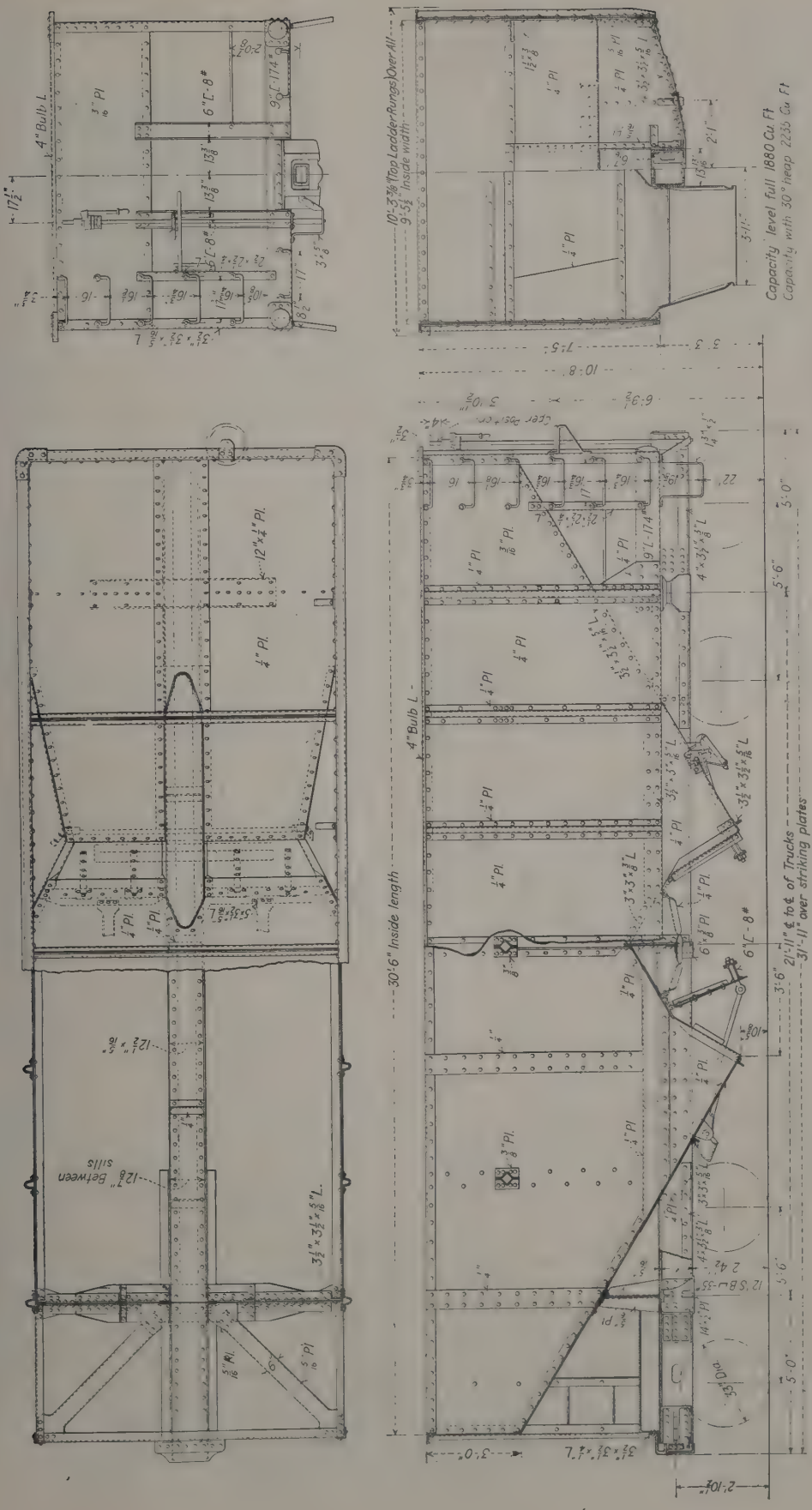

4" Bulb L
6"-8#
9'-1 7/4"
10'-3 3/8" Top Ladder Rungs Over All
9'-3 5/8" Inside width
Capacity level full 1880 Cu Ft
Capacity with 30° heap 2235 Cu Ft
30'-6" Inside length
12" x 1/2" Pl.
4" Pl.
12 7/8" Between sills
3 1/2" x 3 1/2" x 5/16" L.
4" Bulb L
21'-11" ℄ to ℄ of Trucks
31'-11" over striking plates
6'-8"
3" x 3" x 1/2" L
3 1/2" x 3 1/2" x 5/16" L
12 SB-55

Fig. 118—Standard All-Steel 55-Ton Hopper Car designed by the United States Railroad Administration. (*See also Fig.* 117.)

Enterprise Hopper Cars and Attachments

The question of hopper car design to best meet a specified service is usually the subject of debate in the minds of railroad officers having such specifications to prepare. The Enterprise Railway Equipment Company, after spending many years in careful study and experimentation on the development of this type of car, with its door operating mechanisms, safety devices, etc., is prepared to submit designs, comparative data and such other information as desired to all users of such equipment.

There are three distinctive types of hopper cars which may be referred to as Side Discharge—Fig. 123, Center Discharge—Fig. 126, and Bottom Discharge—Fig. 127. The latter incorporates two types of doors, the vertically suspended door at the end section and the horizontal twin doors at the intermediate section. The cars illustrated are all of fifty-five tons capacity. Designs of similar seventy-ton cars of the same general types are available.

Equipment for hopper car doors of the vertically suspended type are shown in Figs. 119 and 120, representing two types of door operating mechanisms, known as type "C" and type "D," respectively; the detail parts of the two types differing considerably as regards the automatically locking parts, both of which form very positive locks when in a closed position.

The Safety Door Lowering Device illustrated in Fig. 121 is an important feature of both types "C" and "D" mechanisms and it has been found is of great importance as a preventive of accidents and has made injury to the operator impossible.

Fig. 121—Safety Door Lowering Device

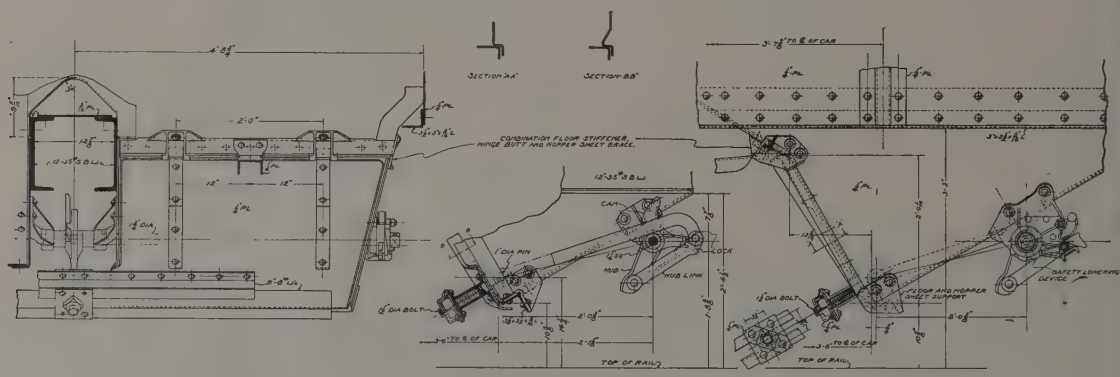


Fig. 119—Vertically Suspended Hopper Doors and Operating Mechanism, Type C

In conjunction with these door opening mechanisms there is illustrated in both Figs. 119 and 120 a recommended adjunct product, the Combination Floor Stiffener, Hinge Butt and Hopper Sheet Brace Casting. This member combines in one piece the hopper floor stiffener and the hinge butts; also includes a brace at the end which prevents tearing of the hopper sheet. The casting also provides a seal along the top edge of the car door and as the hopper sheets are flanged along their sides to form a shield and abutment for the edges of the car door

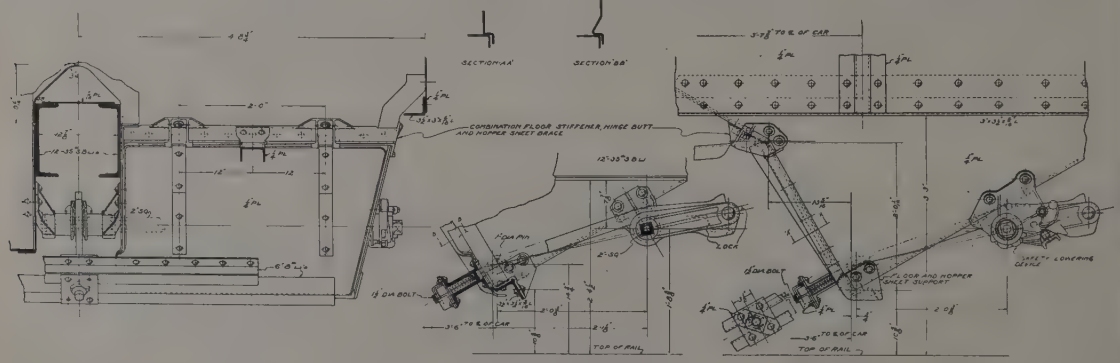


Fig. 120—Vertically Suspended Hopper Doors and Operating Mechanism, Type D

For other products and branch offices, see classified and alphabetical indexes.

Enterprise Hopper Cars and Attachments *(Cont'd.)*

as shown on cross sections *A-A* and *B-B*, the possibility of leakage may be entirely overcome. The small floor and hopper sheet support casting at the bottom of hopper is also an effective member.

Drop doors of the twin type which are nearly horizontal when in their closed position are shown in Fig. 122. The door locking mechanism, located between the center sills of the car form locks for the doors of unquestioned integrity, there being two points of support, one for each door, that both may be securely locked instead of balanced as would be the case if there were one point of support only. Features of adjustment and convenience are incorporated with this mechanism as is also the Safety Door Lowering Device. The Combination Floor Stiffener, Hinge Butt and Hopper Brace Casting above referred to is likewise shown in this illustration.

Drop door latch equipment of the Ingoldsby type is also obtainable from this Company for use on hopper cars. It is not claimed, however, that latch equipment will satisfactorily take the place of a door operating mechanism. A serviceable lock is incorporated in such latches, but qualities of safety, convenience and adjustment are not comparable.

Ore Hopper Cars must be designed within unusual limitations due to the fact that most of the large ore docks around the Great Lakes provide only for the handling of short cars and to obtain a car of seventy tons capacity plus a ten percent overload, all available space must be utilized. As the material hauled is usually of a very sticky nature, it is necessary to provide steep inclined floors, preferably concave, and meeting the side walls of the car in a manner whereby pockets or other retarding influences are eliminated. Of equal importance is a large door opening so that bridging of material may be prevented and the quick discharge of the load assured. Such a door opening prevents the use of a continuous center sill construction which would be highly desirable and to obtain corresponding members of equal value for absorbing and transmitting the draft shocks the underframe of the car is boat-shaped, as illustrated in Fig. 144. It is claimed that the draft shocks are thereby effectively transmitted through the draft sills to the sides of the car. The car doors are necessarily large and support very unusual loads; therefore, the car door locking mechanisms must be of great strength, positive in character and the power for operating them multiplied. On such cars safety operating equipment must be provided on both sides so that the operator may conveniently and safely operate them from his position at either side of the track.

The Enterprise Railway Equipment Company designs all of the above mentioned types and in fact all load-discharging cars for handling coal, coke, ore, ballast and grain. It also furnishes the car builders with the door-operating mechanism castings for such cars. To design cars to meet the varied fixed conditions which exist in different localities and to have the designs one hundred per cent efficient for the service intended has been the purpose of this company as car designers. Whether the conditions warrant the use of a hopper, a gondola or a general service car, or whether it be desired that the load be discharged to the side, or to the center of the track, or just below the car does not matter. So long as the conditions to be met are understood the company is prepared to furnish a suitable design.

This company believes that the light weight of a car should bear a proper ratio to the total weight of the car and the load to be carried; that the material used in the construction of the car be placed in such manner that the greatest cubic capacity will be obtained and that the arrangement of the doors should be such that the load will discharge freely from the car body.

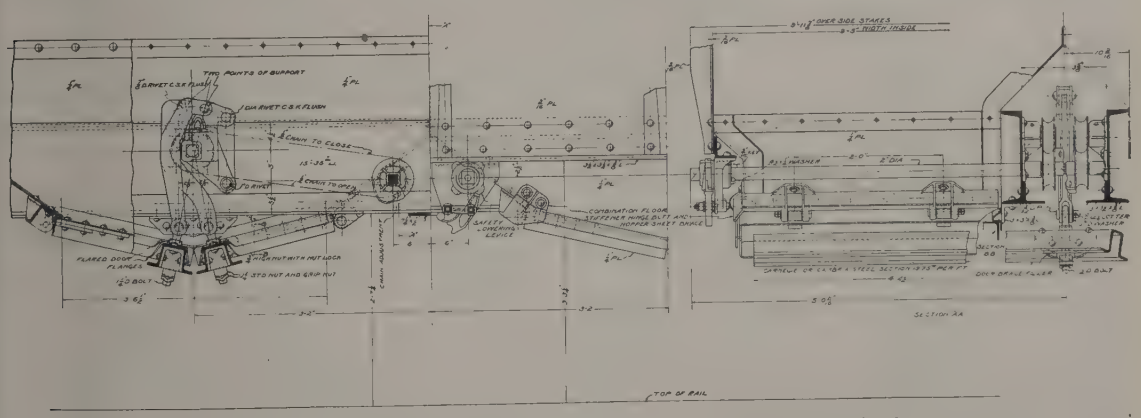

TWO POINTS OF SUPPORT
SAFETY LOWERING LEVER
COMBINATION FLOOR STIFFENER HINGE BUTT AND HOPPER SHEET ANGLE
SECTION A-A
TOP OF RAIL

Fig. 122—Twin Type Hopper Doors with Operating and Locking Mechanism

In the designing of load discharging cars, the Enterprise Railway Equipment Company performs the service of Consulting Engineers for the purpose of better presenting its door-operating mechanisms, which are applicable to all standard designs of load-discharging cars and which the company supplies to the builders.

The door operating mechanisms of this company are in extensive use on nearly all of the large railway systems in the United States. They combine the essential qualities of strength and simplicity with positive automatic lock adjusting features, also convenience and safety.

For other products and branch offices, see classified and alphabetical indexes.

ENTERPRISE RAILWAY EQUIPMENT CO., CHICAGO, ILL.

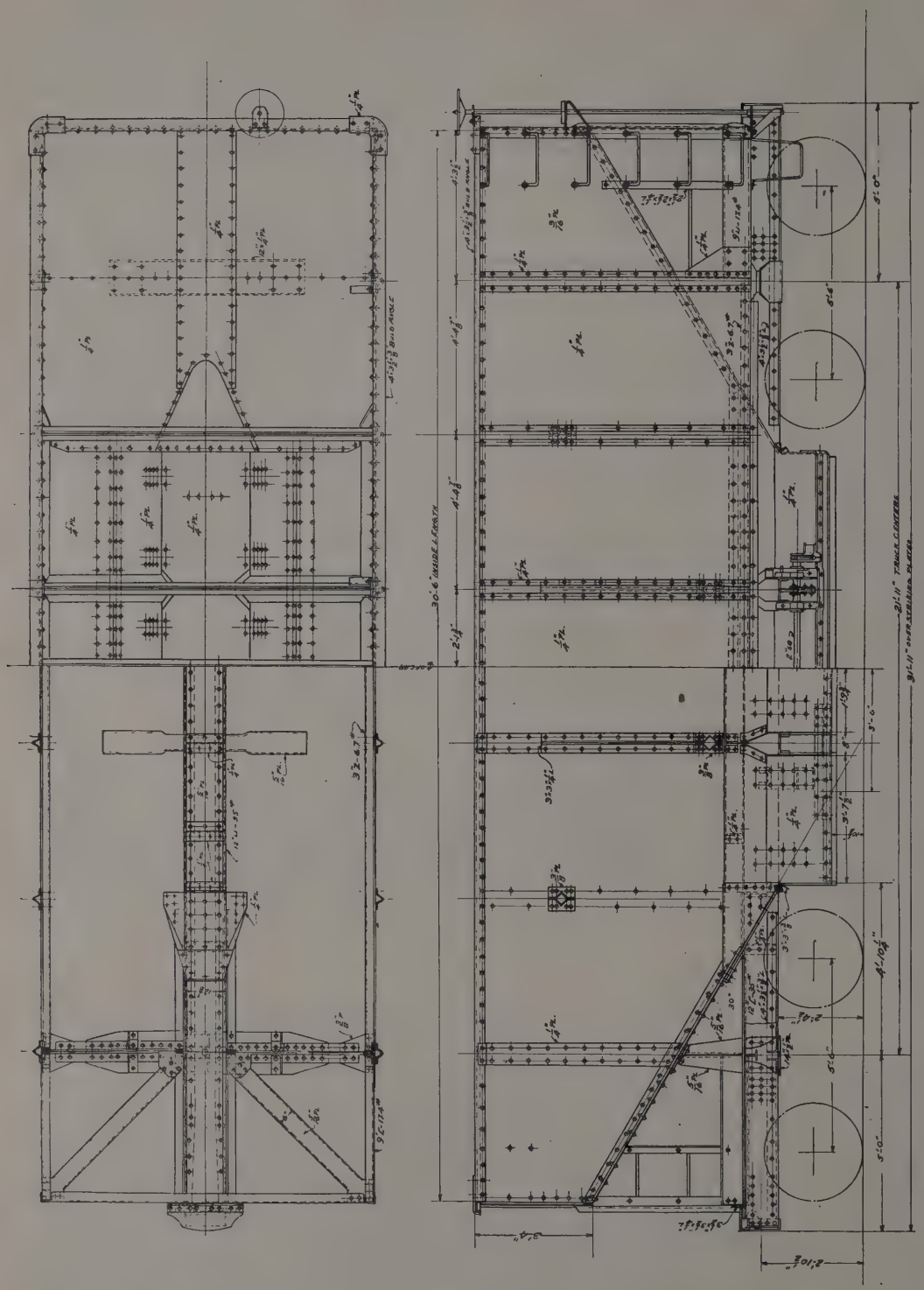


Fig. 123—All-Steel 55-Ton Capacity Side Discharge Hopper Car. Cubic Capacity, 2033 cu. ft. Level or 2321 cu. ft. with 12 in. Average Heap. Designer; Enterprise Railway Equipment Company.

(*See also Fig. 124 and Pages 166-167.*)

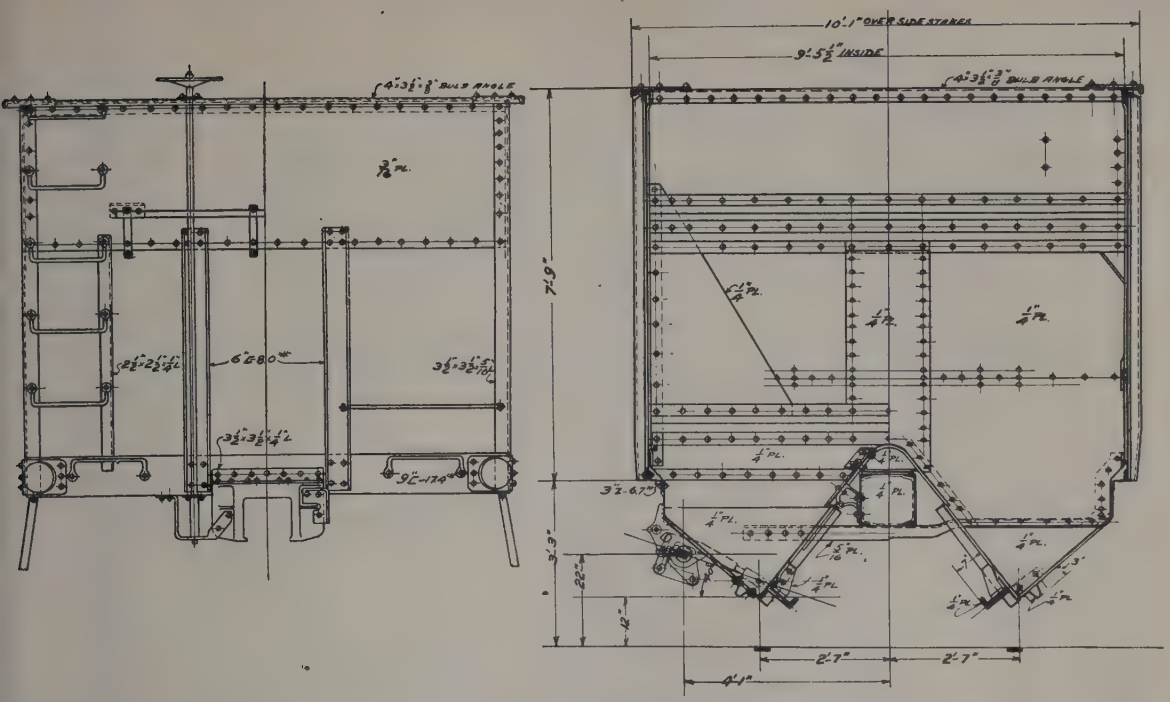


Fig. 124—End Elevation and Cross Section of All-Steel 55-Ton Capacity Side Discharge Hopper Car Shown in Fig. 123.

Principal Dimensions and Weights of 55-Ton Side and Center Discharge Hopper Car.

Side Discharge, Figs. 123-124.		Center Discharge, Figs. 125-126.	
Length over Striking Plates	31 ft. 11 in.	Length over Striking Plates	31 ft. 11 in.
Truck Centers	21 ft. 11 in.	Truck Centers	21 ft. 11 in.
Truck Wheel Base	5 ft. 6 in.	Truck Wheel Base	5 ft. 6 in.
Inside Length	30 ft. 6 in.	Inside Length	30 ft. 6 in.
Inside Width	9 ft. 5½ in.	Inside Width	9 ft. 5½ in.
Cubical Capacity—Level	2033 cu. ft.	Cubical Capacity—Level	2012 cu. ft.
Cubical Capacity with 12 Average heap	2321 cu. ft.	Cubical Capacity—12 Average heap	2300 cu. ft.

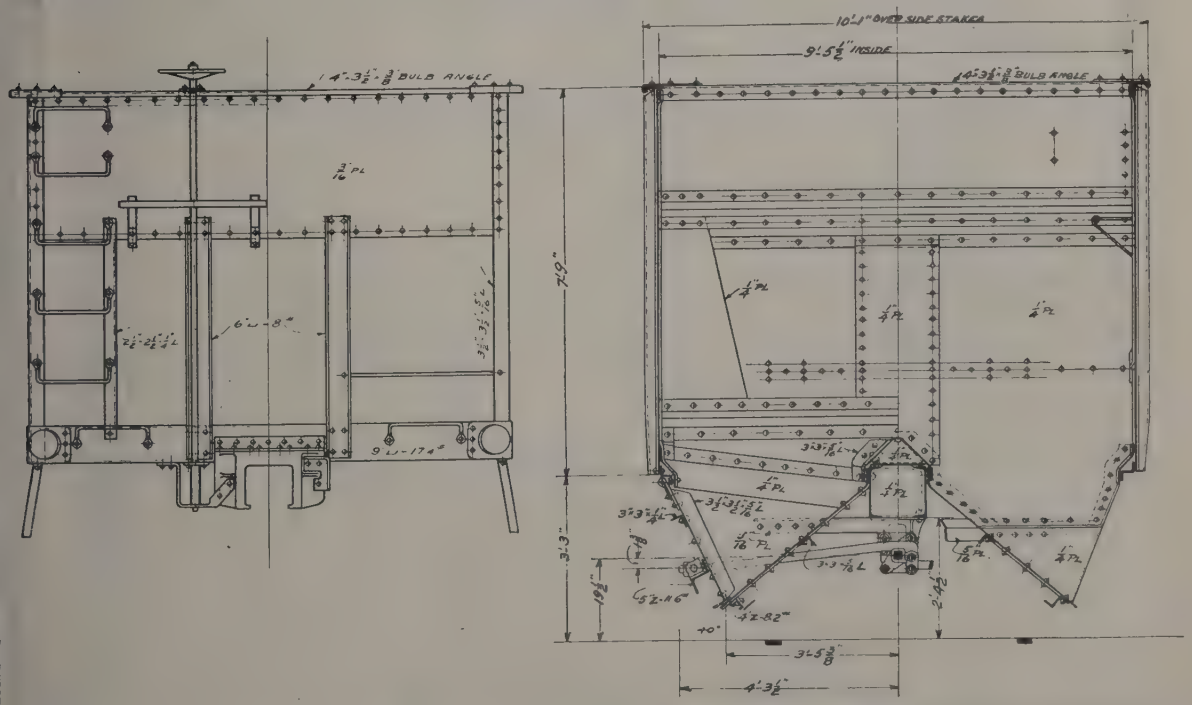


Fig. 125—End Elevation and Cross Section of All-Steel 55-Ton Capacity Center Discharge Hopper Car shown in Fig. 126.

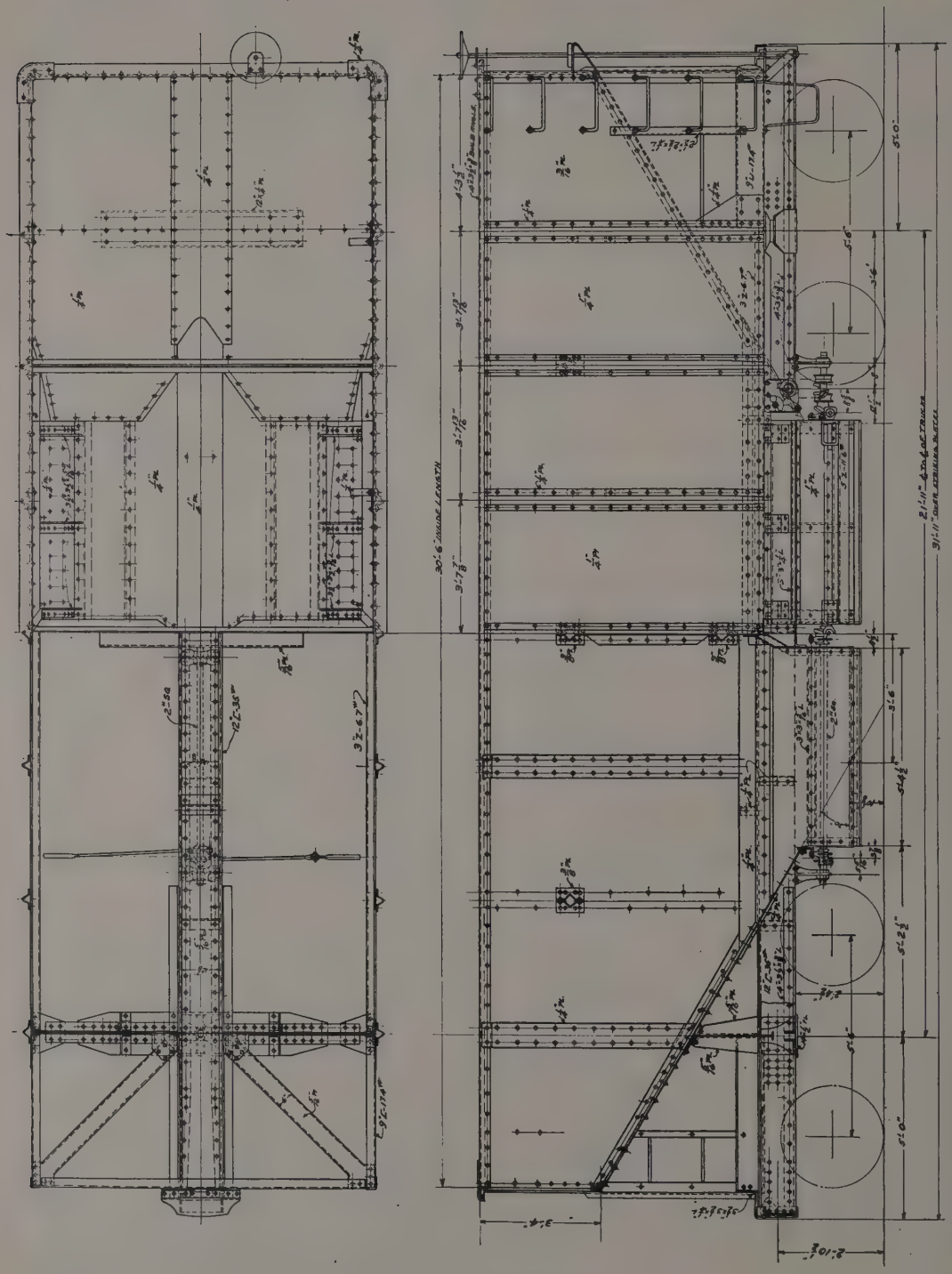


Fig. 126—All-Steel 55-Ton Capacity Center Discharge Hopper Car. Cubic Capacity, 2012 cu. ft. Level or 2300 cu. ft. with 12 in Average Heap. Designer; Enterprise Railway Equipment Company.

(*See also Fig. 125 and Pages 166-167.*)

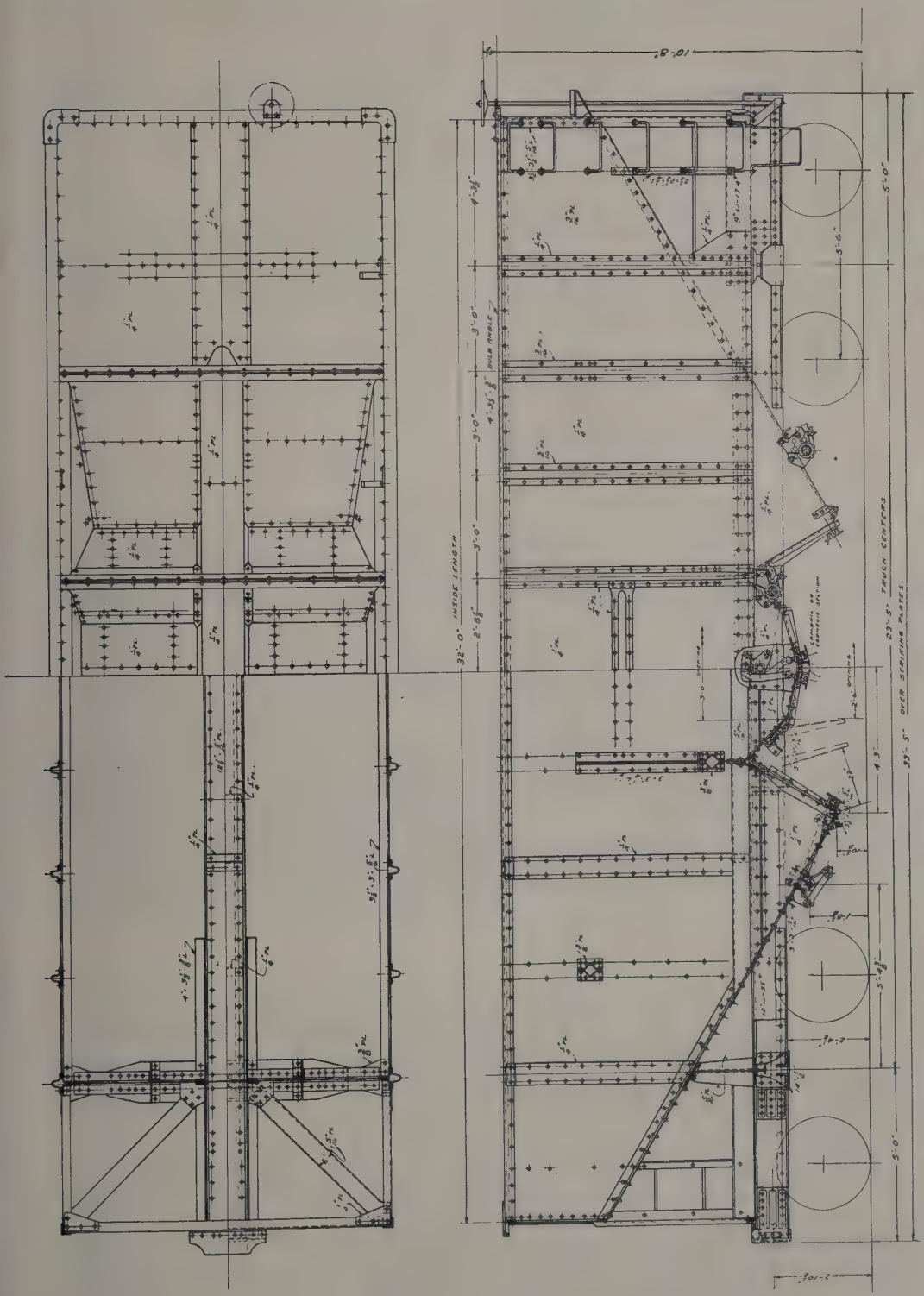


Fig. 127.—All-Steel 55-Ton Capacity Hopper Car with Interposed Hopper. Cubic Capacity, 2029 cu. ft. Level or 2331 cu. ft. with 12 in. Average Heap. Designer, Enterprise Railway Equipment Company.
(*See also Fig.* 128 *and Pages* 166-167.)

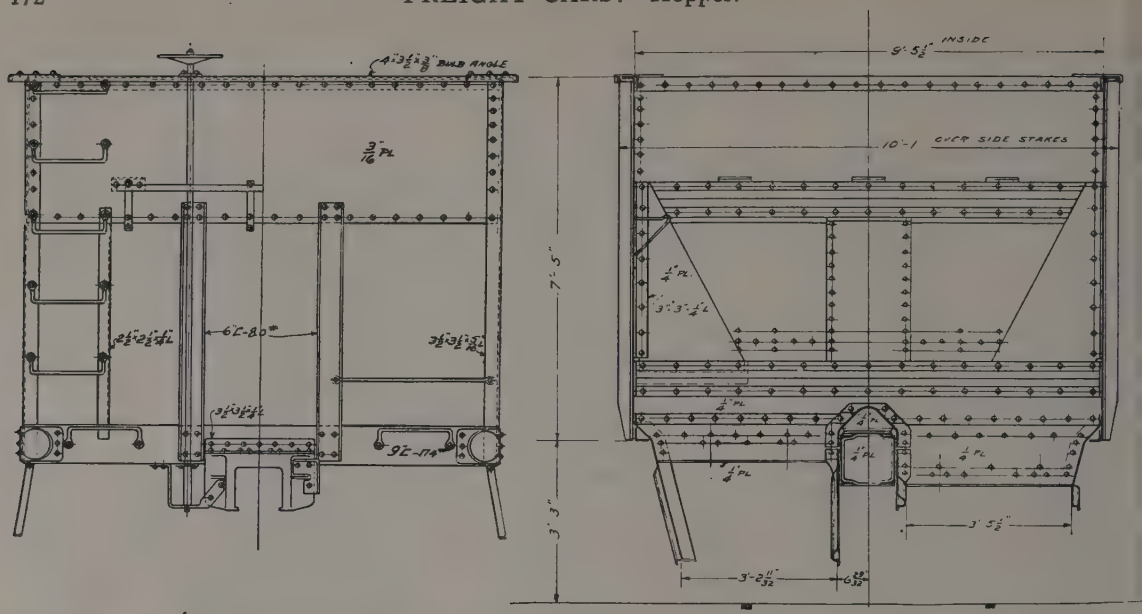


Fig. 128— End Elevation and Cross Section of All-Steel 55-Ton Capacity Hopper Car Shown in Fig. 127

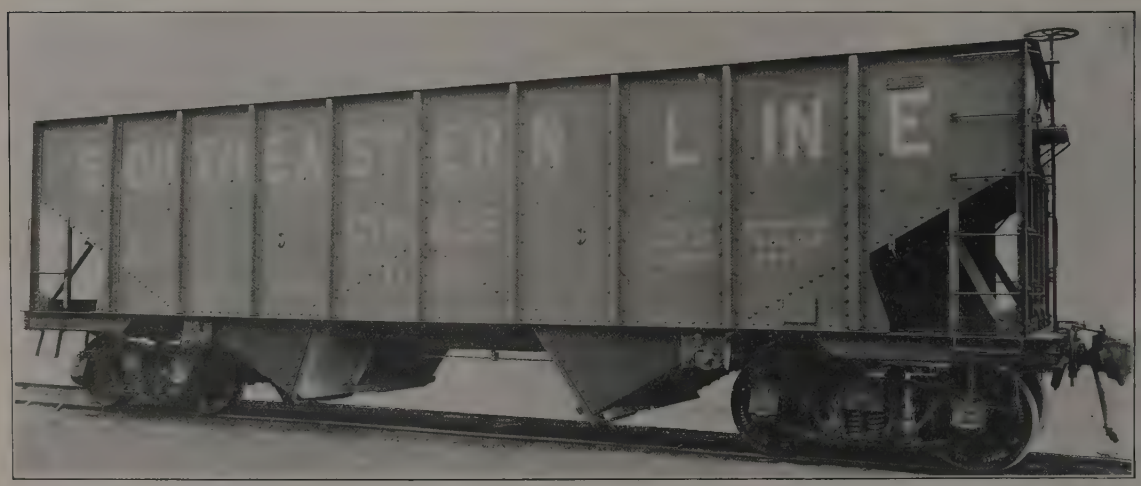


Fig. 129—All-Steel 50-Ton Capacity Hopper Car. Builder, The Pullman Company—Haskell Barker Plant.

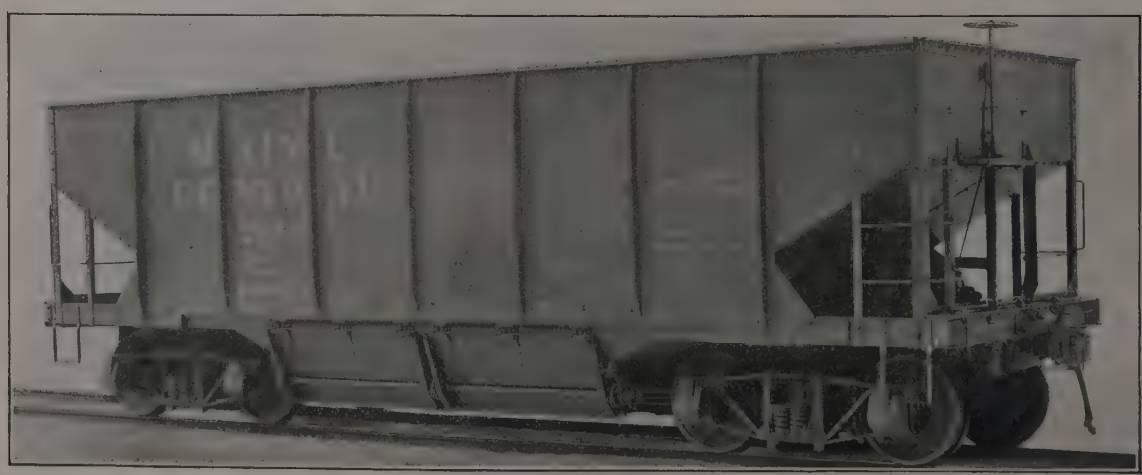


Fig. 130—All-Steel 50-Ton Capacity Side Dump Hopper Car. Weight, 38,200 lbs.; Inside Length, 30 ft. 0 in.; Inside Width, 9 ft. 5½ in. Builder, Standard Steel Car Company.

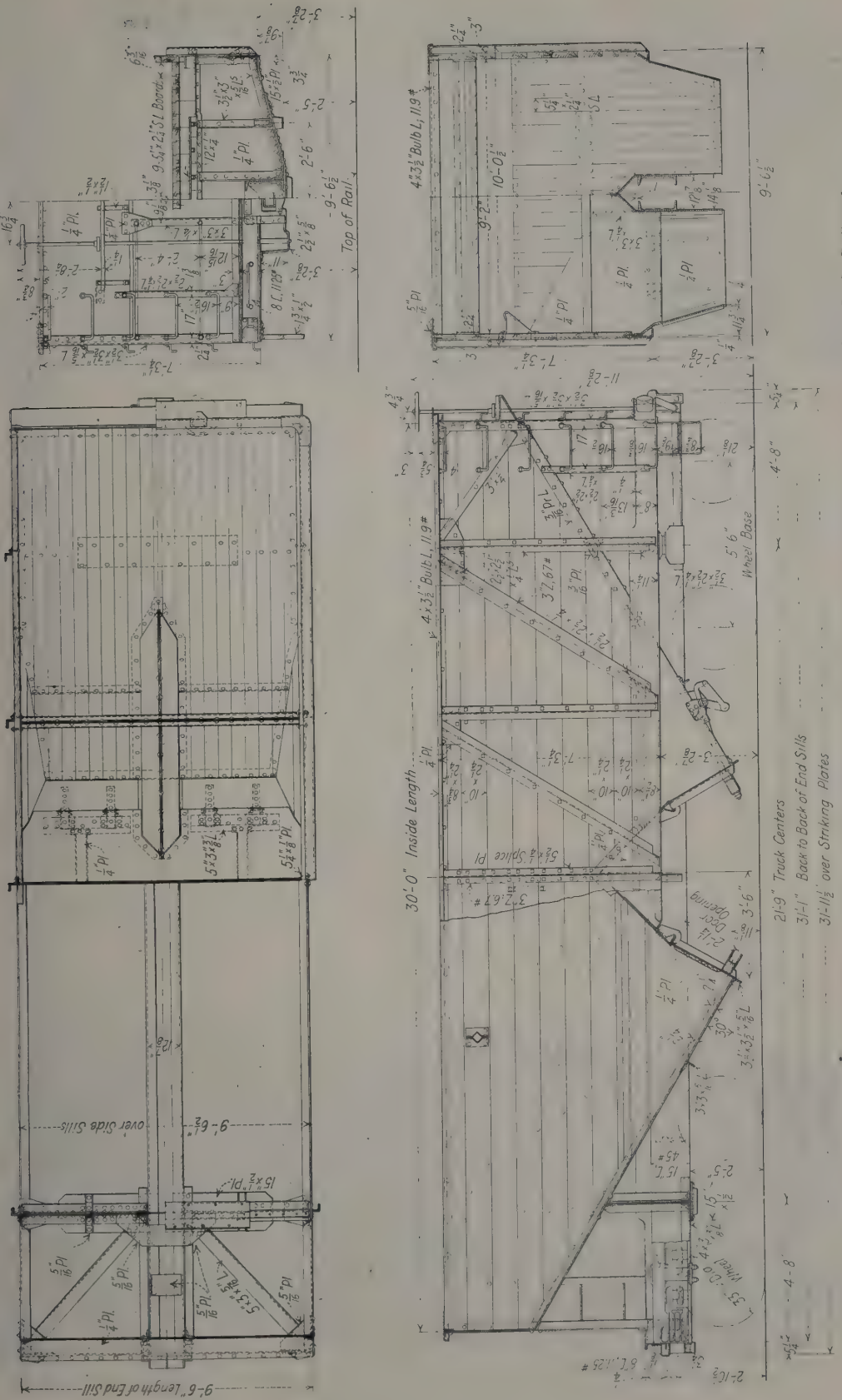
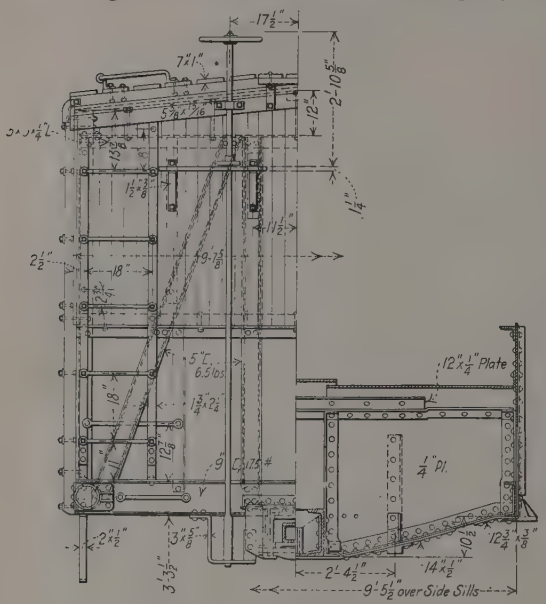


Fig. 131—Composite, 55-Ton Capacity, Hopper Car. Built by the Standard Steel Car Company for the N. Y. C. & St. L. Railroad.
(See also Fig. 132.)

Fig. 132—Steel Underframe 55-Ton Capacity Hopper Car. Inside Length, 30 ft. 0 in.; Width, 9 ft. 2 in.



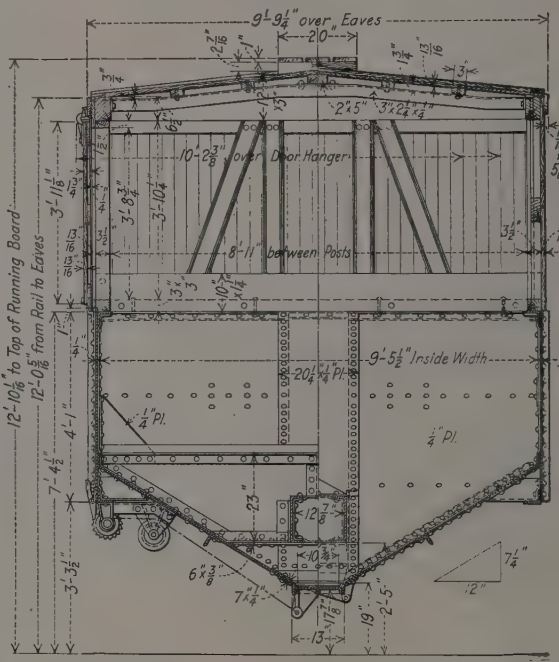


Fig. 133—End Elevation and Cross Section of Hopper Bottom Phosphate Car Shown in Figs. 134-135

Fig. 134—Steel Underframe and Steel Superstructure Framing 50-Ton Capacity Hopper Bottom Phosphate Car, Weight, 52,400 lbs.; Inside Length, 37 ft. 7½ in.; Inside Width, 9 ft. 5½ in.

Standard Steel Car Company

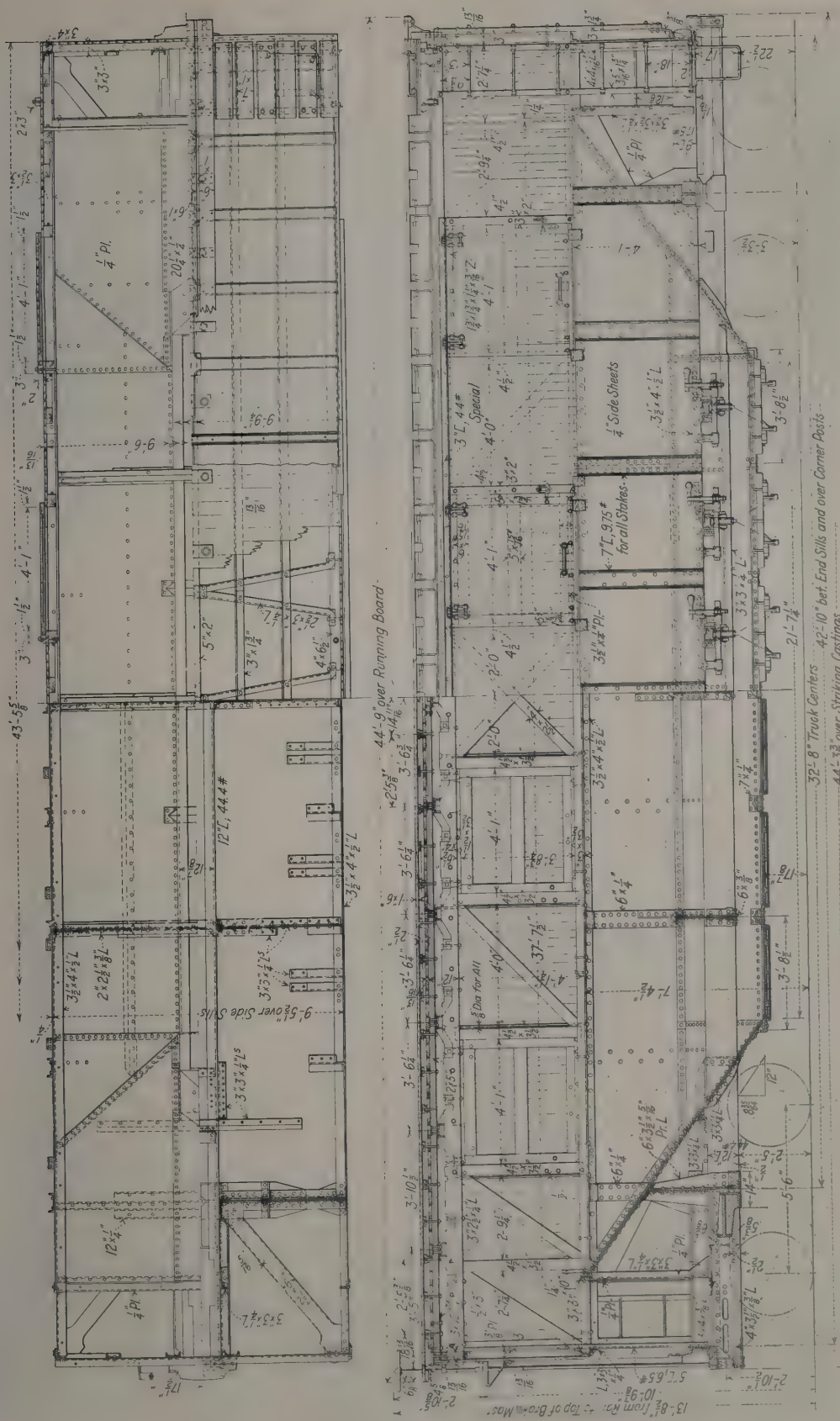
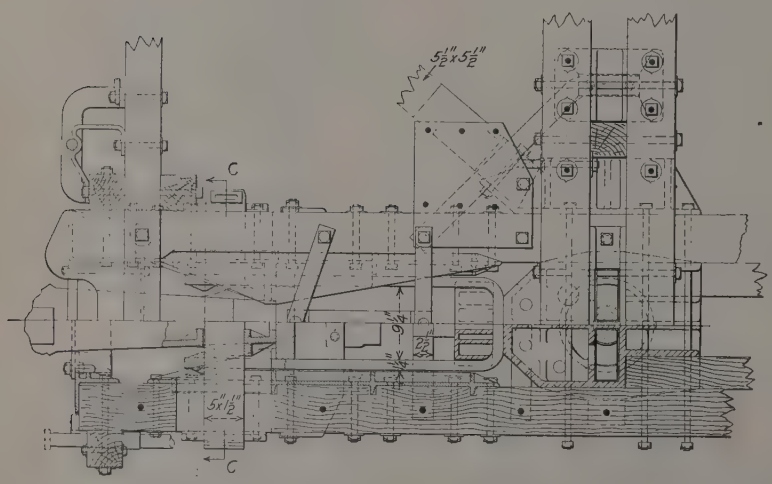
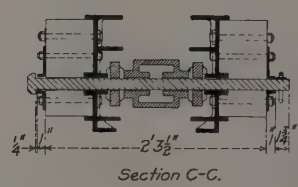


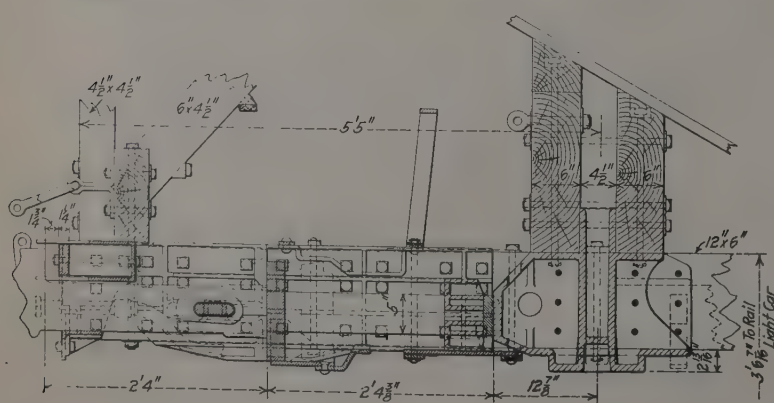
Fig. 135.—Steel Underframe and Steel Body Framing 50-Ton Capacity Hopper Bottom Phosphate Car. Builder, Standard Steel Car Company.
(*See also Figs.* 133-134.)

Fig. 136—Wooden Hopper Car. Capacity 57½ Tons, 1,980 cu. ft.; Inside Length, 33 ft. 4⅞ in.; Inside Width, 9 ft. 2¼ in. Builder, Norfolk & Western Railway.

(*See also Figs.* 137-138.)







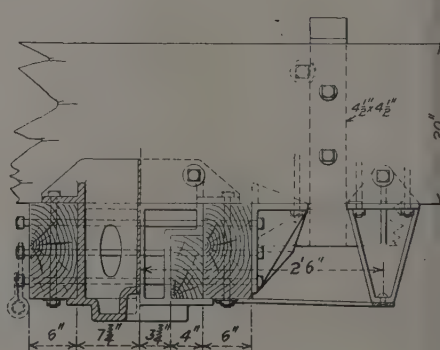


Fig. 137—Draft Gear and Bolster Details. Wooden Hopper Car Shown in Figs. 136 and 138.

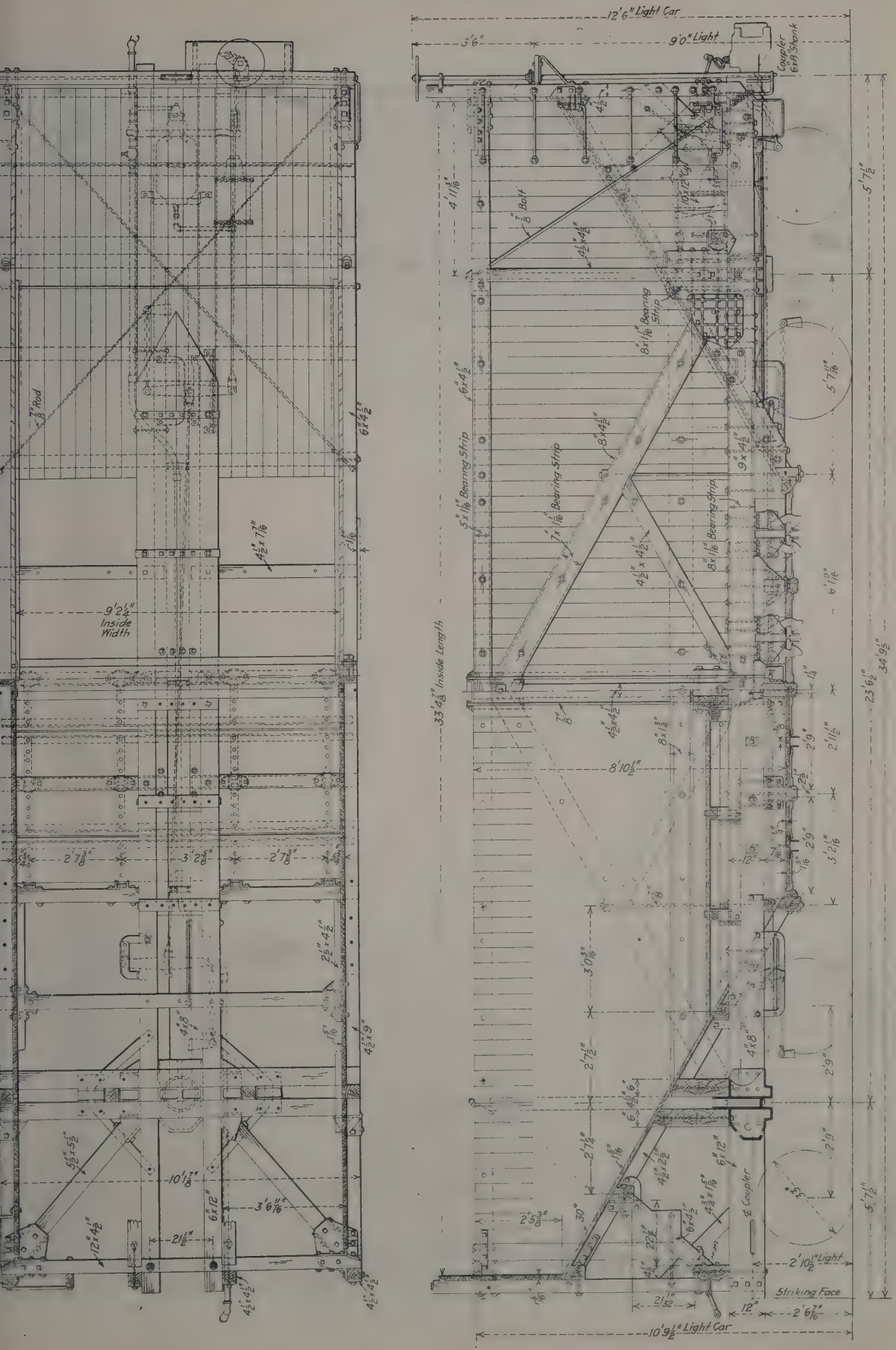


Fig. 138—Plan and Elevation of the Norfolk & Western Wooden Hopper Car Shown in Figs. 136-137.

Fig. 139—All-Steel 50-Ton 2,420 cu. ft., Capacity Hopper Car. Builder, The Bettendorf Company.

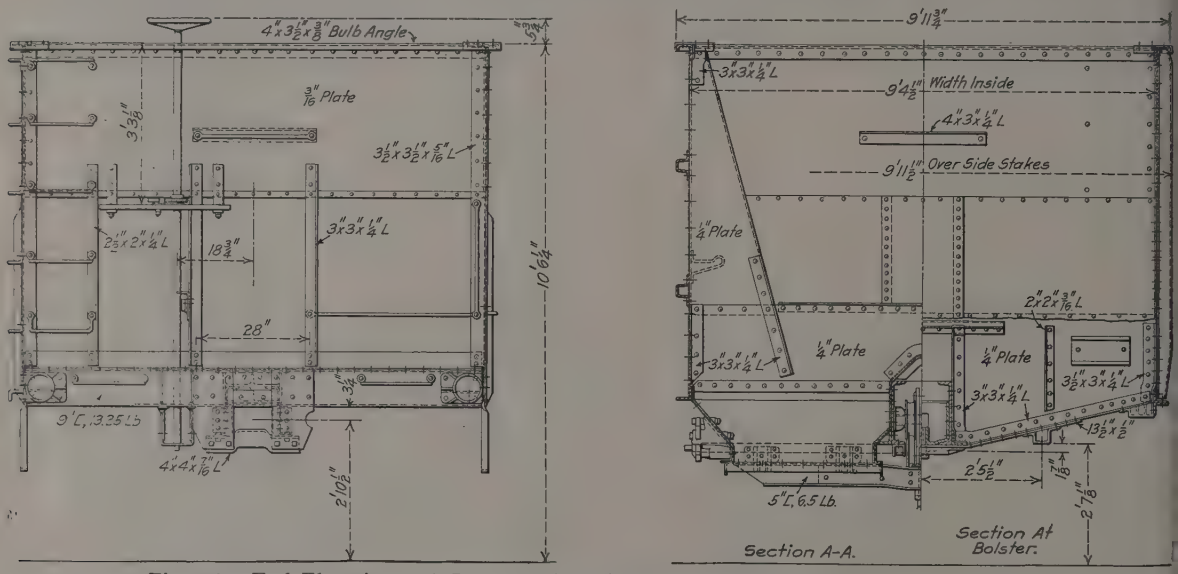


Fig. 140—End Elevation and Cross Sections 50-Ton Hopper Car Shown in Figs. 141-142

Fig. 141—All-Steel 50-Ton Capacity Hopper Car. Weight, 41,400 lb.; Inside Width, 9 ft. 4½ in.; Inside Length 30 ft. 6¾ in. Builder, Pressed Steel Car Company.

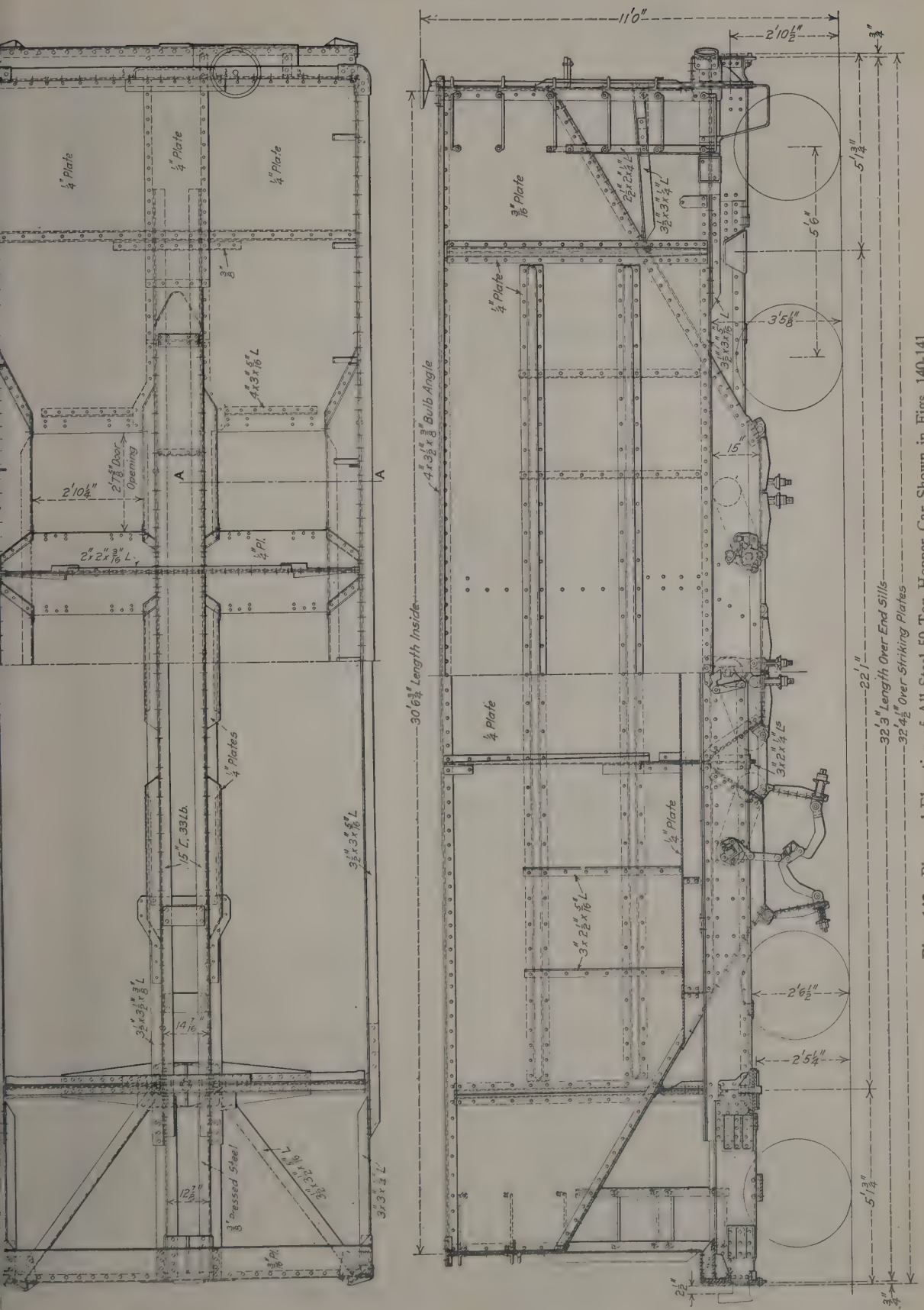


Fig. 142—Plan and Elevation of All-Steel 50-Ton Hopper Car Shown in Figs. 140-141.

Hopper Car Parts.

1 *Draft Sill*
2 *Center Sill*
3 *Center Sill Top Cover Plate*
4 *End Sill*
5 *Draft Plate or Check Casting*
6 *Body Center Plates*
7 *Body Bolster*
8 *Cross Bearer*
9 *Diagonal or Corner Brace*
10 *Push Pole Pocket*
11 *Striking Plate*
12 *Uncoupling Lever*
13 *Coupler*
14 *Brake Mast*
15 *Hand Brake Wheel*
16 *Hopper Door*
17 *Door Operating Gear*
18 *Slope Floor Sheet*
19 *End Sheet*
20 *Side Sheets*
21 *Side Stake*
22 *Coupler Carrier*
23 *Corner Post Grab Iron*
24 *Side Sill Step*
25 *Brake Step*
26 *Brake Ratchet Wheel*
27 *Top Side Angle of Coke Rack*
28 *Wheel*
29 *Corner Post*
30 *Gusset; Cross Ridge to Side*
31 *Body Cross Tie*
32 *Intermediate Side Angles of Coke Rack*

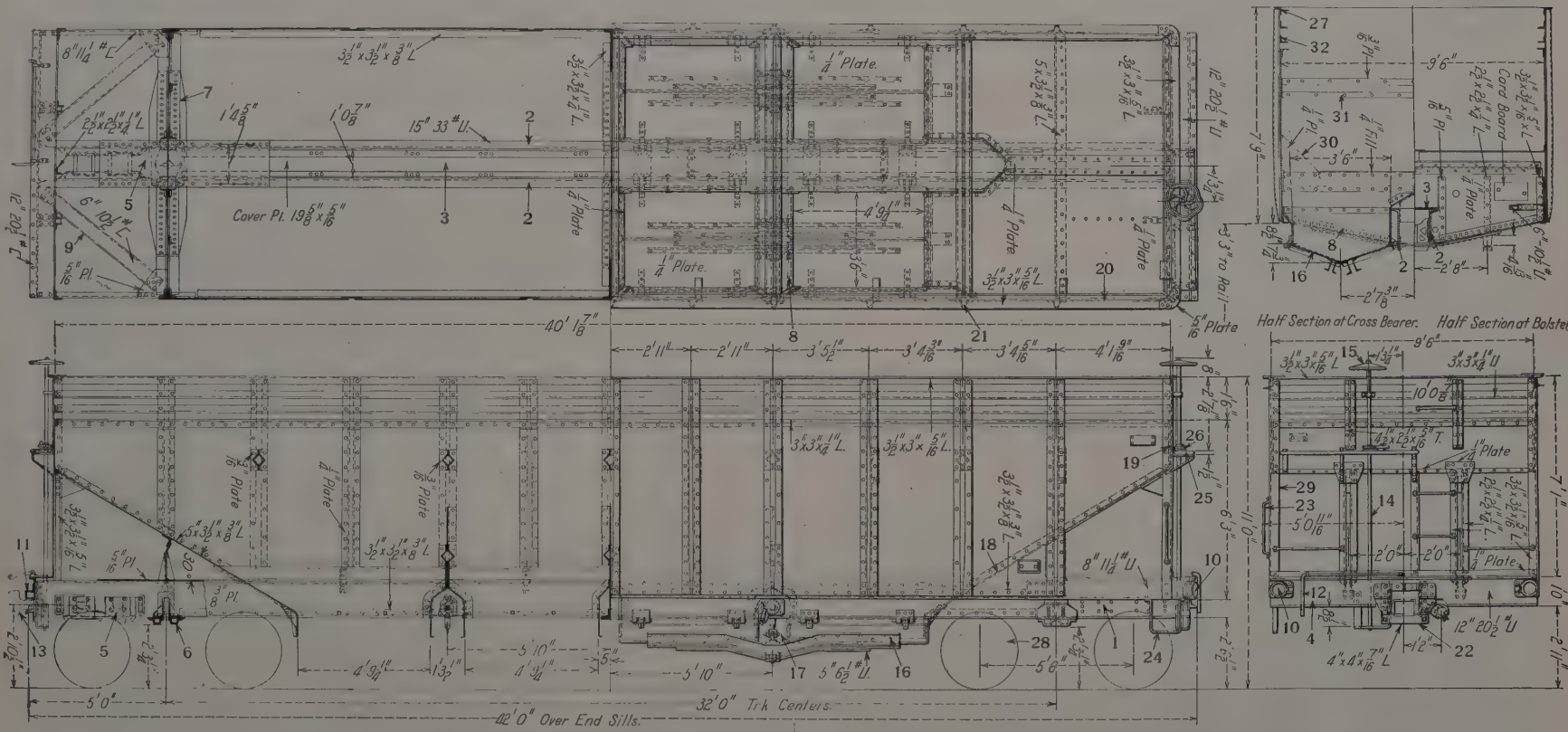


Fig. 143—All-Steel 50-Ton Capacity Hopper Coke Car. Builder, Cambria Steel Company.

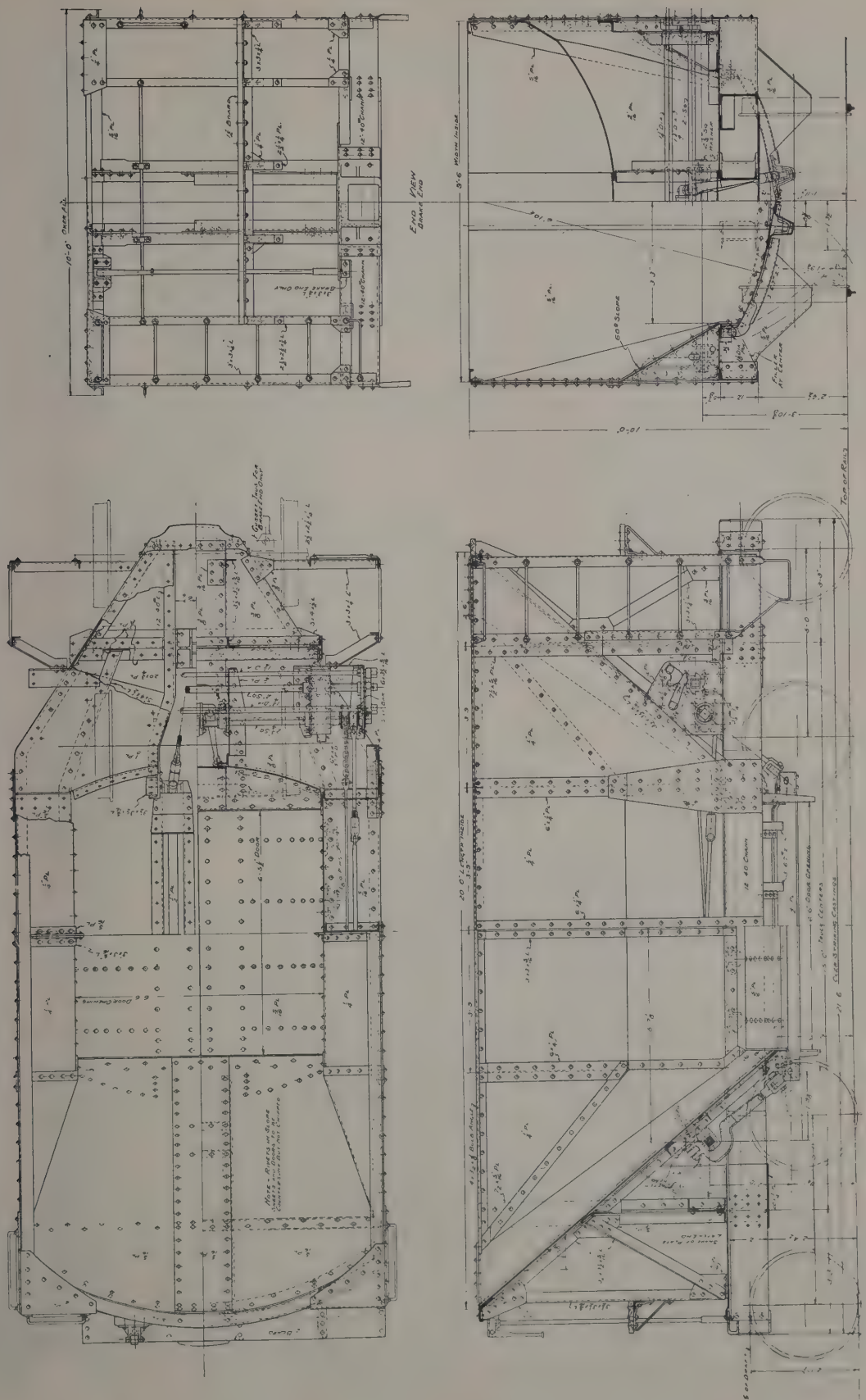


Fig. 141—All-Steel 70 Ton Capacity Bottom Discharge Hopper Ore Car. Cubic Capacity 852 cu. ft. Level or 1032 cu. ft. with 12 in. Average Heap.
Designer, Enterprise Railway Equipment Company.
(*See also Pages* 166-167.)

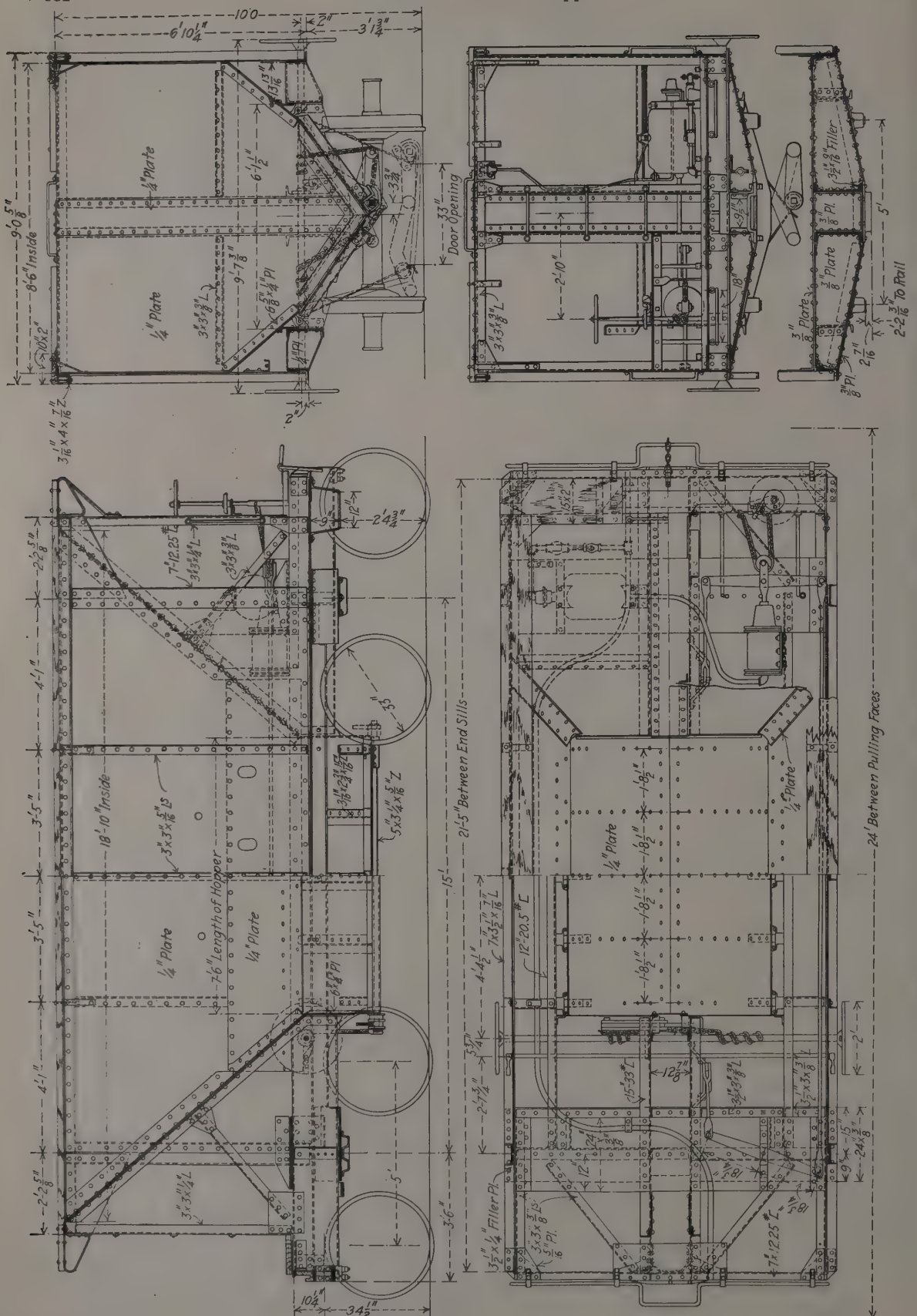


Fig. 145—All-Steel 50-Ton Capacity Hopper Ore Car. Builder, National Dump Car Company.

National Hopper Cars

The National Dump Car Company designed and built a number of special 50-ton and 75-ton ore cars with large hopper doors, thereby adding to their already complete line of dump and general service cars. One of the unusual features of this design is the shape and size of the hopper doors which are so large that when opened there is a suction effect which cleans the hopper instantly. Another feature is the fact that the hopper doors are operated by links so arranged that when closed the weight of the load secures the locking of the doors.

A very important feature of the operating mechanism of the National Dump cars is the fact that the links and chains used in operating and closing the hopper doors never come in contact with the lading. This is very desirable as it minimizes the chance of accident to the operating mechanism when the cars are being discharged and thus insures satisfactory operation at all times. Furthermore, this mechanism is so located that it can be readily examined by the car inspector whether the car is under load or empty. At loading points this expedites the dispatch of the car for the inspection can be made quickly.

The operating features of this type of car are well planned and practical. The brake wheel and uncoupling device are conveniently located on a 12 in. platform at the ends of the car directly over the end sills. The opening and closing mechanism of the hopper doors is operated from either side of the car at a height of 35 in. from the top of the rails by a removable hand wheel or by a removable crank or ratchet lever.

Fig. 146—Hopper Doors Closed

Fig. 148—Hopper Doors Open

Fig. 147—A Fifty-Ton Hopper Car Built by the National Dump Car Co.

Large numbers of this car are used by the Minneapolis, St. Paul & Sault Ste Marie and the Great Northern Railways.

For other products and branch offices, see classified and alphabetical indexes.

THE NATIONAL DUMP CAR COMPANY, CHICAGO, ILL.

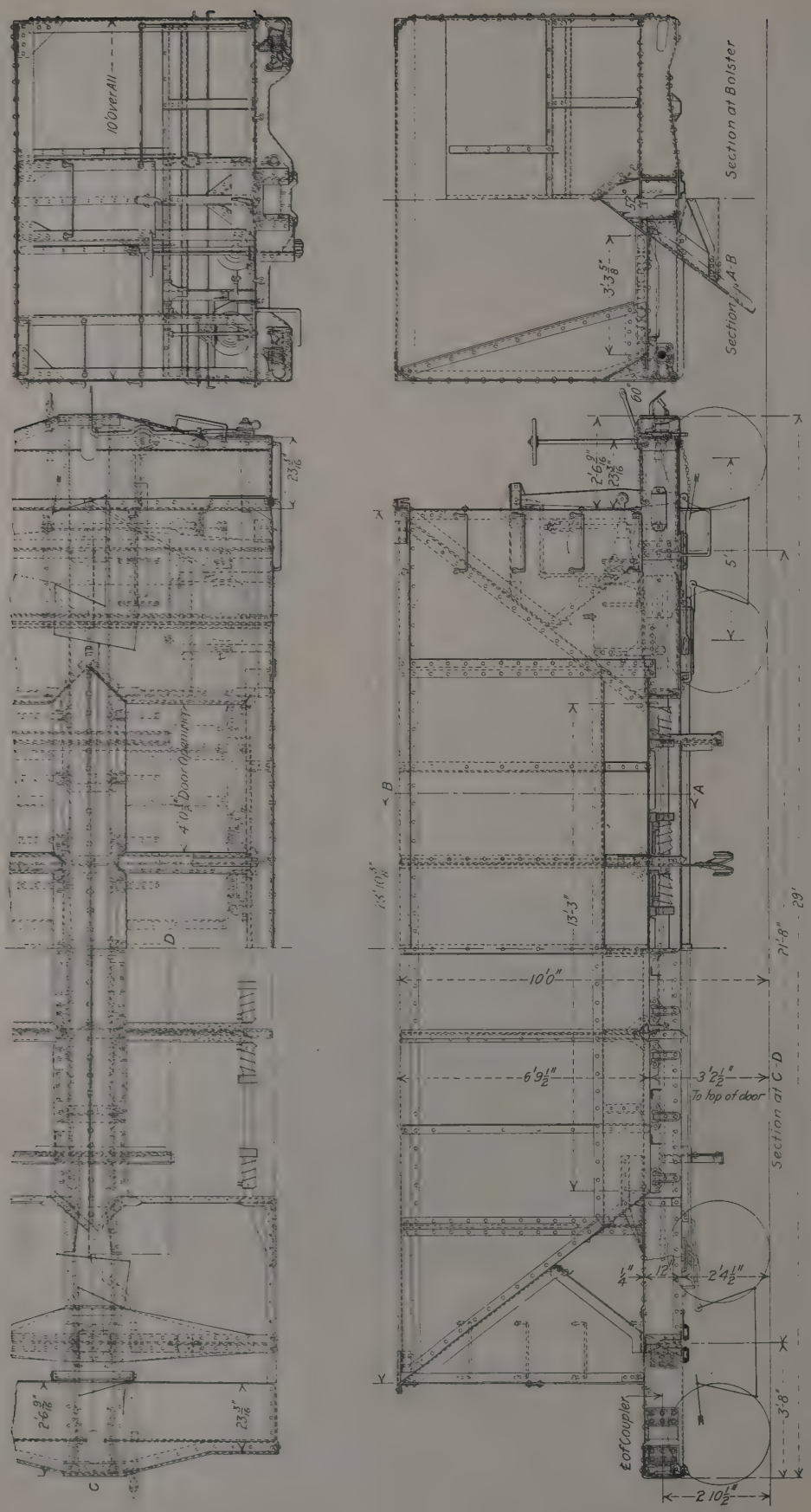


Fig. 149—Bingham & Garfield All-Steel 60-Ton Capacity Hopper Ore Car Shown in Fig. 150. Builder, Pressed Steel Car Company.

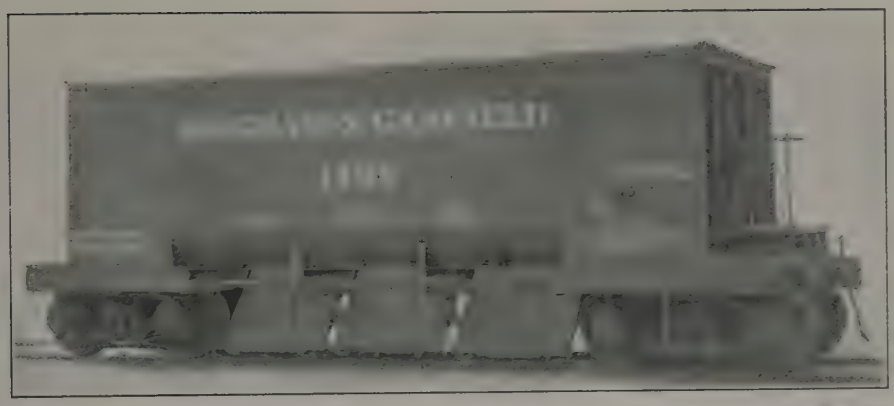


Fig. 150—All-Steel 60-Ton Capacity Ore Car. Weight, 42,300 lb.; Inside Length, 23 ft. 10⅛ in.; Inside Width, 9 ft. 10 in.; Inside Height, 6 ft. 9½ in. Builder, Pressed Steel Car Company.

See also Fig. 144.

Fig. 151—All-Steel 50-Ton Capacity Ore Hopper Car. Weight, 34,700 lb. Builder, Clark Car Company.

Fig. 152—All-Steel 50-Ton Capacity Ore Car. Weight, 34,200 lb.; Inside Length, 17 ft. 5 in.; Inside Width, 8 ft. 10 in. Capacity Level Full, Cubic Feet, 704. Builder, Western Steel Car & Foundry Company.

Fig. 153—All-Steel 100-Ton Capacity Hopper Car. Builder, Clark Car Company.

Fig. 154—All-Steel 75-Ton Capacity Ore Hopper Car. Builder, American Car & Foundry Company.

Fig. 155—All-Steel, 50-Ton Capacity Ore Hopper Car. Weight, 34,600 lb. Builder, The Pullman Company—Haskell & Barker Plant.

Fig. 156—All-Steel 50-Ton, 30 cu. yd. Capacity, Two-way Air Operated, Extension Sides Dump Car. Builder, Clark Car Company.

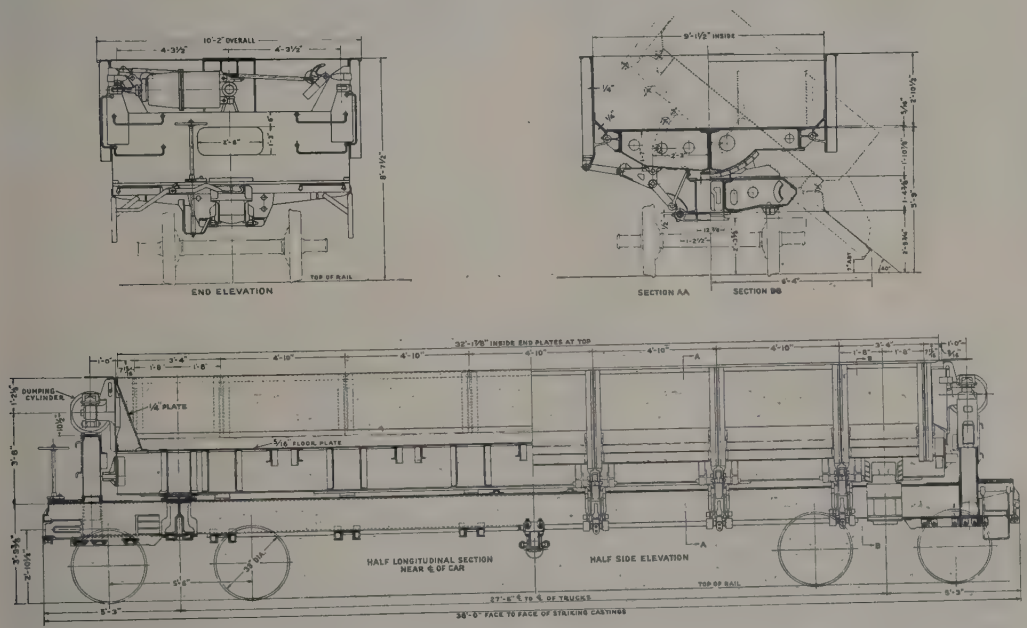


Fig. 157—Side and End Elevations and Cross Sections of Clark Air-Operated, Extension Side-Dump Car

Fig. 158—Dumped Position of All-Steel Dump Car Shown in Fig. 156.

(*See also Pages* 188-189.)

Clark Car Company.

The Extension Side Dump Car

The Extension Side Dump Car takes its name from the fact that the entire side of the car turns down and out coincident with the tilting of the body. This forms a chute over which the load in the car is discharged; the side being entirely out of the way, no obstruction is presented to the dumping of the load regardless of the size of individual pieces. This extended side delivers the material well beyond train clearance, absolutely eliminating the necessity of a second handling to permit movement of the car or the safe passage of following trains.

The "Balanced Door" feature, inherent in all the Clark Car Company designs, is incorporated in the Extension Side Dump Car in such a manner that, when empty and released from the dumped position, the car closes by gravity and locks automatically. This balance feature also produces a dumping motion without shock to the track, and cars may therefore be safely dumped when in motion if desirable. The body is a separate structure supported over the underframe bolsters by rockers, and rolls to the side when dumping. The sides are hinged to the body along their lower edges and are further connected by mechanisms under the car body floor, so designed that they hold the side upright when the body is closed and turn the side down as the body is tilted. Each mechanism is operated by a link connected to a latch hook located on the underframe. These links not only operate the mechanisms, but serve to lock the body in upright position.

The car is dumped through the medium of compressed air supplied from a storage reservoir located on the car and charged from the locomotive. The air dump equipment throughout is arranged so as to be entirely independent of the brake system; the reservoir, with the proper initial charge, is of sufficient capacity to dump the car. Since each car has its own storage supply, the dumping of two or more cars as a unit is accomplished as easily as the dumping of single cars.

Fig. 160—Train Clearance Always Maintained

Dumping is accomplished by turning the handle of a control valve located on one platform of each car, serving to charge or exhaust a separate train line known as the operating line. Connection of the operating line between cars in a train allows the dumping of all cars in the train from any one car.

The locks are operated by a separate air cylinder connnected to the operating line through a cut-out cock. Closing the cut-out cock leading to any latch cylinder cuts out the dumping operation of that car.

The body of the dump car is tilted by two

Fig. 159—Ditcher Working Between Two Extension Side Dump Cars

The Extension Side Dump Car *(Cont'd)*

dump cylinders, one of which is mounted on each end of the body. The same pair of cylinders is used to tilt the body in either direction, reversal of dumping being effected by the simple process of swinging the cylinders around in a horizontal plane so that they push the body the other way. The locks are reversed manually, by means of a short pull rod which is located transversely of the underframe at the center of the car.

The characteristics of the Clark Extension Side Dump Cars, making them effective in maintenance service, are size, simplicity, safety, strong construction and efficiency of discharge. Their size makes them adaptable for general service work and efficient for handling coal, sand, gravel and ashes.

They are particularly adaptable for use in the disposal of engine terminal ashes—a daily necessity. The supply of ashes is usually constant in volume and a train of cars can therefore be spotted, loaded, dumped and returned on a regular schedule. The custom of loading ashes into any open type freight car that happens to be immediately available, and then unloading by hand, has reached a point where, by reason of congestion of traffic, scarcity of equipment, cost of labor and the definite time limits available, its further continuance is impracticable. The labor should be put to other uses and the unloading done with side dump cars. This will not only materially reduce the cost of ash handling, but probably the ashes will be put to some use, in view of the ease in handling, where they otherwise would be thrown on a waste dump. The saving in unloading costs will pay for the cars in a remarkably short time.

The cars have a level-full capacity of 30 cu. yd., giving a normal loading of 43 cu. yd., and carry 100,000 lb., based on the standard A. R. A. rating.

The simplicity of the cars renders their operation and maintenance economical; their operation is readily understood and repairs to them are made easily.

The car is built strictly in accordance with A. R. A. rules and recommended practice, meeting all the requirements of standard railroad equipment; it contains all the safety appliances required by the orders of the Interstate Commerce Commission. In safety and construction, therefore, it is acceptable by the railroads as regular, and not special equipment, and for this reason is highly efficient, since it can be used in interchange service as a gondola under load. Efficiency of discharge eliminates that big problem in all maintenance work—the man with the shovel.

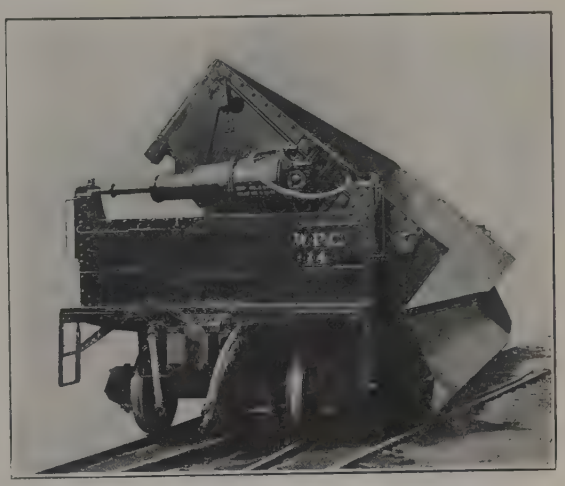


Fig. 162—Extension Side Dump Car—Tilted Position

Fig. 161—Extension Side Dump Car—Closed Position

For other products and branch offices, see classified and alphabetical indexes.

CLARK CAR COMPANY, PITTSBURGH, PA.

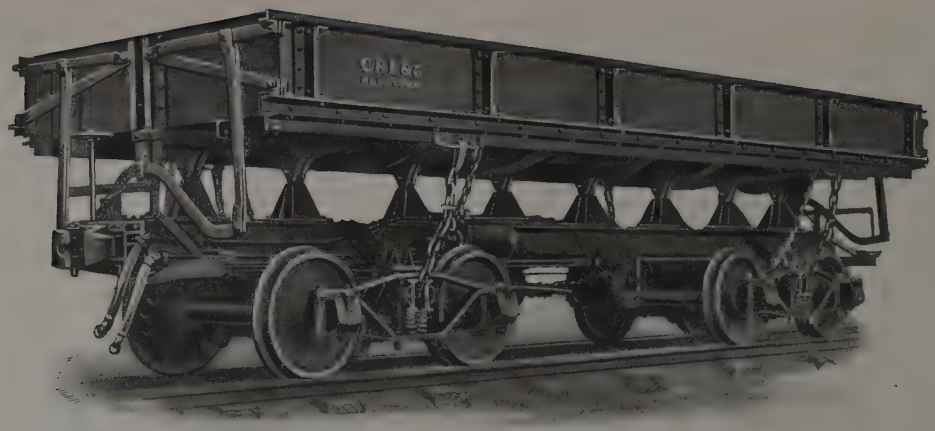


Fig. 163—All-Steel Air Dump Car Equipped for Main Line Service. Builder, The Gregg Company, Ltd.

Fig. 164—All-Steel 20-yd. Capacity Automatic Two-Way Air Dump Car.
Builder; The Kilbourne & Jacobs Manufacturing Company.

Fig. 165—Dumped Position of Dump Car Shown in Fig. 164.

(*See also Page* 191.)

"K. & J." All Steel Automatic Air Dump Cars

An extremely rugged type of automatic dump car has been perfected by the Kilbourne & Jacobs Manufacturing Company. These cars dump to either side and are of all steel construction.

The body underframe consists of four I-beams reinforced and held in place by adequate cross bracing. The sides and ends are constructed of steel plates reinforced by channels and angle irons. Supporting the body are wide cast steel hinges specially designed and braced to withstand vertical shocks. The hinge bearing provided is liberally proportioned to the size of the body and weight of the contents.

Fig. 166—"K. & J." 20-yd. All Steel Automatic Air Dump Car, Dumped Forward, showing steep dumping angle and wide discharge opening.

The complete operation of the "K. & J." All Steel Automatic Two-Way Air Dump Car—unlocking, dumping, righting and re-locking—is accomplished by means of two simple levers—one for each side. Dumping one car or any number of connected cars is a matter of not more than ten seconds.

Powerful vertical dump cylinders on each side of the car perform the dumping and righting of the car body.

By connecting auxiliary operating lines, an entire train of cars may be operated as a unit.

Operating air is drawn from the regular air-brake train line and stored in a reservoir of sufficient capacity to operate the dump cylinders several times. This exclusive feature permits operation of cars with any locomotive, or at any point in a mixed train and eliminates the necessity of special air equipment on the locomotive.

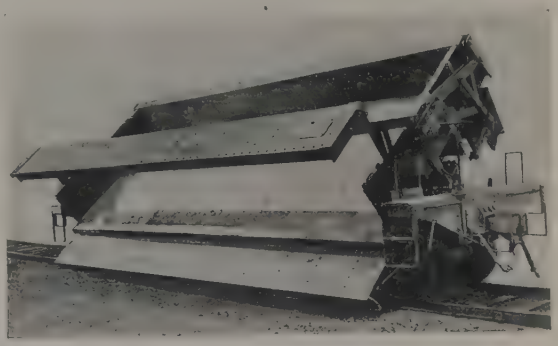


Fig. 168—"K. & J." 20-yd. All Steel Automatic Air Dump Car.

"K. & J." Cars are in use on more than seventy railroads for steam shovel and steam ditcher excavation, trestle filling, bank widening, track elevation, rip-rapping, double tracking, yard extension, grade reduction, re-location, removing slides, making fills, ashes, slag and refuse disposal, betterment work of all kinds and general maintenance of way operations.

They are also used extensively by the open-pit iron, copper and coal mines, quarries and for general industrial use where the efficient and economical handling of material is desired.

Fig. 167—"K. & J." Standard A. R. A. 30-yd. All Steel Automatic Air Dump Car. Acceptable for Interchange under load by all Railroads.

"K. & J." Cars are covered by the following United States Patents:

872,057	Nov., 1907	1,034,418	Aug., 1912
907,218	Dec., 1908	1,057,413	Apr., 1913
921,376	May, 1909	1,178,208	Apr., 1916
973,229	Oct., 1910	1,236,368	Aug., 1917
1,029,247	June, 1912	1,281,508	Oct., 1918

These cars are manufactured for railway, mining, industrial and contractor's service in capacities of 12, 16, 20, 25, 30 and 33 cubic yards.

For other products and branch offices, see classified and alphabetical indexes.

KILBOURNE & JACOBS MFG. CO., COLUMBUS, OHIO, U. S. A.

Fig. 169—Steel Frame Two-Way Air Operated Dump Car. Builder, Magor Car Corporation.

Fig. 170—All-Steel Air or Hand Operated Side or Center Dump Car of 40-Ton Capacity. Weight, 50,000 lb.. Builder, Goodwin Car & Manufacturing Company.

Fig. 171—All-Steel 45 cu. yds. Capacity Air Dump Car. Builder, Western Wheeled Scraper Company.

(*See also Page* 193.)

Automatic Compression-Lock Air-Dump Cars

The development of the steam shovel to increased size and efficiency has brought about a corresponding need of development in the dump car. Successful operators have realized that the secret of utilizing the capacity of the powerful steam shovel lies not in the actual excavation work itself but in the ability to rapidly handle the excavated material.

The Western Wheeled Scraper Company, whose experience in earth-moving problems dates back to 1877, has developed the large size automatic air dump car to maintain the pace of the modern steam shovel. One of the testing grounds of the present form of compression-lock air-pump car was the Mesaba Iron Range, where great quantities of heavy material had to be moved quickly and economically. Sturdy Western Automatic Air Dump Cars have been handling this work steadily and efficiently with practically no delay for repairs.

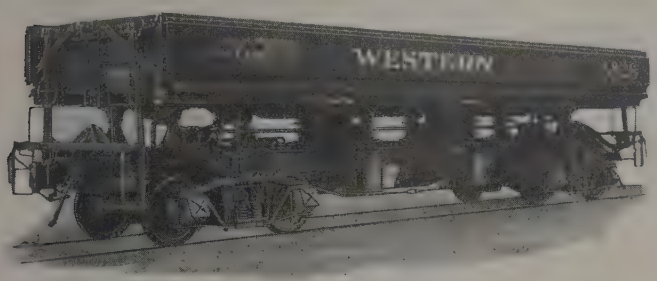


Fig. 172—Western Automatic Compression Lock, 30 Yd. Air Dump Car —Upright Position

The Western Automatic Compression-Lock Air-Dump Car has a body of either steel or wood with steel underframe, pivoted longitudinally in the center over the draft beams enabling its discharge on either side. When dumping, the hinges, which are riveted to the center sill under the car body, rock on the pedestal castings, which are riveted to the draft beams. The hinges are held on the pedestals by a flat bar which drops loosely in the socket of the pedestal casting in a perpendicular position, the upper end of the bar being held between the lugs of the body hinge by a pin. The weight of the car does not rest on this pin, thus is avoided the possibility of bending the pin, with subsequent dumping trouble.

The simplified air dumping device has greatly increased the dumping power permitting the easy handling of large capacity loads. Single cylinders on either side of the car body are used on the smaller size cars while in the 30-yd. and 45-yd. size twin cylinders distribute the dumping strain. The body is so supported that all the members between it and the underframe are in compression with the result that the shock of loading is carried directly through the truck springs to the road bed. The car body is locked, unlocked and controlled automatically by the air dumping device avoiding the necessity of using side-chains or other fixed connection between the body and the underframe.

The Western Automatic Compression-Lock Air-Dump Car is built in 12, 16, 20, 25, 30 and 45 cu. yd. sizes for standard gage track in conformity with the A. R. A. specifications and is used in excavation, construction, ditching, trestle filling, coal handling, or emergency work occasioned by washouts or landslides.

The Western 30-yard air dump car has met with marked success in heavy service—on railroads in mining operations, constructing large levees, dams, embankments, and similiar work, where the hauling of huge loads considerable distances and at high speeds is desirable. They are particularly useful in emergencies, like the situation caused by the Pueblo floods, Pittsburgh slide, etc., where it has been necessary, in the repair of damage, to handle large volumes of material quickly.

The Western 45-yard air dump car is built primarily for coal, cinders and similar bulky material weighing not over a ton to the yard. The car can be run at high speed. It is of great value for coal-handling, particularly where it is desired to store the coal, while awaiting system cars for shipping to the market, and for disposal of ashes, cinders, waste, etc., from engine terminals, industrial plants, etc. The car is equipped either with safety side chains or with automatic compression lock. With the former type, the bed is held in carrying position by the side chains; in the operation of dumping, the chains are unlatched instantly by the dump man, who also relatches them after the car is righted.

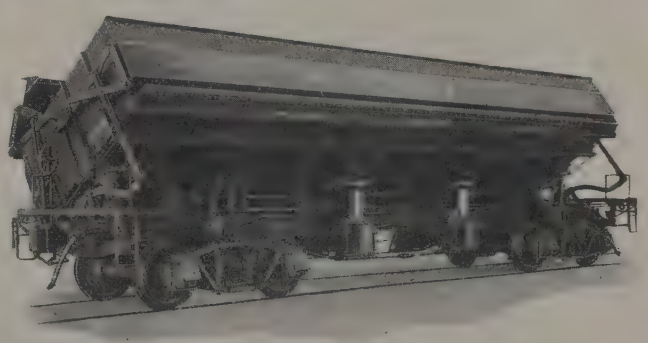


Fig. 173—Western Automatic Compression Lock, 45 Yd. Air Dump Car —Dumping Position

The Western Wheeled Scraper Company also manufactures Hand Dump Cars which are used in railroad construction work where the use of large capacity standard gage air dump cars is not practicable. These cars are of small size and are built at various gages. Cars of one-half, one, and one and one-half cu. yd. capacities are generally used on 24-inch gage; the two cu. yd. car, on 30-inch gage; and the 3. 4. 5 and 6 cu. yd.—double truck—capacities are 36-inch gage. These cars are so designed that they will ride safely on the poorest of tracks.

For other products and branch offices, see classified and alphabetical indexes.

WESTERN WHEELED SCRAPER COMPANY, AURORA, ILL.

Fig. 174—Steel Underframe, 40-Ton Capacity, Stock and Coke Car. Builder, The Pullman Company—Haskell & Barker Plant.

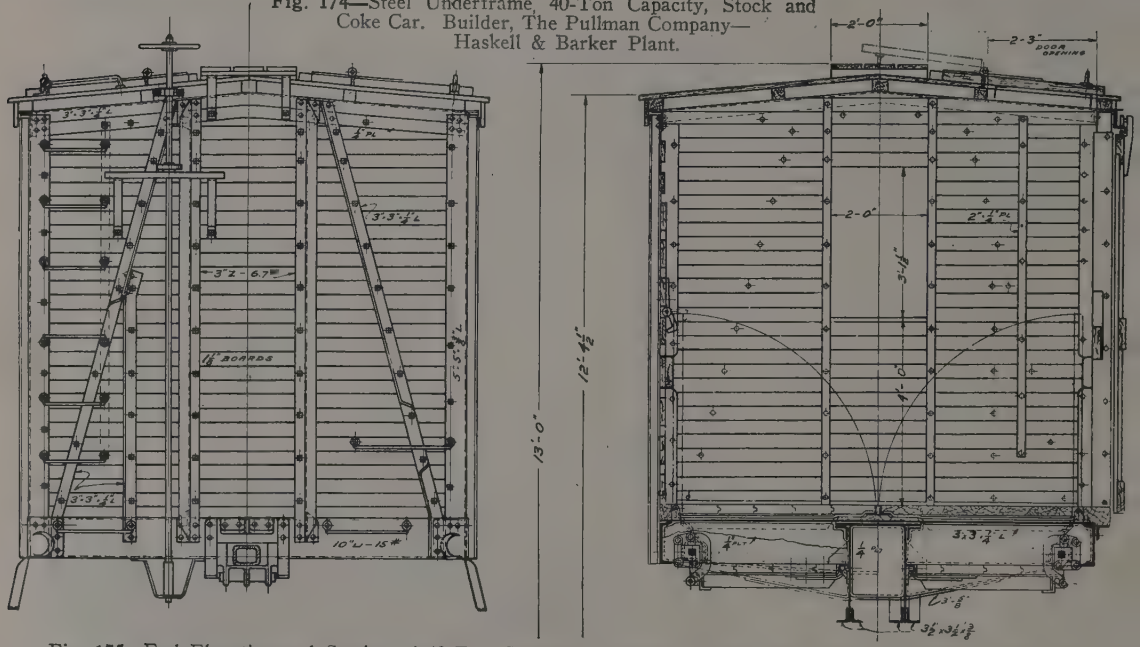


Fig. 175—End Elevation and Section of 40-Ton Capacity, Convertible Stock and Coke Car Shown in Fig. 177.

Fig. 176—Steel Underframe and Steel Superstructure Frame, 40-Ton Capacity, Double Deck Stock Car. Builder, Standard Steel Car Company.

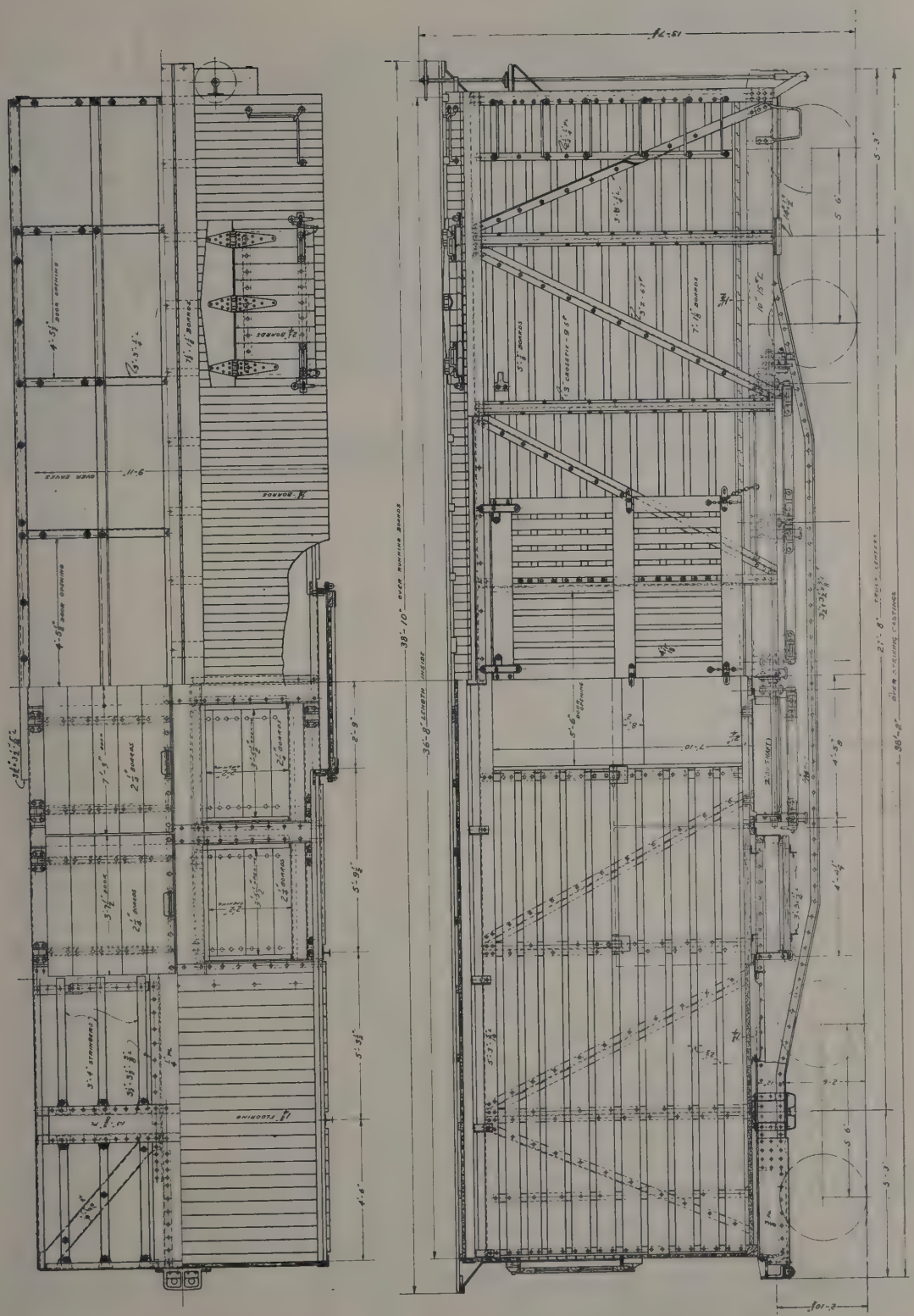


Fig. 177—Steel Underframe 40-Ton Capacity Convertible Stock or Coke Car. Designer, Enterprise Railway Equipment Company.

Fig. 178—Steel Frame, Southern Pacific Stock Car. Capacity, 40-Ton, 2,596 cu. ft.; Weight, 35,500 lb.; Inside Length, 36 ft. 6⅛ in.; Inside Width, 8 ft. 5⅜ in. Builder, The Ralston Steel Car Company.

(*See also Figs.* 179-180.)

Principal Dimensions of 40-Ton Stock Car Shown in Figs. 178-180.

Width over eaves	9 ft. 11⅛ in.	Height from rail to running board	13 ft. 0 in.
Width over corner posts	9 ft. 1⅓ in.	Height from rail to top of brake mast	13 ft. 7⅛ in.
Width over end sills	9 ft. 0⅝ in.	Width of door	5 ft. 2¾ in.
Height from top floor to bottom side plate	7 ft. 10 in.	Width of running board	2 ft. 0 in.
Height from top of floor to bottom car line	8 ft. 0¼ in.	Width, inside	8 ft. 5⅜ in.
Height from bottom of floor to top car line	8 ft. 4¾ in.	Length, inside	36 ft. 6⅛ in.
Height from rail to eaves	12 ft. 4½ in.	Length over running boards	38 ft. 5 in.

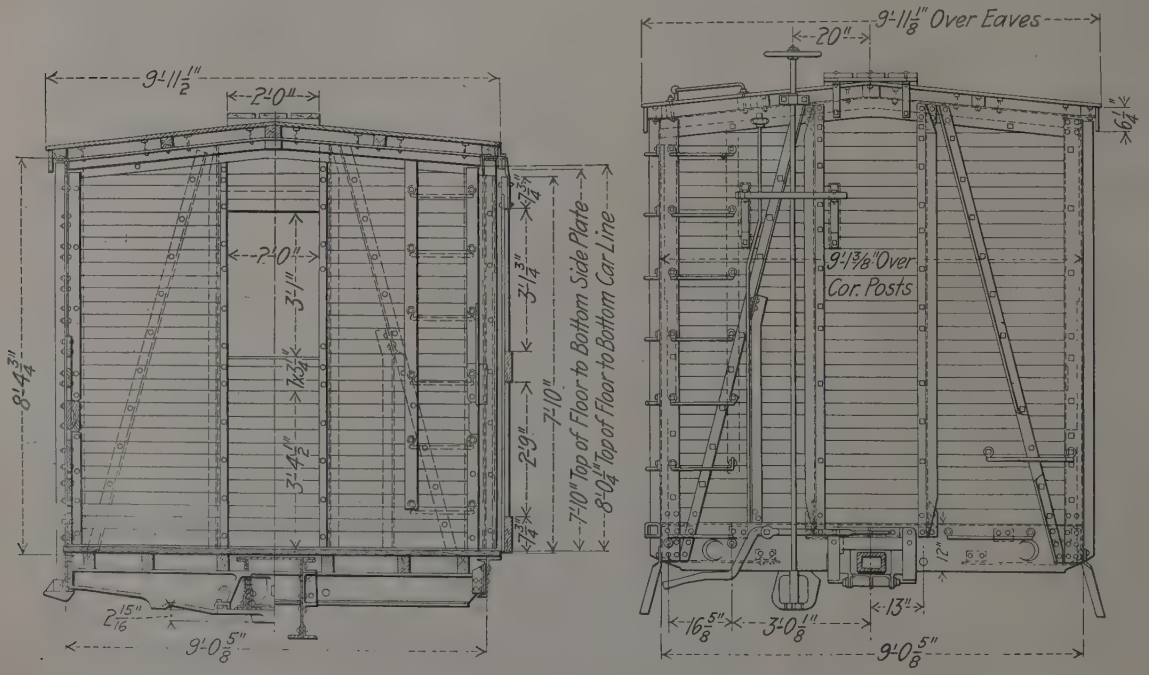


Fig. 179—Cross Sections and End Elevations of 40-Ton Stock Car Shown in Figs. 178-180.

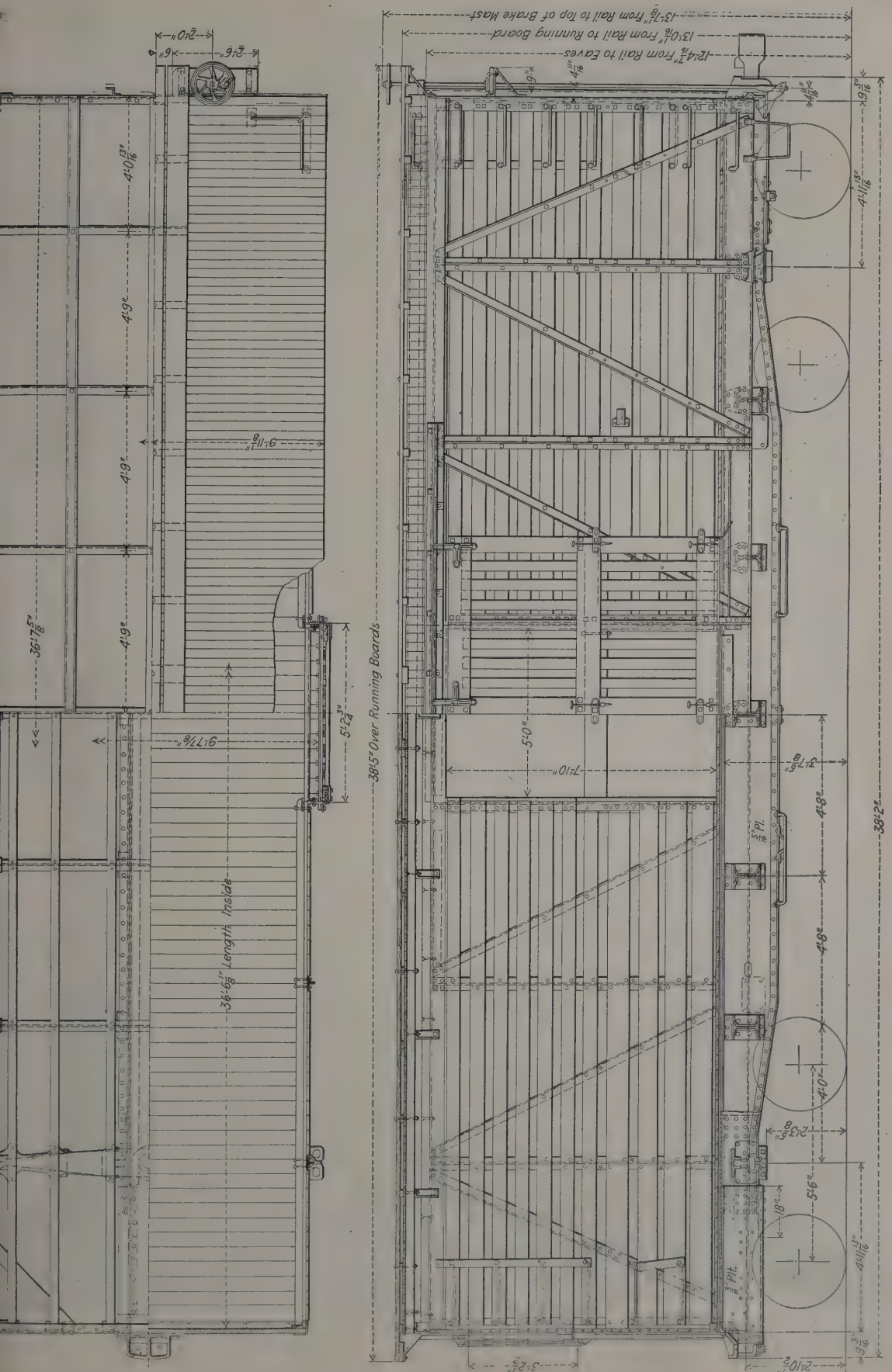


Fig. 180—Plan and Elevation of 40-Ton Stock Car Shown in Figs. 178-179. Builder, The Ralston Steel Car Company.

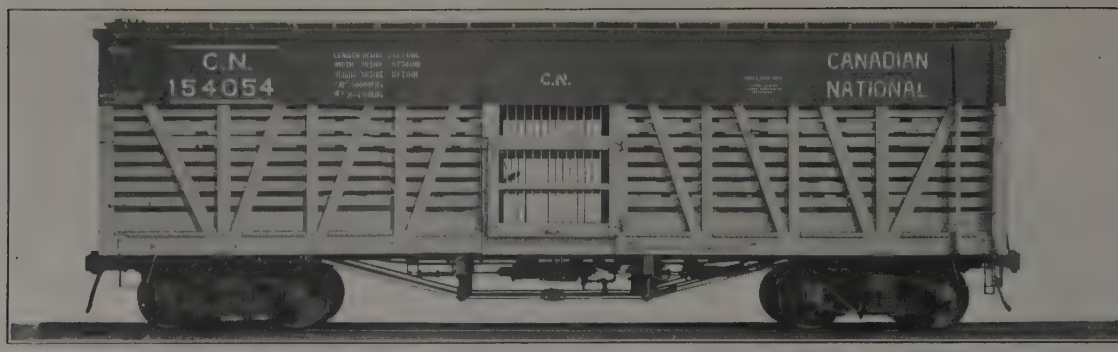


Fig. 181—Wood Frame and Superstructure 30-Ton Stock Car. Builder, National Steel Car Corporation, Ltd.

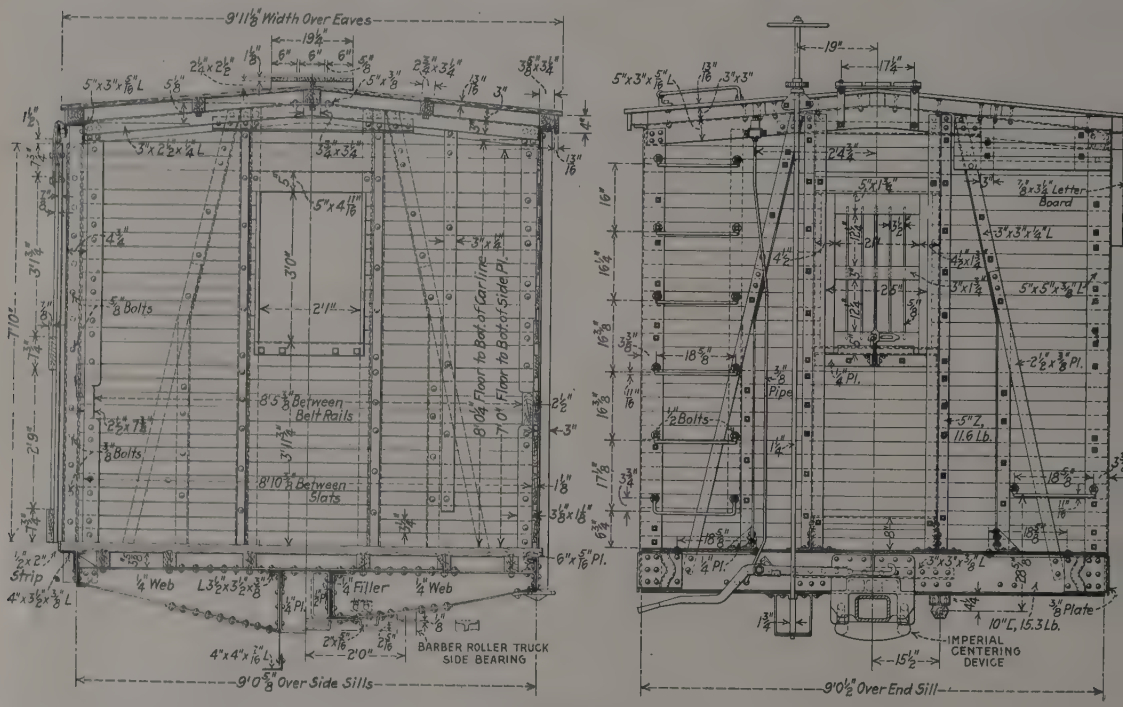


Fig. 182—Cross Section and End Elevation of Stock Car Shown in Fig. 184.

Fig. 183—Steel Frame 40-Ton Stock Car. Builder, American Car and Foundry Company.

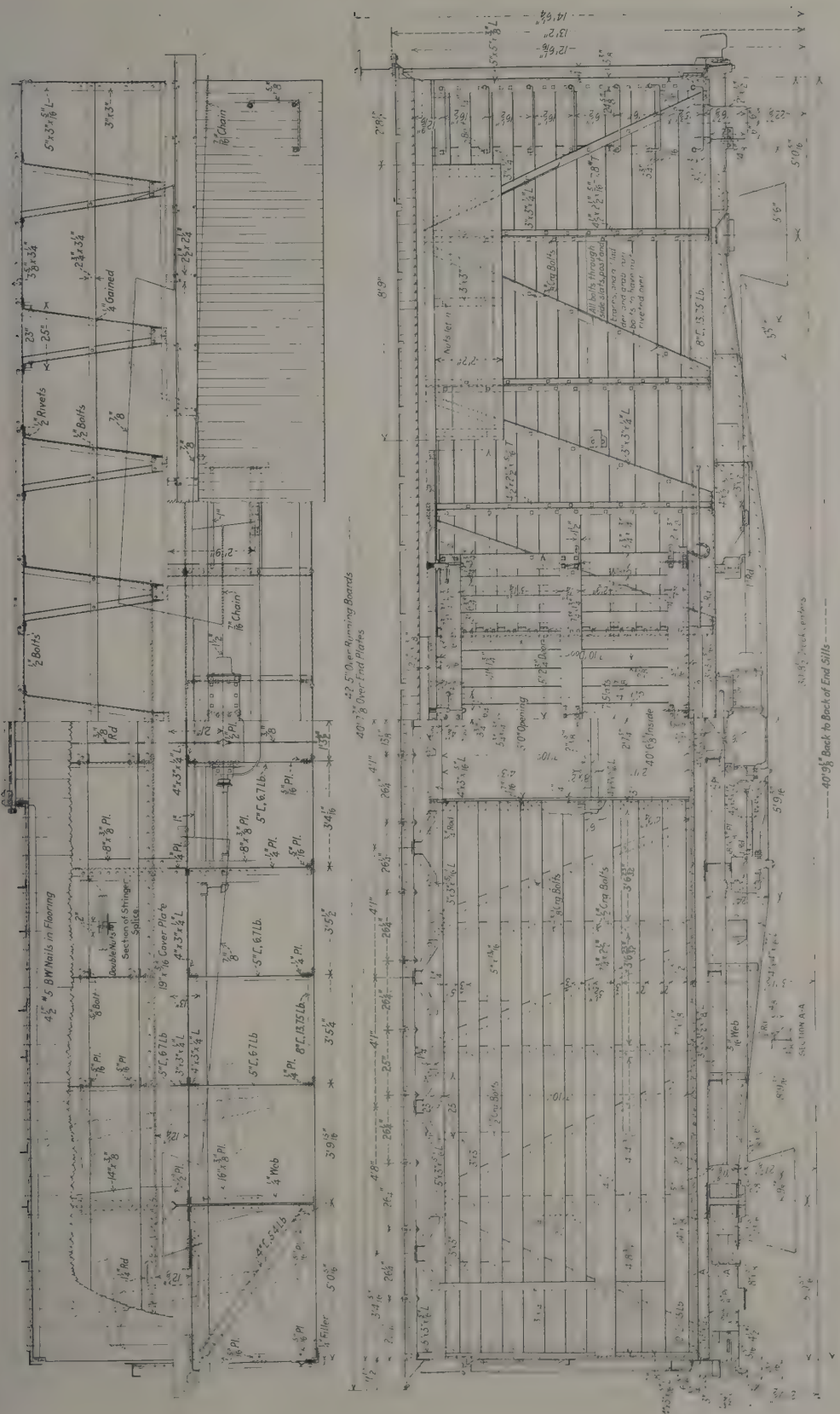

4½" S. B.W. Nails in Flooring
Section of Stringer Splice
Double Nuts
Cover Plate
Section A-A
Steel Web
Steel Body Bolsters
Steel Center Sills
Steel Side Sills
Steel Floor Beams
Steel Cross Bearers
Steel Diagonal Braces
Steel Truss Rods
Steel Draft Timbers
Steel Buffer Timbers
Steel Body Corner Posts
Steel Body Side Posts
Steel Body Door Posts
Steel Body Intermediate Posts
Steel Body End Posts
Steel Body Roof Sheets
Steel Body Side Sheets
Steel Body End Sheets
Steel Body Door Sheets
Steel Body Roof Carlines
Steel Body Side Carlines
Steel Body End Carlines
Steel Body Door Carlines
Steel Body Roof Purlins
Steel Body Side Purlins
Steel Body End Purlins
Steel Body Door Purlins
Steel Body Roof Rafters
Steel Body Side Rafters
Steel Body End Rafters
Steel Body Door Rafters
Steel Body Roof Ridge Pole
Steel Body Side Ridge Pole
Steel Body End Ridge Pole
Steel Body Door Ridge Pole
Steel Body Roof Eave Strip
Steel Body Side Eave Strip
Steel Body End Eave Strip
Steel Body Door Eave Strip
Steel Body Roof Gutter
Steel Body Side Gutter
Steel Body End Gutter
Steel Body Door Gutter
Steel Body Roof Drip
Steel Body Side Drip
Steel Body End Drip
Steel Body Door Drip
Steel Body Roof Flashing
Steel Body Side Flashing
Steel Body End Flashing
Steel Body Door Flashing
Steel Body Roof Coping
Steel Body Side Coping
Steel Body End Coping
Steel Body Door Coping
Steel Body Roof Cornice
Steel Body Side Cornice
Steel Body End Cornice
Steel Body Door Cornice
Steel Body Roof Fascia
Steel Body Side Fascia
Steel Body End Fascia
Steel Body Door Fascia
Steel Body Roof Soffit
Steel Body Side Soffit
Steel Body End Soffit
Steel Body Door Soffit
Steel Body Roof Frieze
Steel Body Side Frieze
Steel Body End Frieze
Steel Body Door Frieze
Steel Body Roof Architrave
Steel Body Side Architrave
Steel Body End Architrave
Steel Body Door Architrave
Steel Body Roof Pediment
Steel Body Side Pediment
Steel Body End Pediment
Steel Body Door Pediment
Steel Body Roof Dentil
Steel Body Side Dentil
Steel Body End Dentil
Steel Body Door Dentil
Steel Body Roof Modillion
Steel Body Side Modillion
Steel Body End Modillion
Steel Body Door Modillion
Steel Body Roof Bracket
Steel Body Side Bracket
Steel Body End Bracket
Steel Body Door Bracket
Steel Body Roof Console
Steel Body Side Console
Steel Body End Console
Steel Body Door Console
Steel Body Roof Scroll
Steel Body Side Scroll
Steel Body End Scroll
Steel Body Door Scroll
Steel Body Roof Volute
Steel Body Side Volute
Steel Body End Volute
Steel Body Door Volute
Steel Body Roof Ionic
Steel Body Side Ionic
Steel Body End Ionic
Steel Body Door Ionic
Steel Body Roof Corinthian
Steel Body Side Corinthian
Steel Body End Corinthian
Steel Body Door Corinthian
Steel Body Roof Composite
Steel Body Side Composite
Steel Body End Composite
Steel Body Door Composite
Steel Body Roof Tuscan
Steel Body Side Tuscan
Steel Body End Tuscan
Steel Body Door Tuscan
Steel Body Roof Doric
Steel Body Side Doric
Steel Body End Doric
Steel Body Door Doric
Steel Body Roof Ionic
Steel Body Side Ionic
Steel Body End Ionic
Steel Body Door Ionic
Steel Body Roof Corinthian
Steel Body Side Corinthian
Steel Body End Corinthian
Steel Body Door Corinthian
Steel Body Roof Composite
Steel Body Side Composite
Steel Body End Composite
Steel Body Door Composite
Steel Body Roof Tuscan
Steel Body Side Tuscan
Steel Body End Tuscan
Steel Body Door Tuscan
Steel Body Roof Doric
Steel Body Side Doric
Steel Body End Doric
Steel Body Door Doric

Fig. 184—Steel Underframe and Steel Body Frame Stock Car, 40-Ton Capacity. Builder, American Car & Foundry Company.
(*See also Fig.* 182.)

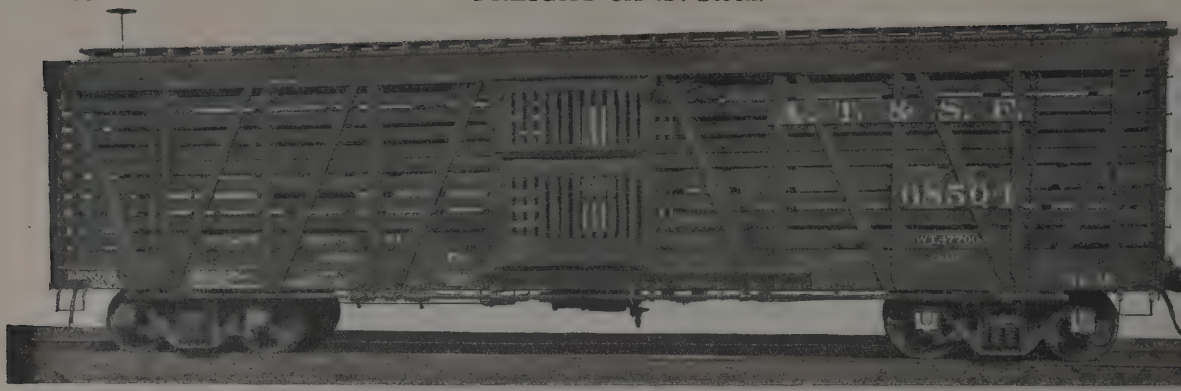


Fig. 185—Steel Frame, Double Deck Stock Car. Capacity, 40 Tons, 2,366 cu. ft.; Weight, 47,700 lb.; Inside Length, 40 ft. 0 in.; Inside Width, 8 ft. 8 in. Atchison, Topeka & Santa Fe Railway.
(*See also Figs.* 186-187.)

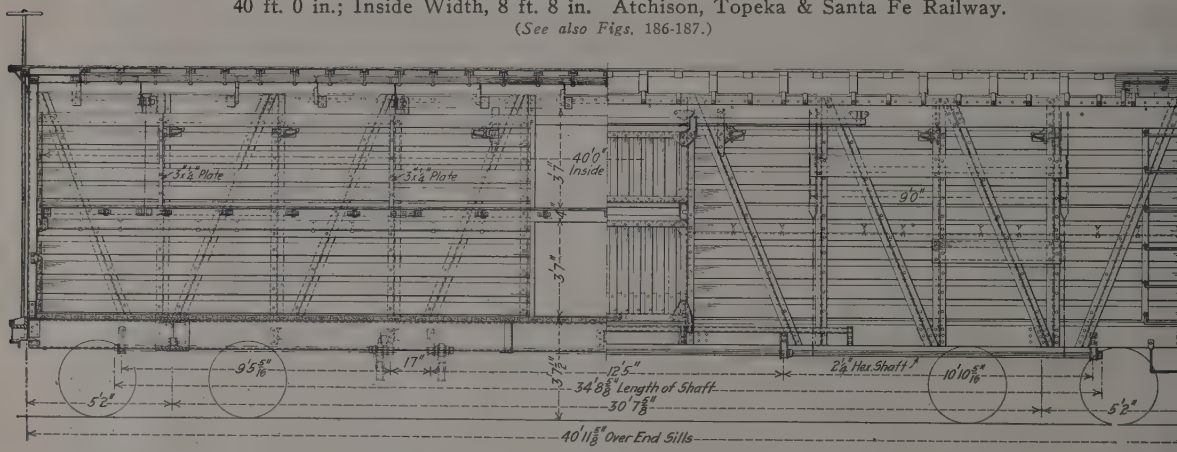


Fig. 186—Side Elevation of Santa Fe Stock Car.

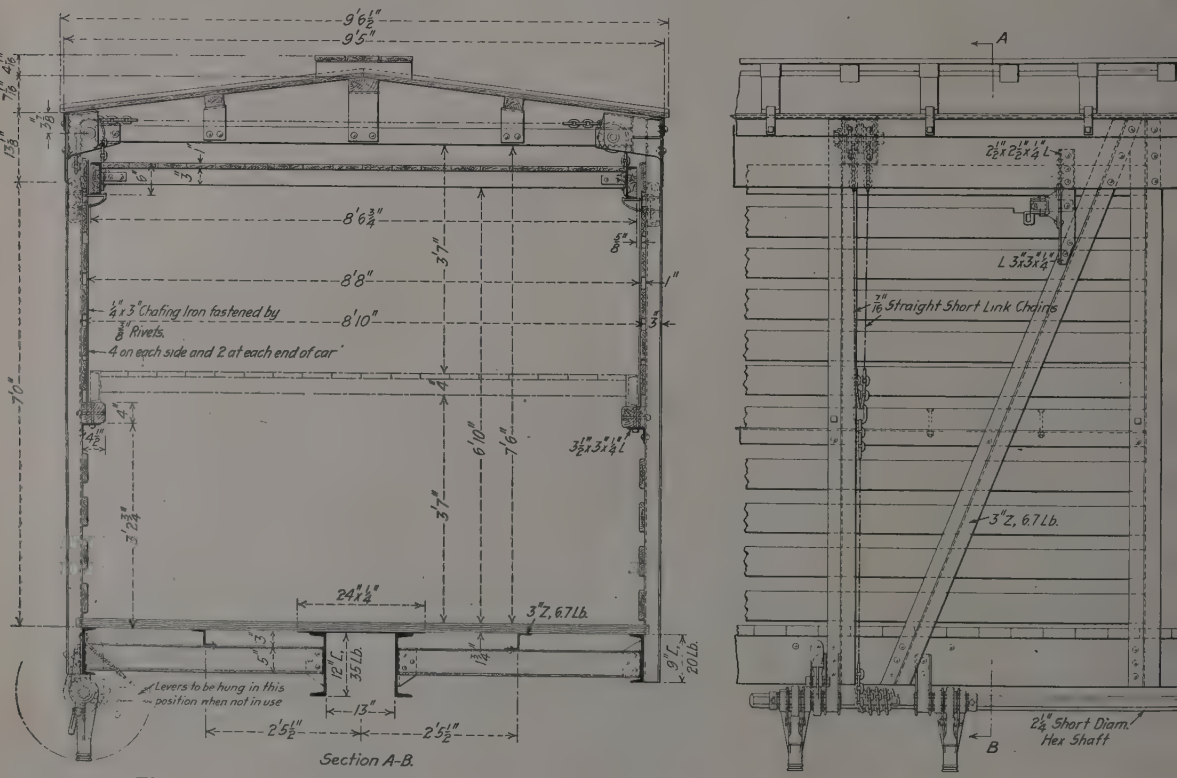


Fig. 187—Side Elevation and Cross Sections Showing Door Operating Mechanism of Santa Fe Stock Car.

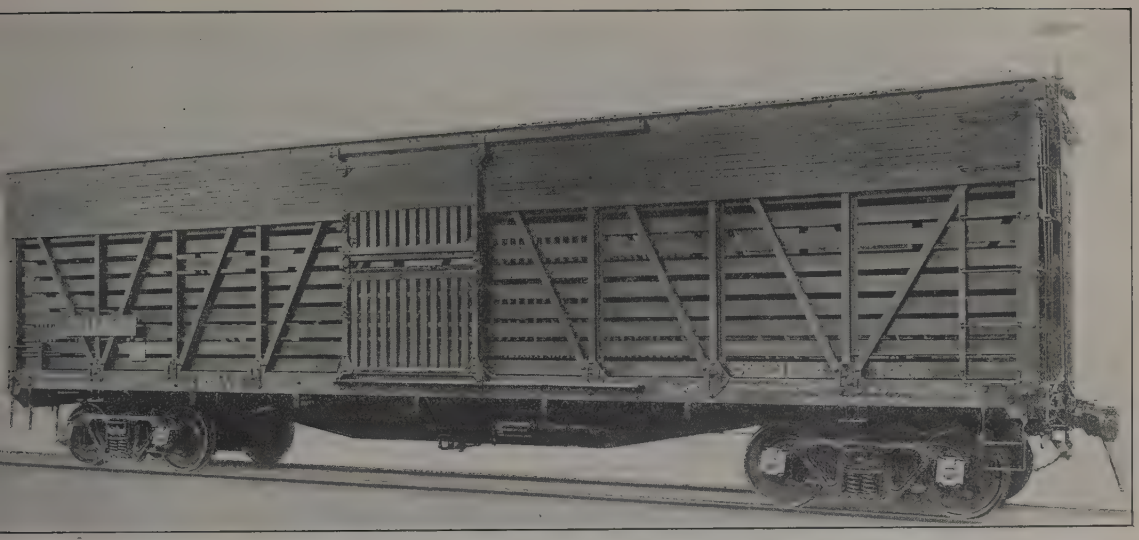


Fig. 188—Steel Frame, 40-Ton Capacity Stock Car. Builder, the Pullman Company—Haskell & Barker Plant.

Fig. 189—Wooden 40-Ton Capacity Stock Car. Builder, American Car & Foundry Company.

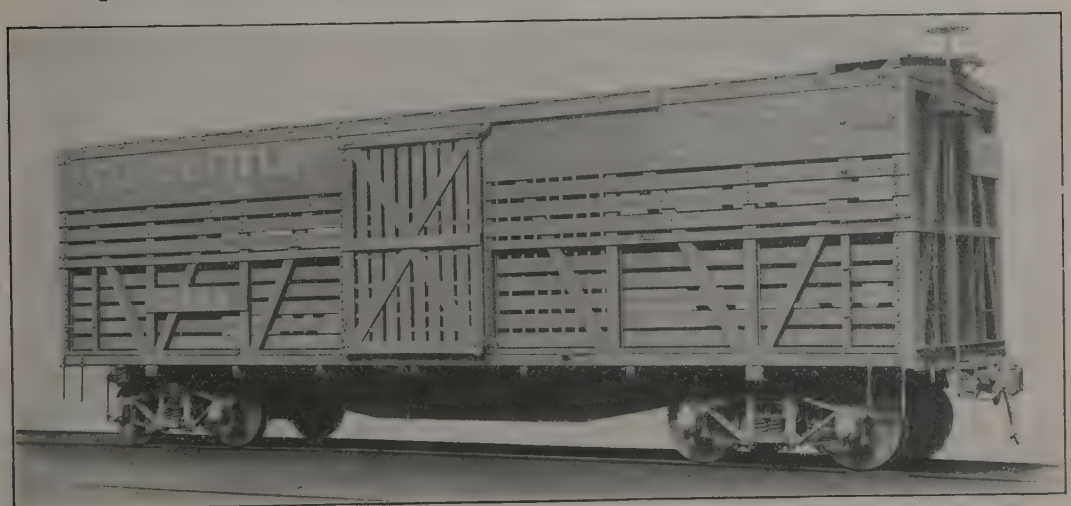


Fig. 190—Steel Underframe, 40-Ton Capacity Stock Car. Builder, Pressed Steel Car Company.

Fig. 191—General Service Stock Car. Drop Doors Open After Unloading Coal.

Fig. 192—General Service Stock Car. Drop Doors Open After Unloading Coal.

Fig. 193—General Service Stock Car. Drop Doors Closed for Loading Stock, Coal or Coke, etc.
National Dump Car Company.

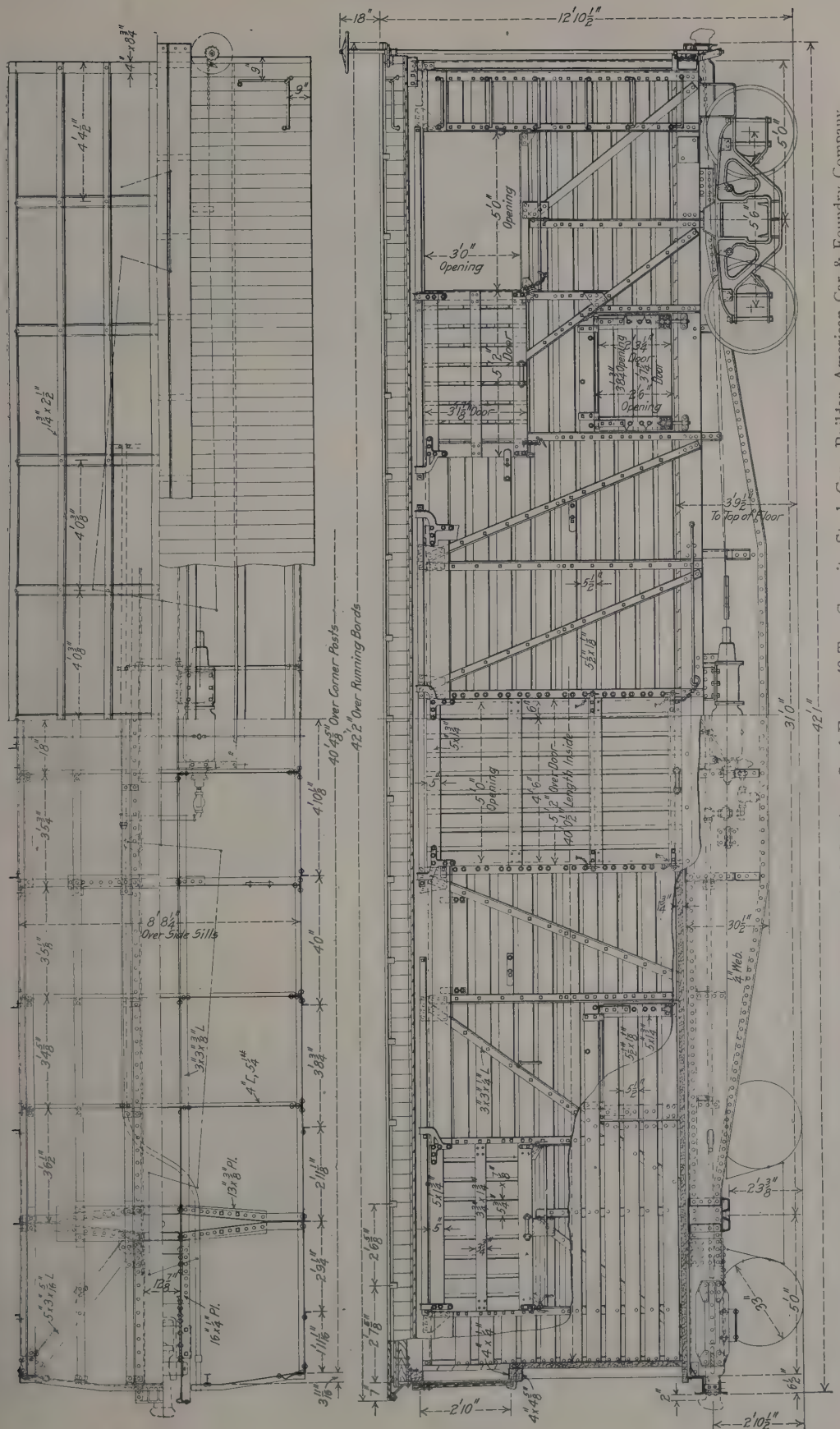


Fig. 194—Plan and Elevation of St. Louis, Iron Mountain & Southern Steel Frame 40-Ton Capacity Stock Car. Builder, American Car & Foundry Company.
(See also Fig. 196.)

Fig. 195—Steel Underframe 40-Ton Capacity Car with Wood and Lumber Rack. Inside Length, 38 ft. 1 in.; Inside Width, 8 ft. 6 in.; Inside Height, 8 ft. 1 in. Builder, Laconia Car Company.

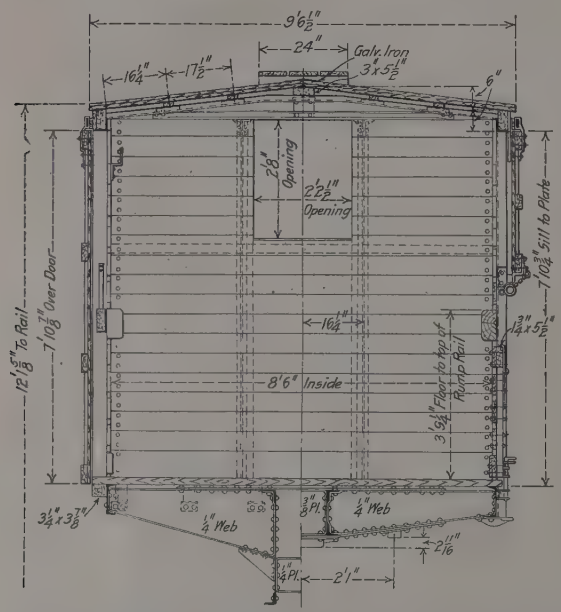


Fig. 196—Cross Sections Steel Frame Stock Car Shown in Fig. 194.

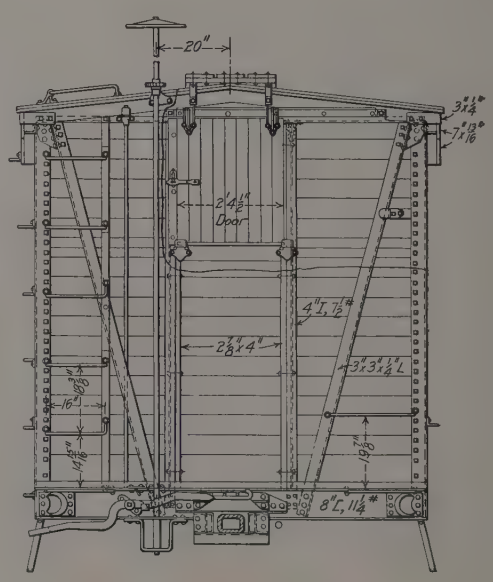


Fig. 197—End Elevation of Steel Frame Stock Car Shown in Fig. 194.

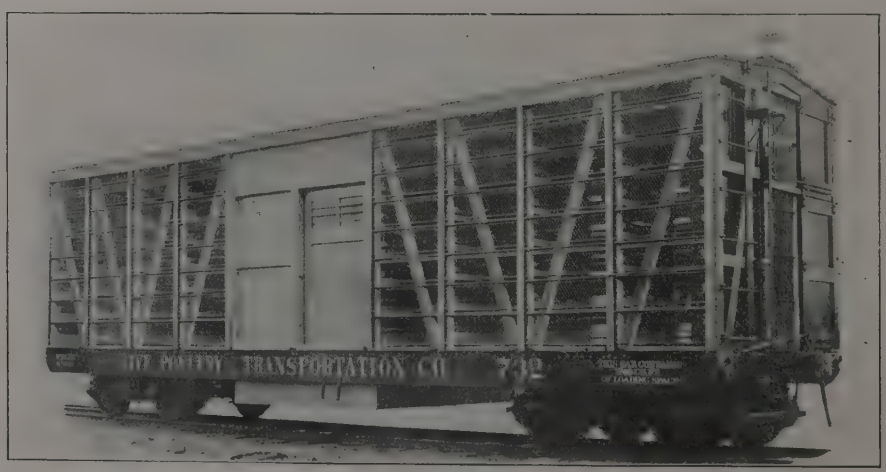


Fig. 198—Steel Underframe 10-Ton Capacity Poultry Car. Weight, 43,000 lb.; Inside Length, 36 ft.; Number of Coops, 128. Builder, American Car & Foundry Company.

Refrigerator and Heater Cars

TRANSPORTATION OF PERISHABLE COMMODITIES such as meat, milk, fruit and vegetables is a very large and important part of railway business and the necessity for properly protecting such lading from the effects of heat in summer and cold in winter has resulted in the development of various types of refrigerator and heater cars. Excepting milk, these products are largely handled in freight trains and therefore the equipment in which they are carried is designed mostly for freight train operation. However, a considerable number of cars are equipped for passenger train operation. The total number of cars in both classes of service in March, 1922, was as follows:

Type of car	Privately owned	Railroad owned	Total
Refrigerator—Freight	36,007	69,675	105,682
Refrigerator—Passenger express.	.....	1,919	1,919
Milk—Passenger express	.....	1,543	1,543
Heater—Box freight	.....	1,343	1,343
Total cars in service	36,007	74,480	110,487

In addition to these cars many box cars are provided with insulation and ventilators and used to carry semi-perishable products not requiring either refrigeration or heat but simply protection against extreme outside temperatures or the heat of the lading itself. The following table gives the number of such cars in service:

Type of car	Privately owned	Railroad owned	Total
Insulated—Box freight	175	3,646	3,821
Ventilator—Box freight	.....	62,738	62,738
Total cars in service	175	66,384	66,559

These cars have been classified by the American Railway Association as follows:

CLASS "R."

"RA"—Meat and Provision Refrigerator. A car with body, doors and hatch plugs equipped with insulation and brine ice tanks and without ventilating devices.

"RB"—Beer and Ice Refrigerator. A car with body and doors equipped with insulation, having no ice tanks or ventilating devices.

"RM"—Refrigerator or Produce Car. A car suitable for carrying commodities that need icing in transit. This car is equipped with two or more ice bunkers or baskets and suitable means for draining off melted ice or briny water. This car has body, door and hatch plugs equipped with insulation, with trap door in the roof for admission of ice and salt; also water seals inside of car.

"RS"—Standard Refrigerator. A car with body, doors and hatch plugs equipped with insulation, with ice tanks and either with or without ventilating devices.

CLASS "B."

"BM"—Milk Car. Exclusively for the transportation of milk, being a car for this purpose and fully equipped for handling in passenger trains.

"BR"—Refrigerator Express. A car constructed and equipped for passenger train service and fitted with ice bunkers or boxes, and suitable to carry produce, oysters, fish or any commodity requiring icing in transit.

CLASS "V."

"VA"—Vegetable Ventilator. A car equipped with insulation, but having common box car end and side doors which afford no protection against heat or cold.

"VS"—Standard Ventilator. A car equipped with insulation, including insulated side, end and top openings, and ventilating devices without ice tanks.

CLASS "X."

"XV"—Box Car, Ventilated. Similar to ordinary box, only having ventilation, and suitable for the transportation of produce or other foodstuffs not needing refrigeration.

"XI"—Box Car, Insulated. A box car having walls, floor and roof insulated, not equipped with ice bunkers or ice baskets. This car ordinarily used for transporting vegetables, fruit, etc.

Refrigerator Cars

The prevailing method of obtaining refrigeration in transit on American railroads is by means of naturally-circulated air, cooled either by contact with ice or mixtures of ice and salt, placed in ice containers or bunkers located at each end of an insulated car; or brine contained in tanks. Some modifications of this system and others differing radically have been designed and operated but are not in extensive use.

Refrigerator cars may be divided into two general types: one, equipped with brine tanks and generally used for carrying meats; the other, equipped with ice bunkers and used principally for carrying commodities such as eggs, butter, vegetables and fruit.

Construction

In the construction of refrigerator cars, as in other modern cars, the tendency has been toward steel underframes and also largely toward steel body framing; in some cases all-steel construction has been employed—except for insulation and some minor parts. The use of proper materials and care in initial construction are very important factors; the right grades of properly seasoned lumber for each part should be used; insulation should be handled carefully, so that it does not become torn or damaged. Floors, walls, and roofs, and the bulkheads and other parts of the interior should be constructed in accordance with the best practices in car construction as established by experience.

Floors.—In floor construction the chief problem is to make the structure waterproof, as the insulating value of the materials is greatly decreased when water is absorbed. Water causes most of the insulating materials used in refrigerator car construction to become mushy and sag or drop out of place; it also causes wood floors, lining and

Note—Part of the information contained in this article was obtained from a paper entitled, "Some Notes on Railway Refrigerator Cars," by W. H. Winterrowd, Chief Mechanical Engineer of the Canadian Pacific Railway, presented at a joint meeting of the Metropolitan Section and the Railroad Division of the A. S. M. E., and the A. S. R. E., New York, May 16, 1922.

	Service	Over striking castings, ft.-in.	Truck centers, ft.-in.	Between bulkheads, ft.-in.	Width inside, ft.-in.	Height clear, ft.-in.	Door height, ft.-in.	Door width, ft.-in.	Height of floor rack	Height opening below bulkhead	Height opening above bulkhead	Type of bulkhead	Tank or bunker	Floors: Layers: Wood	Floors: Layers: Waterproof paper or fabric	Floors: Layers: Air space	Floors: Layers: Insul. mat'l	Floors: Kind of insulating material	Sides: Layers: Wood	Sides: Layers: Waterproof paper or fabric	Sides: Layers: Air space	Sides: Layers: Insul. mat'l	Sides: Kind of insulating material	Roof: Type of outside roof	Roof: Layers: Wood	Roof: Layers: Waterproof paper or fabric	Roof: Layers: Air space	Roof: Layers: Insul. mat'l	Roof: Kind of insulating material	Type of underframe
Freight		42-5¼	31-2	34-4¾	8-7⅜	6-8 Meat rack 7-3½ ceiling	6-9⅝	5-0	5½"	7"	16½"	Solid, swinging to side	Brine tank	4	2 Paper	2	4	½" Keystone Hairfelt	3	..	2	3	½" Keystone Hairfelt	Outside metal	5	1 Paper	4	6	½" Keystone Hairfelt	Steel
		41-8½	30-8	33-2¾	8-2¾	7-0 $^{3}/_{16}$	6-8⅛	4-0	4⅞"	12"	14"	Solid, rigid	Basket bunker	2	1 Paper	..	1	2" Cork	3	2 Paper	3	3	½" Keystone Hairfelt	Outside metal	3	1 Paper	2	4	½" Keystone Hairfelt	Steel
		40-8½	29-10½	32-2⅛	8-0½	7-2	6-4¼	4-0	⅞" Slat	..	3½"	Swinging to roof	Bunker (collap.)	3	1 Paper	1	4	½" Insulite	3	4 Paper	3	4	½" Flaxlinum	Wood	5	5 Paper	3	4	½" Flaxlinum	Steel
		34-0 Endsills	24-0	28-8	8-1	7-4½	6-0	4-0	...	2'7"	17"	Solid, swinging to sides	Brine tank	5	8 Paper	3	1	1" Hairfelt	4	6 Paper	2	1	1" Hairfelt	Wood	5	5 Paper	4	2	1" Hairfelt	Steel
		42-1½	31-1½	33-2¾	8-2¾	7-0 $^{7}/_{16}$	6-8¼	4-0	4¾"	12"	14"	Solid, rigid	Basket bunker	2	..	..	1	2" Cork	3	1 Fabric	1	2 1	½" Keystone 1" Hairfelt	Outside metal	3	1 Fabric	2	2 2	½" Keystone ¾" Hairfelt	Steel
		36-11⅛	26-0	29-10¾	8-2¾	7-1⅞	6-3	5-0	4½"	12½"	14⅞"	Solid, swinging to side	Brine tank	4	2 Paper	3	1 1	Keystone Woolfelt	3	4 Paper	2	1	Keystone	Wood	5	3 Paper	2	1 1	Keystone sawdust	Steel
		37-9⅛ Endsills	26-10	36-0 Bet. ends	8-3⅜	8-0 $^{1}/_{16}$	7-0	6-0	...	..	.....	.....	Ice boxes at roof	3	..	4	3	½" Flaxlinum	3	2 Paper	3	2	½" Flaxlinum	Outside metal	3	..	2	4	½" Flaxlinum	Steel
		42-1½	31-1½	33-1¾	8-2¾	7-1	6-4¾	5-0	4¾"	15¼"	11½"	Solid, rigid	Basket bunker	2	..	..	1	2" Cork	2	2 Paper	2	4	1" Flaxlinum	Outside metal	3	1 Paper	2	1 1	½" Hairfelt 2" Hairfelt	Steel
		40-10 Endsills	30-9⅜	33-5⅜	8-2⅝	7-5⅛	6-4	4-0	...	16"	12"	Solid, rigid	Box bunker	5	1 Paper	2	3	½" Hairfelt	3	2 Paper	3	3	½" Hairfelt	Outside metal	3	1 Paper	2	4	½" Hairfelt	Steel
		43-3½	32-0	34-6	8-10½	7-3½	6-3⅝	4-0	...	12"	12"	Solid, rigid	Basket bunker	5	4 Paper	3	4	Woolfelt	..	..	..	..	.....	Wood	5	5 Paper	5	4	Woolfelt	Steel
		41-2	30-1	32-10½	8-10½	7-2 $^{7}/_{16}$	6-5	4-0	4¾"	12"	10 $^{13}/_{16}$"	Slat syphon, rigid	Box bunker	4	1 Fabric	2	4	½" Flaxlinum	3	..	1	4	½" Flaxlinum	Outside metal	..	..	2	5	½" Flaxlinum	Wood
		40-9½ Endsills	31-9½	33-6¾	8-2¾	7-0 $^{7}/_{16}$	6-8¼	4-0	4¾"	..	.....	Rigid	Basket bunker	2	..	..	1	2" Cork	3	2 Paper	1	4	½" Arctic Keystone	Outside metal	3	..	2	1 2	½" Arctic Keystone 1" Hair	Steel
		40-0 Endsills	30 0	32-6⅞	8-3¼	7-4 $^{13}/_{16}$	...	4-0	$^{13}/_{16}$" Slats	11"	3¼"	Syphon, swinging to roof	Bunker (collap.)	4	7 Paper	1	2	½" Flaxfelt	3	3 Paper	3	4	½" Flaxfelt	Wood	4	6 Paper	3	4	½" Flaxfelt	Steel center sills
		40-0 Endsills	30-0	33-1½	8-3¼	7-4 $^{13}/_{16}$	...	4-0	$^{13}/_{16}$"	15¾"	8⅛"	Solid, rigid	Box bunker	4	1	2	4	½" Arctic Keystone	3	..	3	4	½" Arctic Keystone	Wood	4	..	3	4	½" Arctic Keystone	Steel center sills
		41-8	30-10	33-2¾	8-2⅝	7-2½	5-9¼	4-0	...	12½"	12"	Solid, rigid	Basket bunker	2	..	..	1 1	½" Insulite 1½" Cork	2	1 Paper	1	1 1	½" Insulite 1½" Insulation	Wood	3	1 Rubberoid 1 Waterproof coat	1	1 2	2" Hairfelt ½" Insulite	Steel
		40-0 Endsills	30-0	32-10	8-3⅝	...	6-2⅜	4-0	...	..	.....	Slat syphon, rigid	Box bunker	3	1 Paper	2	2	½" Linofelt	3	2 Paper	3	2	½" Linofelt	Wood	3	1 Paper	3	1 2	⅜" Insulation ½" Linofelt	Steel
		41-10	30-2	32-7	8-4⅝	7-4	5-10	4-0	...	10"	8"	Slat syphon, rigid	Box bunker	5	1 Fabric	3	3	½" Hairfelt	3	4 Paper	3	2	½" Hairfelt	Wood	5	6 Paper	4	3	½" Hairfelt	Steel
		41-11½ Endsills	31-8¼	32-10	8-3	7-1 $^{3}/_{16}$	6-3⅝	4-0	5"	11⅝"	12"	Solid, rigid	Basket bunker	2	2 Paper	1	1	2" Cork	2	9 Paper	1	4 2	½" Hairfelt Cork at bottom	Outside metal	3	13 Paper	1	6	½" Hairfelt	Steel
		42-6	32-6	32-11½	8-4⅜	7-3 $^{3}/_{16}$	6-2	4-2	Slat	12"	12½"	Solid, rigid	Basket bunker	2	3	2	2	1" Corkboard	2	2 Paper	3	3 3	½" Keystone Cork at bottom	Outside metal	2	2 Paper	5	4	½" Keystone	Steel
		48-8¾	34-0	38-4¾	8 7⅜	7-3½	6-9⅝	5-0	5½"	7"	18½"	Solid, swinging to sides	Brine tank	3	2 Paper	1	4	½" Keystone	3	..	2	3	½" Keystone	Outside metal	5	1	4	6	½" Keystone	Steel
Passenger		45-0 Endsills	33-8	38-10	8-1⅞	7-2½	6-3	5-0	4½"	10"	15"	Solid, swinging to side	Brine tank	3	1 Paper	2	2	½" Keystone	4	1	1	4	½" Keystone	Wood, canvas covered	3	1 Canvas	2	4	½" Keystone	Steel
		43-0	30-4	35-5	8-7⅛	7-4	6-3¾	5-0	4¾"	9⅜"	15¾"	Solid, swinging to side	Brine tank	3	1 Paper	2	2	1¼" Tucork	4	..	4	3	½" Keystone	Inside metal	3	..	3	4	½" Keystone	Steel

framing to decay and weaken, thereby making it more difficult to keep the general structure tight. In nearly all recently built cars the floor construction involves the use of cork as an insulating material; to keep moisture away from the cork various waterproofing compounds in liquid or plastic form of waterproof materials in the form of sheets are used.

It was formerly the opinion that floor insulation with intervening dead-air spaces gave the highest insulation value but experience has shown that unless unusual methods of construction are used, it is very difficult to keep the air spaces tight; to be insulators, they must be dead-air spaces; Wall insulation as applied on the most recent cars is rarely less than 2 in. thick; in the majority of cases this is applied in four massed layers of ½ in. insulation; in some cases two massed layers of 1 in. insulation; sometimes in a single layer of 2 in. thick.

Various methods are employed to prevent water getting past the lining at the junction of the floor and side walls and thus into the insulation. This tendency has been a source of great trouble; to overcome it various waterproofing compounds and waterproof fabrics are used.

Another method of waterproof construction is contained in some all-steel refrigerator cars designed and built by

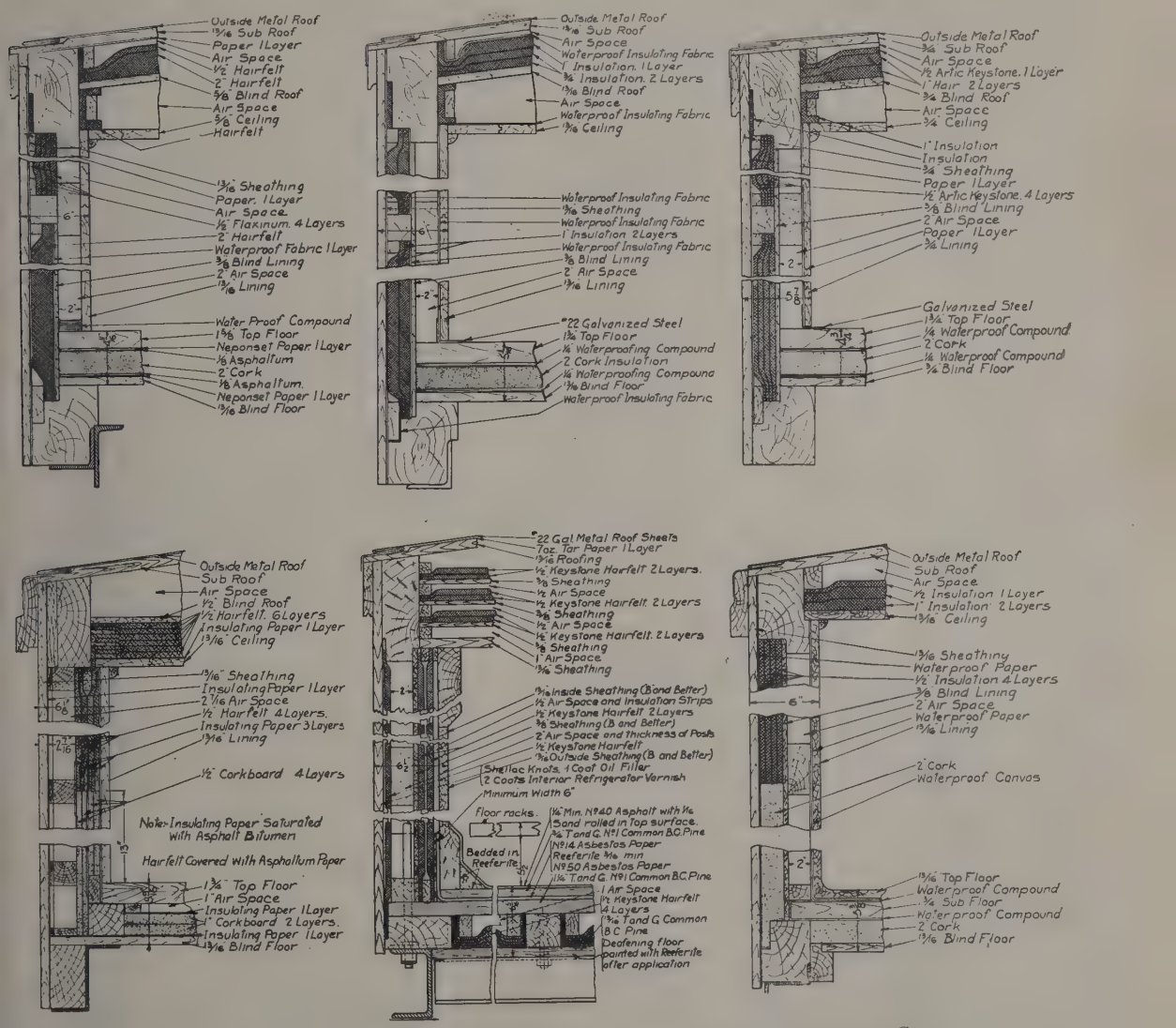


FIG. 200—TYPICAL CONSTRUCTION OF FLOORS, WALLS, AND ROOFS OF REFRIGERATOR CARS.

once air circulation starts their efficiency becomes destroyed.

Walls.—There is a general trend toward massing wall insulation and eliminating air spaces between the layers of insulation. As a rule the insulation is applied in a continuous strip from door post to door post; the advantage of this lies in the fact that a continuous or unbroken surface presents no joints or openings through which air can pass; where insulation is applied in sections, unusually careful and rigid construction is required to prevent air circulation. the Pennsylvania Railroad—Figs. 203-206. Substantially, the body or shell of the car consists of an all-steel container placed within an outer container or shell, the space between the walls being filled with insulation. At the floor, the sections of the inner container are welded together, thus making the floor practically one piece and water-tight and thereby effectually protecting the insulation.

Roofs.—The tendency in roof construction is to apply massed insulation, the most modern cars having 2 to 2½

in. of insulation applied in this way. Some cars are equipped with a double board roof with waterproofing compound between the layers; some with outside metal roofs. The advantages claimed for the outside metal roof are a saving in weight and greater protection to the sub-roofs and insulation against moisture. It is thought that with proper insulation the metal roof has no effect on the interior temperature of the car.

Doors and Hatches.—Doors and hatches should be made in service. Creosote-treated lumber has been used in certain parts of refrigerator cars, such as sills, sub-floors and roof boards, and appears to be giving excellent service; as no part of the treated wood is inside of the car in contact with the lading, no objection can be made to it on account of any odor caused by the treatment. Sufficient time has not elapsed to indicate what increased life can be obtained, but experience in other fields indicates that treated lumber is more durable, and offers much greater resistance to

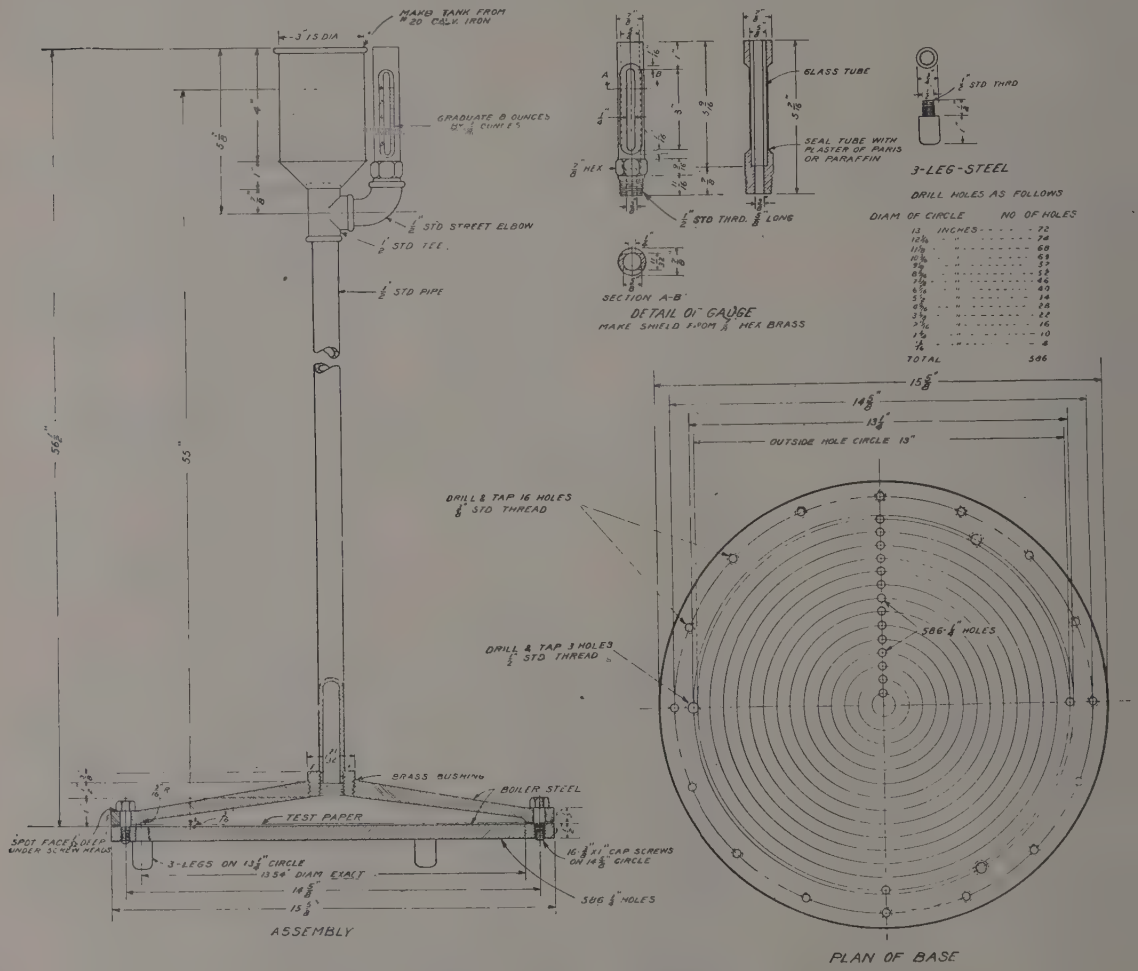


Fig. 201—Porosity Testing Apparatus for Refrigerator Car Insulation.

with ample insulation and constructed so that they will fit tightly and not permit loss of refrigeration due to leakage; an efficient door-locking device should be provided for keeping doors tight, and thereby maintain the efficiency of the car. Any other openings into the car should also be constructed so that they can be kept tightly in place.

Painting.—Refrigerator cars should be kept well painted in order to preserve all exterior surfaces; metal parts should be given particular attention. It is commonly believed that refrigerator cars should be painted with a light or non-heat absorbing color as dark colors absorb heat.

Treatment of Lumber.—The wooden parts of a refrigerator car should, if possible, be made moisture proof or highly resistant to moisture and the efficiency of the car thereby maintained at a high point. To accomplish this, considerable attention has been given to the preservative treatment of the lumber used in their construction and much of it is now moisture and decay than lumber which has not been given preservative treatment.

Insulation

Insulation is the most important factor in obtaining efficient and economical refrigeration, its function being to afford protection to the lading by minimizing heat transmission through the walls, roof, and floor of the car. Therefore, to do its work properly, it must be a non-conductor of heat, and, to promote economical car construction and operation, must also be durable, light in weight, impervious to moisture, proof against vermin and free from odor. Many different materials are used for this purpose: Wool, flax, paper, canvas, rubber and other materials in various combinations in pliable form; and cork—used largely for floor insulation. Some refrigerator cars are in service in which Balsa wood is the principal insulating material; this is a

South American wood that grows very rapidly, and is very light in weight.

The approximate and relative thermal conductivity and density of the various materials and compound structures used in refrigerator cars is as follows:

THERMAL CONDUCTIVITY OF INSULATING MATERIALS

Material	Remarks	Thermal Conductivity[1]	Density[2]
Air	If no heat is transferred by radiation or convection	4.2	0.08
Calorax	Fluffy mineral powder	5.3	4.0
Kapok	Hollow vegetable fibres, loosely packed	5.7	0.8
Pure Wool		5.9	6.9
Pure Wool		5.9	6.3
Hair Felt	Fibers perpendicular to heat flow.	5.9	17.0
Pure Wool		6.3	5.0
Slag Wool	Loosely packed	6.3	12.0
Keystone Hair	Hair felt and other fibers, confined with building paper	6.5	19.0
Mineral Wool	Loosely packed	6.5	12.0
Corkboard	No artificial binder, low density	6.5	6.9
Mineral Wool	Fibers perpendicular to heat flow	6.9	18.0
Cotton Wool	Medium packed	7.0	5.0
Pure Wool	Very loose packing, probably air circulation through material	7.0	2.5
Insulite	Pressed wood pulp	7.1	12.0
Mineral Wool	Firmly packed	7.1	21.0
Linofelt	Vegetable fiber confined with paper, flexible and soft	7.2	11.3
Ground Cork	Less than 1/16 in.	7.1	9.4
Corkboard	No artificial binder	7.3	9.9
Balsa Wood	Very light wood, across grain	7.5	7.1
Balsa Wood	Same sample with 13 per cent waterproofing compounds	8.3	8.0
Flaxlinum	Felted vegetable fibers	7.9	11.0
Fibrofelt	Felted vegetable fibers	7.9	11.0
Rock Cork	Mineral wool and binder	7.9	16.0
Balsa Wood	Across grain, untreated	8.3	7.4
Corkboard	With bituminous binder	8.4	16.0
Balsa Wood	Medium weight wood	9.2	8.8
Sawdust	Various	9.7	12.0
Air Cell (½ in.)	Corrugated asbestos paper, enclosing air spaces	11.0	8.8
Air Cell (1 in.)	Corrugated asbestos paper, enclosing air spaces	12.0	8.8
Asbestos Paper	Built up of thin layers	12.0	31.0
Balsa Wood	Heavy	14.0	20.0
Fire Felt Sheet	Asbestos sheet, coated with cement.	14.0	26.0
Fire Felt Roll	Flexible asbestos sheet	15.0	43.0
Cypress	Across grain	16.0	29.0
Asphalt Roofing	Felt saturated with asphalt	17.0	55.0
White Pine	Across grain	19.0	32.0
Mahogany	Across grain	22.0	34.0
Oak	Across grain	24.0	38.0
Maple	Across grain	27.0	44.0
Virginia Pine	Across grain	23.0	34.0

[1] Thermal conductivity in B.t.u. per day (24 hr.) per sq. ft. per deg. F. per in. thickness.
[2] Density, lb. per cu. ft.

The most commonly used car insulations are in the form of paper and the American Railway Association, in 1917, adopted the following specification as recommended practice:

Paper Insulation for Refrigerator Cars

ADOPTED, 1917.

1. *Scope.*—These specifications cover insulation paper for refrigerator cars.

I. Manufacture.

2. *Material.*—Insulation paper shall be made of good quality fibrous material, thoroughly saturated with an asphaltum bitumen. It shall be furnished in either of two weights, known as 90-lb. or 110-lb. paper.

II. Physical Properties and Tests.

A—Before Exposure.

3. *Porosity Test.*—A test sample one foot square shall not show a leakage of more than 8 oz. of water, when subjected for two hours to a water column of 55 in. at 60 deg. to 80 deg. F. Tests to be made with apparatus as shown in Fig. 201.

4. *Mullen Test.*—The strength of a test sample, as determined by the standard "Mullen" test, made at a temperature of 70 deg. F., and with load applied at the rate of 3 to 4 lb. per second, shall be as follows: 90-lb. paper, not less than 55 lb.; 110-lb. paper, not less than 70 lb.

5. *Bending Test.*—Paper shall be so pliable, after being cooled in water at a temperature of 32 deg. to 35 deg. F., and while at this temperature, that it may be bent flat upon itself without breaking.

6. *Ash.*—The total amount, by combustion of a test sample, of inorganic matter or ash shall not be more than 6 per cent of the original weight.

B—After Exposure.

(This test to be made at the option of the purchaser.)

7. *Mullen Test.*—The strength of a test sample, as determined by the standard "Mullen" test, made at a temperature of 70 deg. F., shall not be affected more than 10 per cent of the original by exposure to a temperature of 150 deg. F., or to air saturated with water vapor at room temperature for 7 days.

8. *Bending Test.*—After exposure to a temperature of 150 deg. F., or to air saturated with water vapor at room temperature for 7 days, paper shall be so pliable at temperature of 32 deg. to 35 deg. F., and while at this temperature, that it can be bent flat upon itself without breaking.

9. *Drying and Absorption.*—The original weight shall not decrease more than 3 per cent by exposure to a temperature of 150 deg. F., nor increase more than 10 per cent by exposure to air saturated with water vapor at room temperature for 7 days.

10. *Sampling.*—The inspector shall examine and weigh 5 per cent of the paper in each lot offered, and select one sample from each lot of 200 rolls or fraction thereof. Not more than one sample shall be taken from any one roll. Each sample shall have the lot number stenciled on it.

III. Permissible Variations.

11. *Weight.*—The average weight of the roll shall correspond within 1 per cent of the weight as indicated by test sample, or the respective weights per 1000 sq. ft. shall not be less than 85 lb. or 104 lb. for the two weights of paper specified in Section 2.

IV. Inspection and Rejection.

12. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the material is being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

13. *Rejection.*—(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Material which, subsequent to test and inspection at the factory or elsewhere and its acceptance, shows defect or imperfections will be rejected and shall be replaced by the manufacturer.

14. *Rehearing.*—Samples tested in accordance with these specifications, which represent rejected material, shall be held for fourteen days from date of test report.

Appendix.

Note.—The paper shall be supported on the under side by a perforated plate or other means, provided the area of the opening through the plate is 20 per cent of the area

of the supported paper. The diameter of the holes in the perforated plate to be approximately ¼ in.

Interior Arrangement

Bulkheads.—Air circulation is assisted by means of partitions, called bulkheads, placed in front of or forming part of the ice containers and constructed so that the relatively warm air must pass over the top to reach the ice. The air becoming chilled, and therefore heavier, sinks toward the floor and reaches the body of the car by passing through a space beneath the bulkheads. These partitions also assist in protecting the lading nearest the ice. Without bulkheads, and particularly when salt is used with the ice to hasten and increase refrigeration, that part of the lading nearest the ice would be likely to freeze—an undesirable and disastrous occurrence with some commodities. At the same time, that portion of the load near the center and top of the car might remain at too high a temperature—an equally undesirable condition.

The prevailing type of construction is the solid bulkhead, either built into place or hinged to the wall or ceiling so that it can be swung open. Some cars are equipped with a siphon system, in which the bulkhead consists of a framework holding a series of galvanized iron louvres—sometimes wood slats—designed to direct the air back and down into the bunkers. The theory is that air entering the bunker

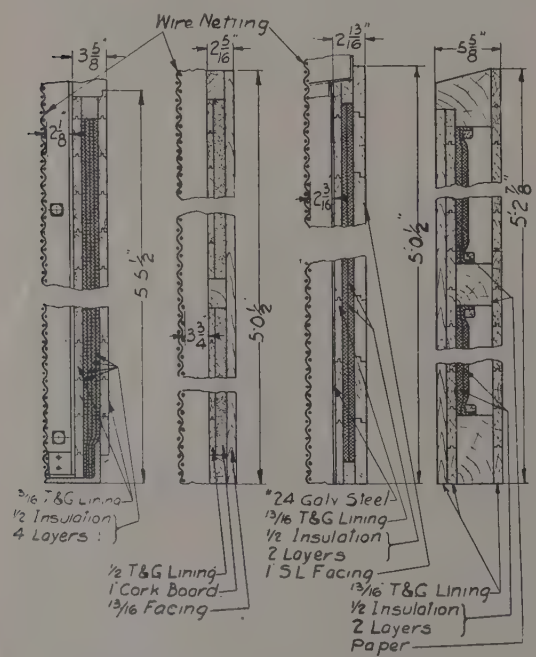


FIG. 202—TYPICAL BULKHEAD CONSTRUCTION.

over the top of the bulkhead becomes chilled, and, passing downward, creates a suction or siphoning effect which draws air from the body of the car into the bunker through the openings in the bulkhead.

The size of the car and the distance between bulkheads are important factors in efficient refrigeration. The cold air passing out beneath the bulkheads flows toward the center of the car; in doing its work it absorbs heat, and, if the distance between bulkheads is too great, the air, when it reaches the center of the car, will not be at a sufficiently low temperature to properly refrigerate the load at that point, particularly near the top. Under such conditions a portion of the load near the bulkheads may be sufficiently chilled while the upper and center part of the load may be too warm. In modern cars, the distance between bulkheads varies between 28 ft. 8 in. and 38 ft. 10 in., the general trend being between 32 and 34 ft.

Bunkers and Tanks.—The type and size of the ice containers—bunkers or brine tanks—materially affects the temperature of the circulating air. The chief consideration in their construction and capacity is the refrigeration required to replace the loss due to transmission and to cool the car quickly and maintain its contents at the required temperature.

Bunkers are made in two different types, the basket bunker and the box bunker.

The basket bunker is usually constructed with wire mesh sides and the bottom consists of a slatted wooden structure. It is placed so that air space exists around the outer surfaces, permitting the air behind the bulkhead to come in contact with a maximum ice area, while the open spaces facilitate circulation. In some few cars overhead bunkers of the basket type have been used.

The box bunker is constructed so that the walls are formed by the bulkhead and the sides and end of the car; this type also has a slatted bottom. In some refrigerator cars, collapsible box bunkers have been applied; the bulkhead is swung up, or to one side, and fastened; the slatted rack is swung or folded back against the end of the car. In this way the space occupied by the bunker is made available for lading when the car may be used for commodities not requiring refrigeration.

Brine Tanks are commonly constructed of galvanized sheet steel and installed at each end of the car—overhead tanks have also been used. The usual design of tank is arranged with three or four compartments in which the brine solution is contained. These compartments are connected by piping and valves and a drip trap and valve is provided so that the brine and condensation will be retained while en route and may be disposed of at terminals or stations.

The proper ice capacity of bunkers and tanks has been the subject of consideration by a committee of the A. R. A. and the following specification has been adopted:

Recommended Practice ADOPTED, 1911

The minimum capacity for ice tanks for fresh meat cars shall be 5,000 lbs.; for fruit and dairy cars 3,000 lbs. minimum, or 6,000 lbs. per car.

Floor Racks.—Floor racks are used as an aid to circulation in cars where the lading is piled or stacked. The lading is placed on the racks which consist of longitudinal runners 3 or 4 in. high, with cross slats fastened on top of them; the space between the top of the racks and the floor averages between 4½ and 5 in. These racks permit the cold air which flows beneath the bulkhead to circulate freely toward the center of the car and up through the lading. Usually the racks are divided in the middle and hinged to the side walls of the car so that they can be turned up to make the floor accessible. Generally modern cars are equipped with these hinged racks, but in many cars long slats or runners are simply fastened to the floor.

Ice Consumption

The amount of ice required for proper refrigeration depends upon the car construction, character of lading, outside temperatures, etc., therefore, no constants for ice consumption are possible. However, some information on this phase of the subject is available.

A comparative test of a car equipped with floor racks and six overhead bunkers at the center and a car without floor

racks and having collapsible end bunkers was conducted in 1919.

The equipment used in the test consisted of Santa Fe car SFRD 12646 and Chicago Great Western car 30000. Both cars were pre-iced and loaded with grapes and handled under standard refrigeration requirements from Lodi, Cal., to Chicago, Ill., leaving Lodi, at 3:15 p. m. October 8 and arriving at Corwith Yards, Chicago, at 1:15 a. m. October 18; the total time for the 2,470 mile trip was 9 days, 9 hours and 55 min., or an average speed of 11.0 miles per hour. The weather conditions were normal for the autumn season. The principal dimensions of the two cars are given in the table:

	CGW 30,000	SFRD 12646
Loading capacity	60,000	60,000
Outside length	40 ft.	41 ft. 3 in.
Inside dimensions—		
Length	37 ft. 10⅝ in.	33 ft. 2¼ in.
Width	8 ft. 2 in.	8 ft. 2¾ in.
Height floor to ceiling	7 ft. 8⅛ in.	7 ft. 3 in.
Height rack to ceiling	7 ft. 3⅜ in.	.....
Height racks to ice tank	5 ft. 11$\frac{11}{16}$ in.	.....
Ice container—		
Kind	Overhead Baskets	Baskets—End Collapsible
Ice capacity	6,300	10,500
Bulkheads	4¾ in. False ends	Siphon
Insulation thickness	2 in.	2 in.

The amounts of ice furnished at each icing station en route, as well as the total amounts furnished were as follows:

		CGW 30000		SFRD 12646	
Location	Date	lb.	Total amount, lb.	lb.	Total amount, lb.
Stockton, Cal.	Oct. 7, 1919	4,275	4,275	10,500	10,500
Stockton, Cal.	Oct. 8, 1919	1,710	5,985	1,995	13,495
Bakersfield, Cal.	Oct. 9, 1919	2,550	8,535	1,950	14,445
Needles, Cal.	Oct. 10, 1919	1,300	9,835	1,750	16,195
Winslow, Ariz.	Oct. 12, 1919	1,100	10,935	1,100	17,295
Belen, N. M.	Oct. 13, 1919	400	11,335	700	17,995
Clovis, N. M.	Oct. 13, 1919	800	12,135	550	18,545
Waynoka, Okla.	Oct. 14, 1919	1,250	13,385	1,000	19,545
Argentine, Kans.	Oct. 16, 1919	2,000	15,385	1,700	21,245
Corwith Yards, Chicago, Ill.	Oct. 18, 1919	500	15,885	1,100	22,345

The ice containers were filled to the same capacity at the final re-icing at Corwith Yards, as at the initial icing at Stockton. The total amount for car SFRD 12646 was 22,345 lb. and for CGW 30000 15,885 lb.; the total amount melted—the difference between the total amount furnished and the initial icing—was 11,845 lb. in car SFRD 12646 and 11,610 lb. in CGW 30000; an ice rate of 47.2 lb. per hour for SFRD 12646 and 46.3 lb. per hour for CGW 30000.

In the car having the end ice bunkers it was necessary to keep the bunkers full of ice in order to secure effective refrigeration; in the car equipped with overhead ice bunkers all of the ice was located near the roof in the best position to create refrigeration.

Pre-Cooling

The temperature of the entering load is a very important factor in the transportation of perishables. If heat is not removed from commodities such as fruits and vegetables prior to loading, it is highly desirable to remove it as quickly as possible after loading; otherwise, the lading may either spoil en route or reach the destination in such condition that the market value is greatly reduced.

The humidity or moisture content of the air in the car is almost as important as the temperature; excess of humidity is highly injurious to many commodities. Generally, if refrigeration is effective and a high initial rate of cooling is obtained, the air is kept sufficiently dry, due to condensation taking place on the surface of the ice or the ice containers. In this way the moisture given off by some classes of lading is also deposited.

To obtain more efficient operation in this respect pre-cooling of the load has been resorted to and two distinct methods of pre-cooling cars and lading are in use: Shippers' pre-cooling—the lading placed in cold storage rooms and allowed to cool to the proper temperature, after which it is loaded into cars that have been pre-iced; and carriers' pre-cooling—generally the car is loaded, after which the interior of the car and the lading are cooled by mechanical means.

Pre-cooling of the car may be effectively accomplished by the use of ice and salt—either by mixing coarse salt with the ice or placing it only on top of the ice pile. The greatest amount of salt is used at the first icing, when the greatest heat is in the lading; at the second icing the amount of salt is reduced, while at the third and successive icings a stipulated minimum amount is used.

At many points where large tonnages of fruit or meat originate, the cars, as well as the lading, are often pre-cooled by mechanical means; at such points the shippers frequently combine to build such a plant. Where small tonnages originate, little pre-cooling has been done by mechanical methods because of the high cost of the plant and equipment.

Some commodities can be frozen hard before loading and therefore require little or no icing en route, the lading itself supplying the necessary refrigeration. This not only insures better condition in transit but is an added economy in ice consumption.

Salt Water Drippings

When salt is used with ice in a bunker, the method of disposing of the salt water drippings requires special attention. If brine falls on the truck parts, rails, etc., the resulting damage is great and heavy maintenance cost results. The subject is of such importance that the American Railway Association as early as 1898 adopted the following:

Recommended Practice ADOPTED, 1898; REVISED, 1910

1. All salt-water drippings should be retained in the ice tanks and drained off only at icing stations.

2. The total capacity of drain openings should not exceed the capacity of traps, and the capacity of both drains and traps should be sufficient to release all drippings within the time limit of icing the train.

3. The mechanism adopted for handling drain valves should be simple and positive, and so designed as to insure closing the valves before hatch plugs can be returned to their places.

4. Salt drippings should be conducted from ice tanks through the drain valves above described and thence to the outside of cars through regular traps and drain pipes.

The A. R. A. interchange rules also specify that after July 1, 1922, cars carrying products which require for their refrigeration the use of ice and salt, and which are equipped with brine tanks, shall not be accepted in interchange unless provided with a suitable device for retaining the brine while en route between the icing stations.

Other Systems of Refrigeration

In the cars already described, refrigeration is accomplished by means of air circulation, the air being cooled by contact with ice or ice containers placed at the ends of the car; there are some modifications of this system:

In one modification ice containers of the basket-bunker type are placed in the center of the car just below the roof. It is claimed that with this system maximum refrigeration can be applied where the air within the car is

at its highest temperature. The principal objections to such a system are the decreased head room in the center of the car; the great weight of ice near the roof—raising the center of gravity; and the difficulty of adapting this system for use with meat racks placed near the ceiling of the car. Provision is made for converting the car to a refrigerator or to a ventilated car. There are not many cars of this type in service.

Another system consists of a brine tank built into the roof at each end of the car. These tanks extend about 9 in. below the ceiling and are heavily insulated; they are connected to each other by pipes hung about 2 or 3 in. below the ceiling. In each tank is a partition running lengthwise of the car; in one partition are check valves opening to the right; in the other partition, opening to the left. The theory is that when ice and salt are placed in the two tanks the swaying of the car when the train is in motion automatically circulates the brine through the pipes, refrigeration being accomplished by contact of the air within the car against the surface of the pipes connecting the two tanks. In order to obtain the benefits of refrigeration these pipes are not insulated and to protect the lading, canvas troughs are placed underneath to catch any condensation or frost slush that may drop from them. A system of piping placed on the floor underneath the floor racks provides a means for converting the car from a refrigerator to a heater car for use in cold weather. This system has not been in use a great length of time but some cars are being tested in various classes of service. The advantages claimed for it are increased loading space, decreased consumption of ice, uniform temperatures, and a car that can easily be changed from a refrigerator to a heater car. The ability of this system to supply refrigeration when the car is not in motion, and what it can accomplish in the way of quick pre-cooling when the car is placed at the loading shed or platform is still to be determined.

A refrigerator car in which the ammonia absorption process of refrigeration and heating is employed was built in 1916. The theory of this process is that as a liquid vaporizes it absorbs heat from its surroundings. There are four distinct stages in the process, whether it be performing the function of refrigeration or heating—the generation of ammonia gas, condensation of the gas, expansion of the condensed gas from a liquid back to a gas, and the absorption of the gas in water for regeneration. The temperature in the car is automatically regulated by a thermostat; a constant temperature anywhere between 32 deg. and 55 deg. F. can be maintained. As the temperature drops below that desired, the action automatically changes into a heating system by reversing the process of refrigeration. The system is self-contained and provides its own power; movement of a lever throws it in or out of service. Charcoal is used as fuel and the fuel storage magazine requires loading only once in two weeks of continuous operation.

Heater Cars

To properly protect perishables—such as fruits and vegetables—in transit during the winter, there must be provision made for the temporary conversion of refrigerator cars to heater cars, or other cars having permanent heater apparatus must be used. Much work is being done along the lines of development of heaters and various types using live steam or employing alcohol, kerosene, coal, or charcoal as fuel have been used; some heat storage systems have also been devised.

One system of heating used with some success derives its heat from steam supplied by the locomotive; a steam duct leading from the locomotive passes under each car to a connection with piping in the interior. A thermostat automatically shuts off the steam when the interior reaches a predetermined temperature, and prevents the car from becoming overheated. This system eliminates the fire risk and the damage to the lading often resulting from the gases produced by combustion in those types of heaters using fuels. In a test of this system, made when the outside temperature varied 48 deg. F.—from 28 deg. F. to minus 20 deg. F.—the temperature inside of the car varied only 8 deg. F.—from 52 deg. to 60 deg. F.

Another steam heating system takes advantage of the heat absorbing and retentive properties of porous terra cotta. This system makes use of the same style of train pipe, valves, traps and hose that are used on passenger train equipment. The train pipe is located below the car floor; its lowest point is at the center of the car where an automatic trap provides an outlet for the water of condensation. At each end of the car a branch pipe extends to one side and passes up through the floor to a heat storage tank or reservoir—an iron cylinder about 8 inches in diameter and about 6 feet long—located in the space below the ice bunker. This cylinder is placed at an angle so that the water of condensation flows to the lower end and passes out through the branch pipe; an automatic air valve on the upper end controls the admission of steam. The reservoir is filled with specially made porous terra cotta bricks which have corrugated surfaces, and facilitate the passage of live steam from the locomotive—or a stationary boiler—to all parts of the reservoir. This insures the absorption of heat by the bricks which enables them to radiate heat for many hours after the steam supply has been cut off—in one instance, with the outside temperature minus 18 deg. F., a sidetracked car retained, for twenty-four hours, sufficient heat to prevent freezing. A thermometer placed in sight from the outside of the car permits an easy check on the temperature inside of the car. The action is such as to cause a mild circulation of air in the car; the cool air sinks to the floor and is drawn toward the heater, the warm air passes upward and is diffused throughout the car from above.

With this heat storage system a car may be side-tracked for from 20 to 24 hours before additional heat is required—which may then be obtained from the engine of a passing train if no other source of supply is accessible.

In a heating system employing coal as fuel the heater is installed in an enclosure underneath the car near the center and the heat is conducted upward through a flue which is enclosed within a larger flue or jacket placed inside of the car. The space between this jacket and the flue also forms an air chamber to which fresh air is admitted through an intake underneath the heater. The air is heated by contact with the flue as it passes upward, and, after circulating through the interior of the car, passes out through an outlet valve in the top of the car. This type of car is designed so that it can be converted from a heater car to a refrigerator car or to a plain ventilated car.

Illustrations of refrigerator and heater cars appear in pages following.

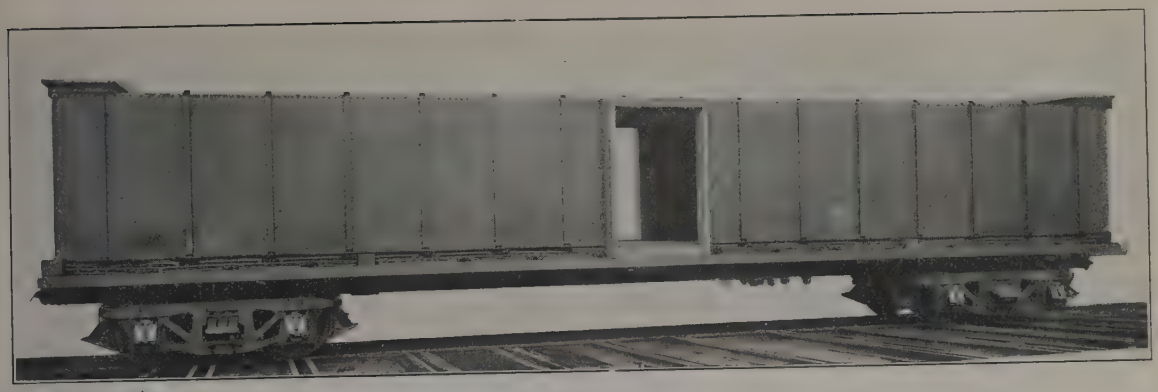


Fig. 203—Inner Shell of Pennsylvania Refrigerator Car Before Insulation is Applied.
(*See also Figs.* 204-206.)

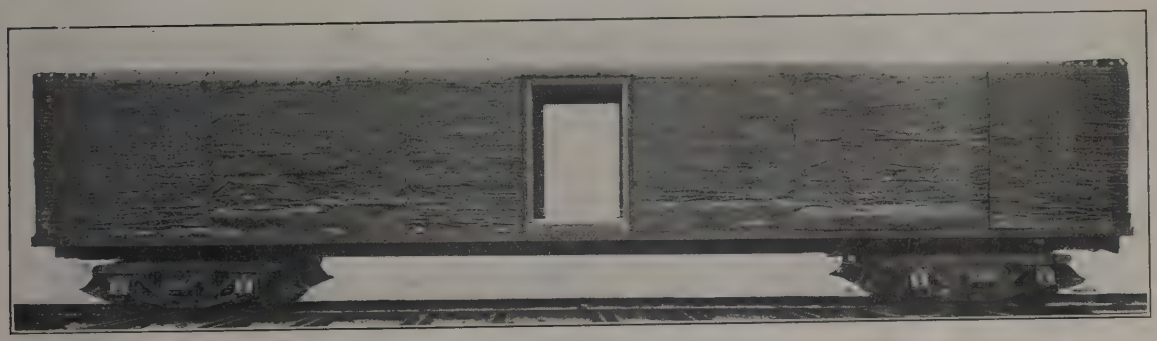


Fig. 204—Insulation Partly Applied.
(*See also Figs.* 203, 205-206.)

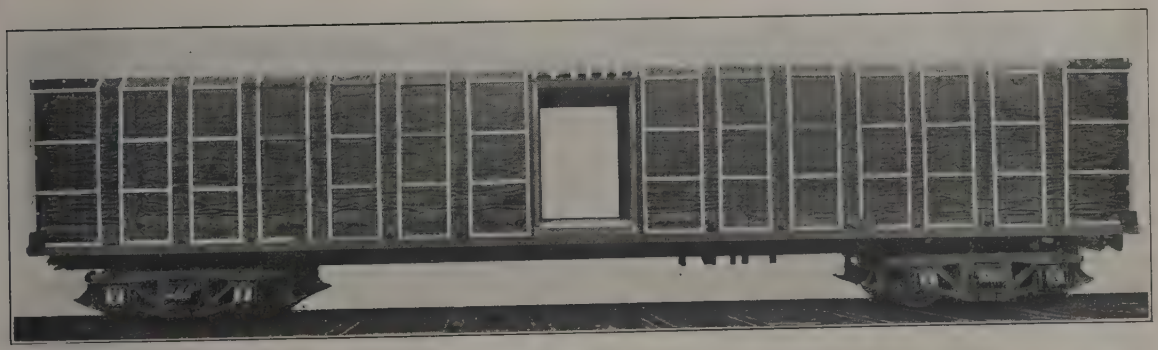


Fig. 205—Insulation Complete.
(*See also Figs.* 203-204, 206.)

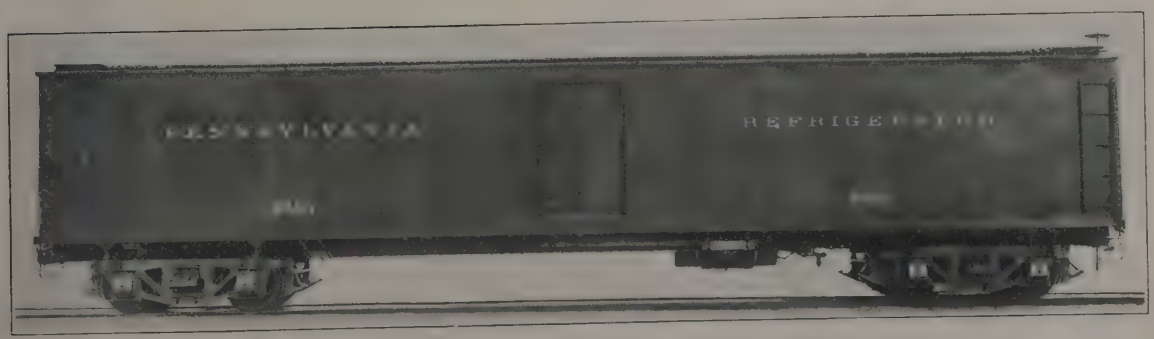


Fig. 206—All-Steel Refrigerator Car for Milk Shipment. Pennsylvania Railroad.
(*See also Figs.* 203-205.)

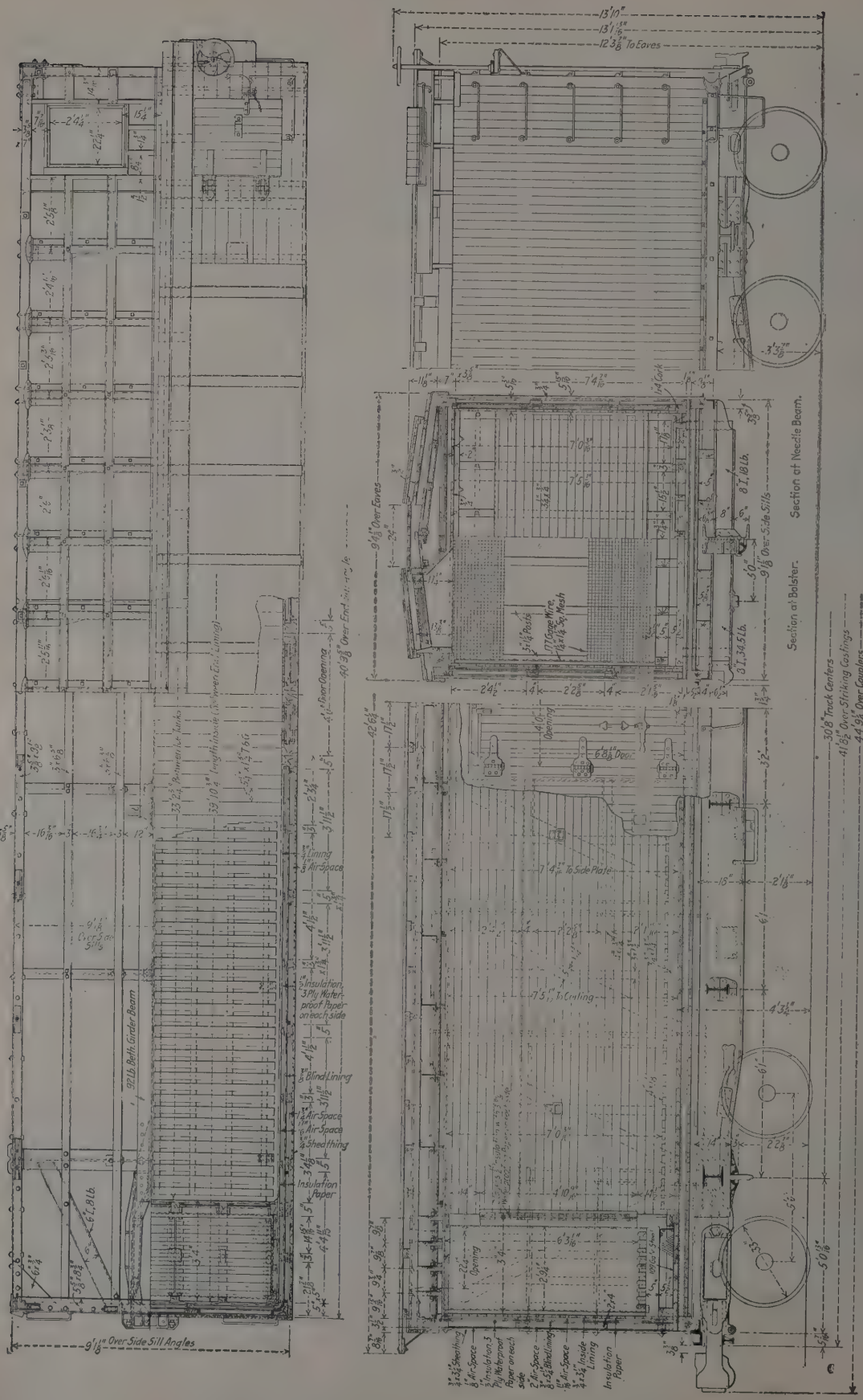


Fig. 207—Plan, Side Elevation and Cross Section of Steel Underframe 30-Ton Capacity Refrigerator Car for Pacific Fruit Express. (*See also Fig.* 208.)

Fig. 208—Steel Underframe, 30-Ton Capacity Refrigerator Car for the Union Pacific System Pacific Fruit Express. Built in the Union Pacific Shops and by the American Car & Foundry Company, Mt. Vernon Car Mfg. Company, Pacific Car & Foundry Company, Pullman Company—Haskell & Barker Plant.

Length over sheathing	40 ft. 11⅛ in.	Cubic capacity between ice tanks	2,029 cu. ft.
Length between ice tanks	33 ft. 2¾ in.	Distance from center to center of body bolsters	30 ft. 8 in.
Width over sheathing	9 ft. 2⅝ in.	Truck wheelbase	5 ft. 6 in.
Width inside of lining	8 ft. 2¾ in.	Truck capacity	80,000 lb.
Height, top floor to ceiling	7 ft. 5⅛ in.	Light weight of car complete (built up center sill)	53,500 lb.
Capacity of both ice tanks	10,500 lb.	Light weight of car complete (Bettendorf underframe)	52,200 lb.

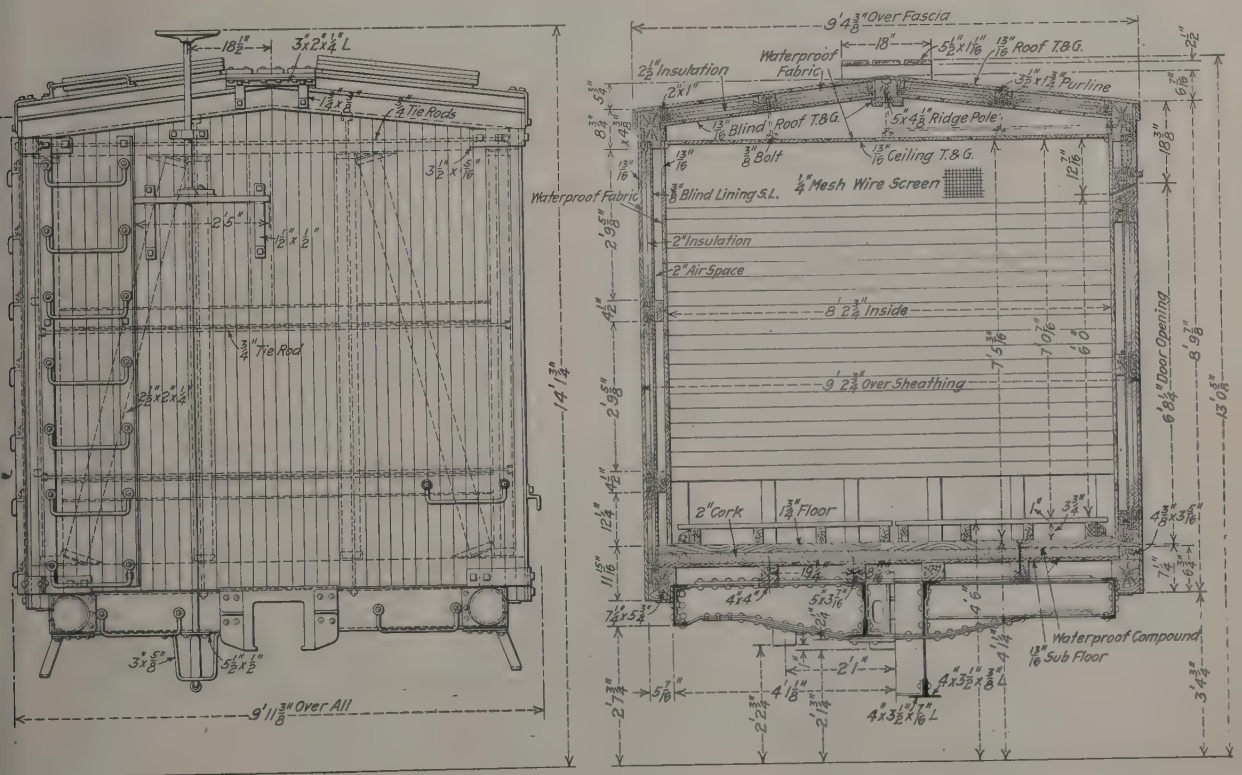


Fig. 209—End Elevation and Section of U. S. R. A. Standard Refrigerator Car Shown in Figs. 210-213.

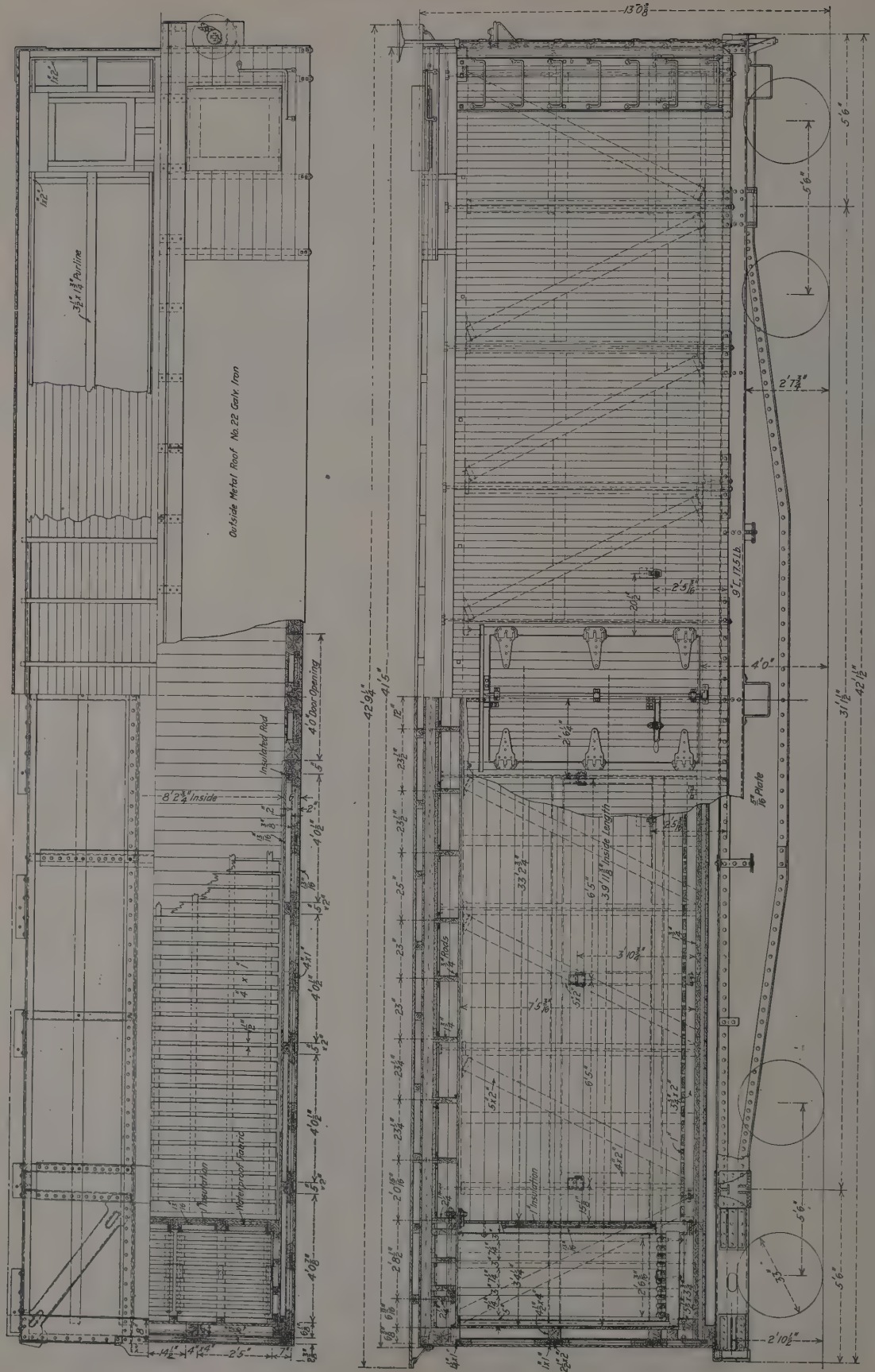


Fig. 210—Elevation and Plan of Standard Refrigerator Car as Designed by the United States Railroad Administration.
(See also Figs. 209, 211-213.)

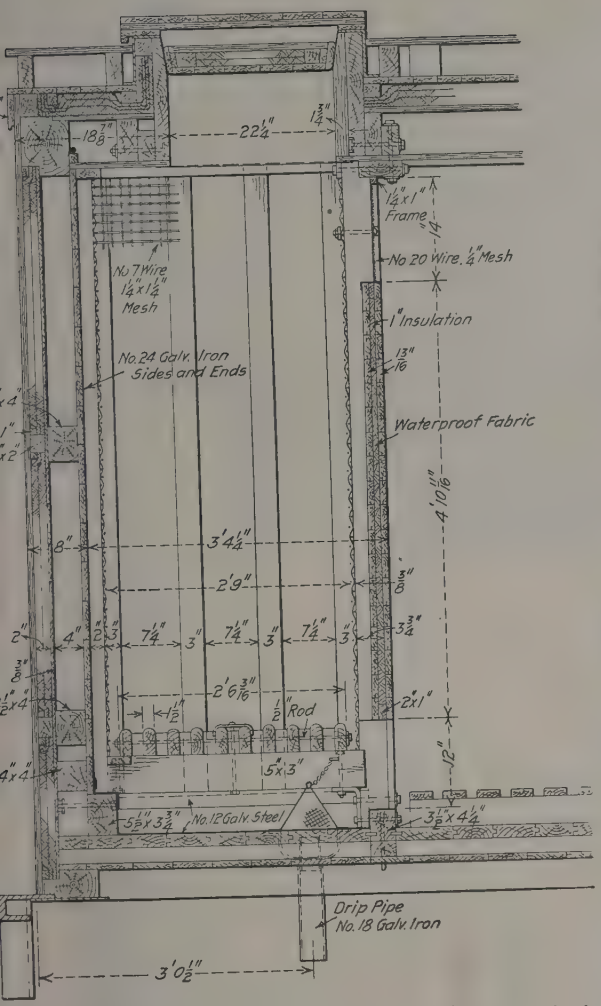

No. 7 Wire 1¼"x1¼" Mesh
No. 24 Galv. Iron Sides and Ends
No. 20 Wire, ¼" Mesh
1" Insulation
Waterproof Fabric
No. 12 Galv. Steel
Drip Pipe No. 18 Galv. Iron

Fig. 211—Arrangement of Ice Box for U. S. R. A. Standard Refrigerator Cars.

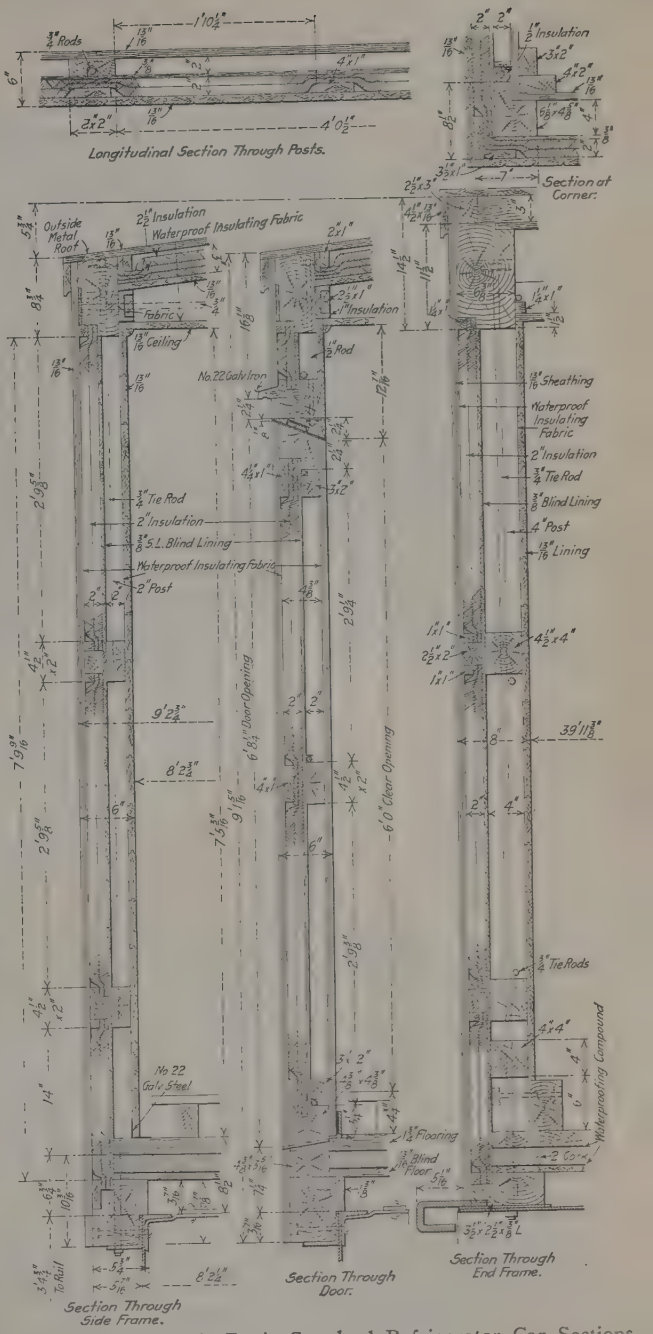


Fig. 212—U. S. R. A. Standard Refrigerator Car Sections Showing Insulation.

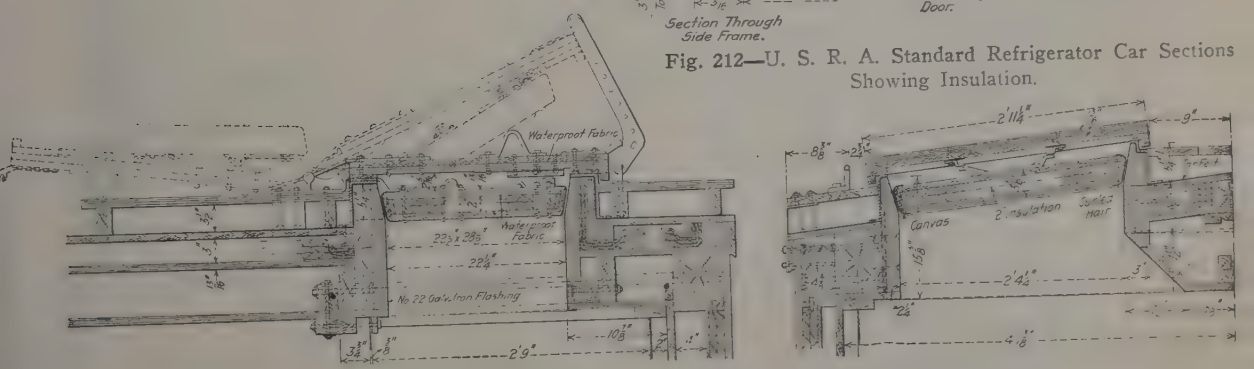
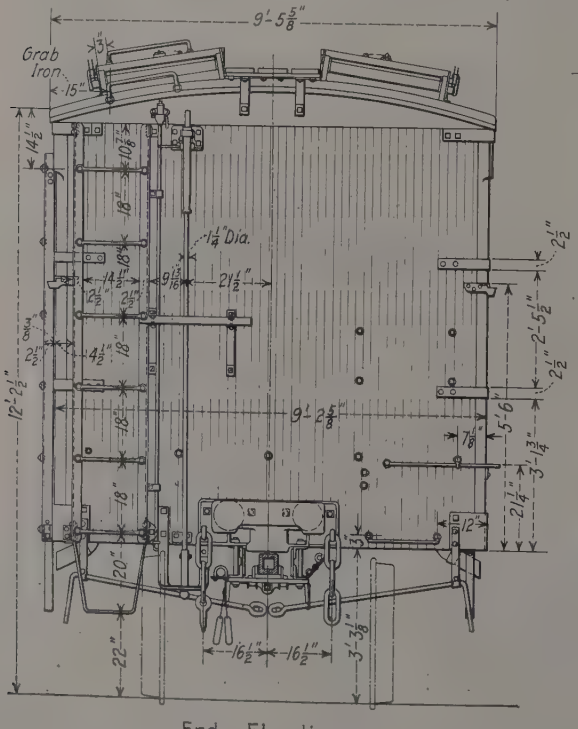


Fig. 213—Sections Through Ice Box Hatch for U. S. R. A. Standard Refrigerator Cars.

(*See also Figs.* 209-212.)

Fig 214— Express Refrigerator All-Wood Superstructure with Passenger Car Type of Spring Buffers.
(See also Figs. 211-212.)

Length over Buffers	48 ft. 5 in.
Length over End Sills	45 ft. 0 in.
Length Inside	44 ft. ⅞ in.
Length Inside, Clear of Brine Tanks	38 ft. 9¾ in.
Width over Side Sills	8 ft. 11 in.
Width Inside	8 ft. 1⅞ in.
Height from Top of Rails to Center of Coupler Drawbar	2 ft. 10½ in.
Height from Top of Rails to Top of Floor	4 ft. 3 5-16 in.
Height	13 ft 1¼ in.
Height Inside	7 ft. 7 in.
Distance Between Truck Centers	33 ft. 8 in.
Cubic Capacity	2,281 cu. ft.
Maximum Load	58,400 lbs.
Light Weight	73,600 lbs.
Total Weight	132,000 lbs.



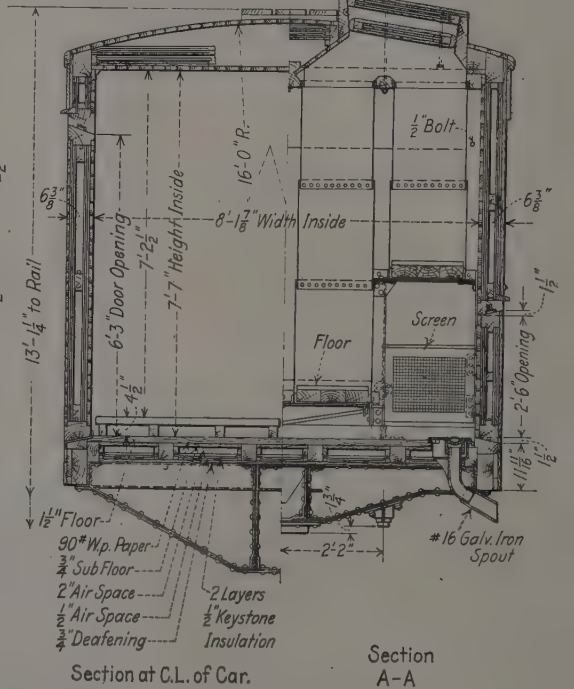


Fig. 215—End Elevation and Cross Section of Express Refrigerator Car Shown in Figs. 214 and 216.
National Steel Car Corporation, Ltd.

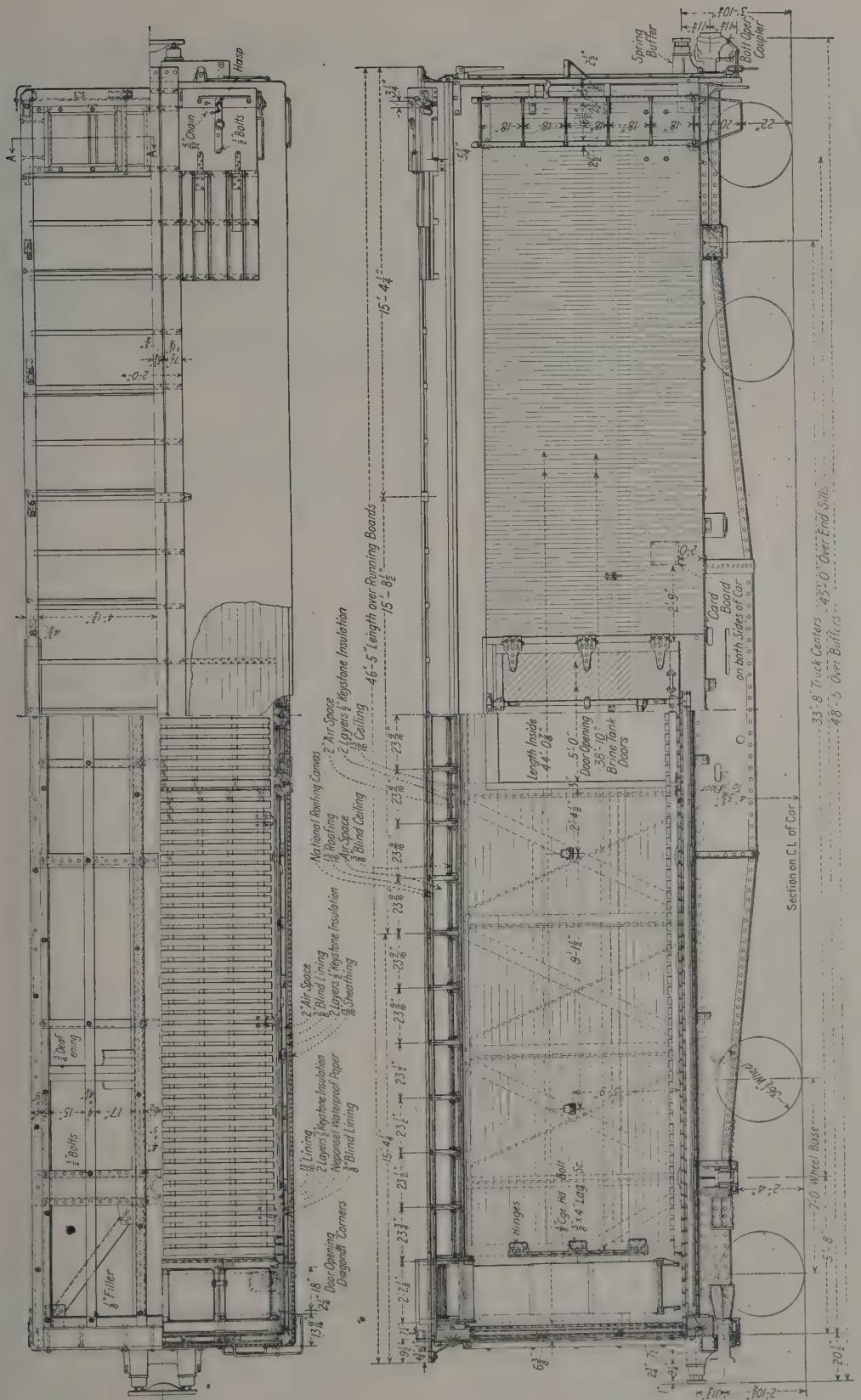


Fig. 216—Plan and Elevation of Express Refrigerator Car for Canadian National Railway. Builder, National Steel Car Corporation, Limited.
(*See also Figs.* 214-215.)

Fig. 217—Steel Frame Refrigerator Car. Capacity, 60,000 lb. of Lading, 10,000 lb. of Ice; Length Between Bulkheads, 33 ft. 4⅝ in.; Inside Width, 8 ft. 4½ in.; Inside Height, 7 ft. 8¼ in. Builder, Norfolk & Western Railway.

(*See also Figs.* 218-222.)

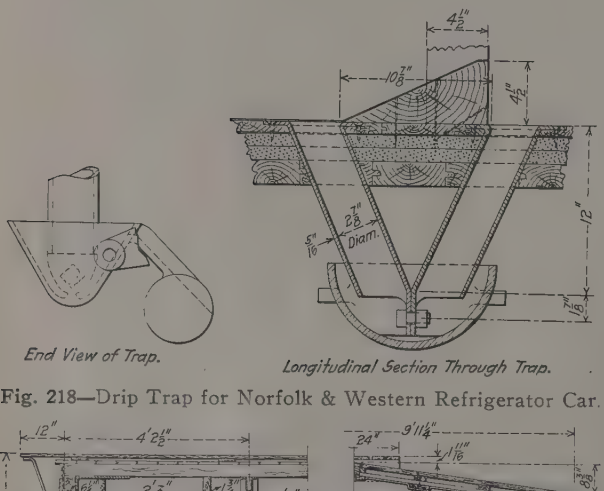


Fig. 218—Drip Trap for Norfolk & Western Refrigerator Car.

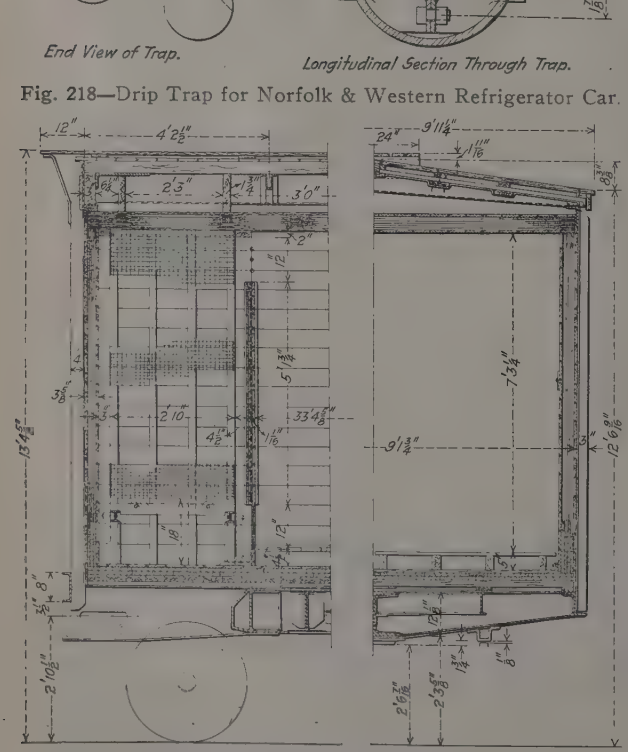


Fig. 219—Longitudinal Section Through Ice Bunker and Half Cross Section of Car Body.

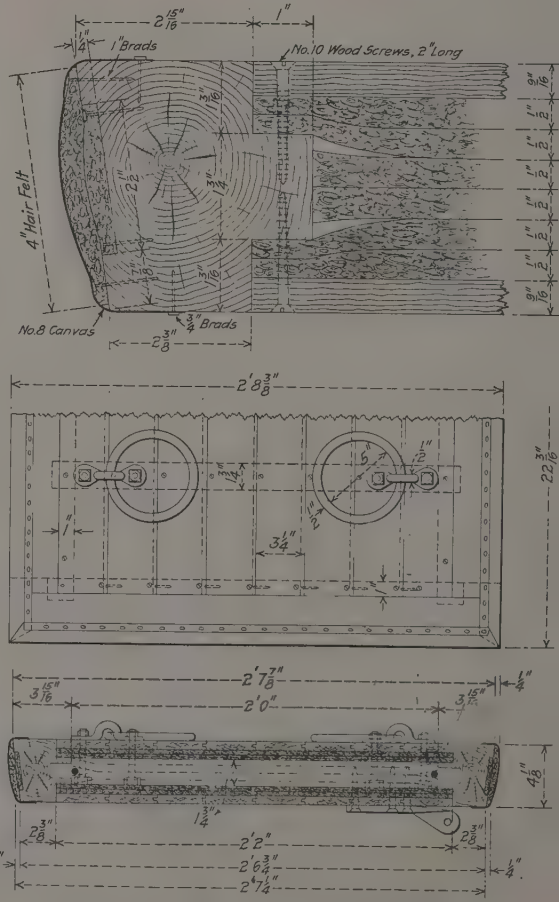


Fig. 220—Details of Hatch Plug.

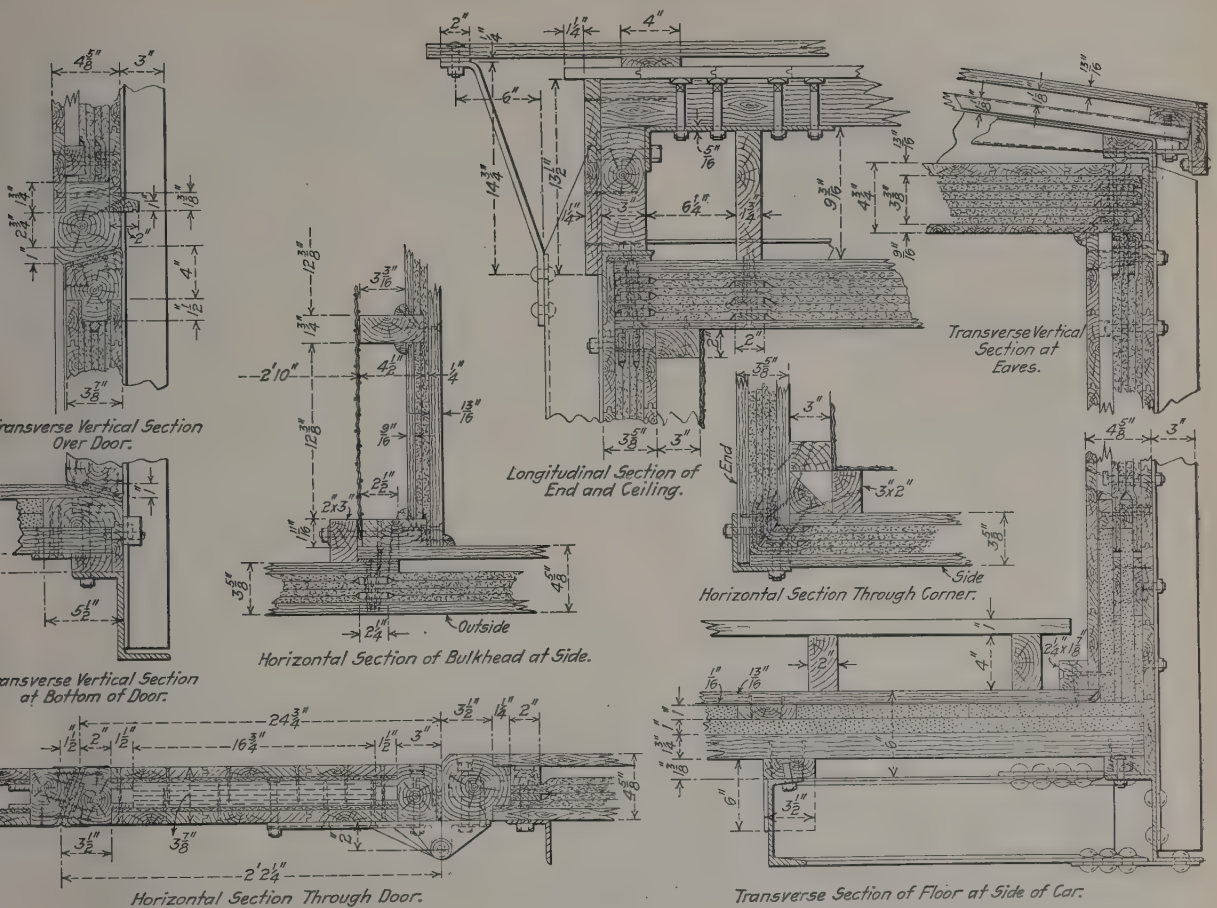

Transverse Vertical Section Over Door.
Transverse Vertical Section at Bottom of Door.
Horizontal Section of Bulkhead at Side.
Outside
Longitudinal Section of End and Ceiling.
Transverse Vertical Section at Eaves.
Horizontal Section Through Corner.
End
Side
Horizontal Section Through Door.
Transverse Section of Floor at Side of Car.

Fig. 221—Details of Insulation and Sheathing Construction of Norfolk & Western Refrigerator Car.

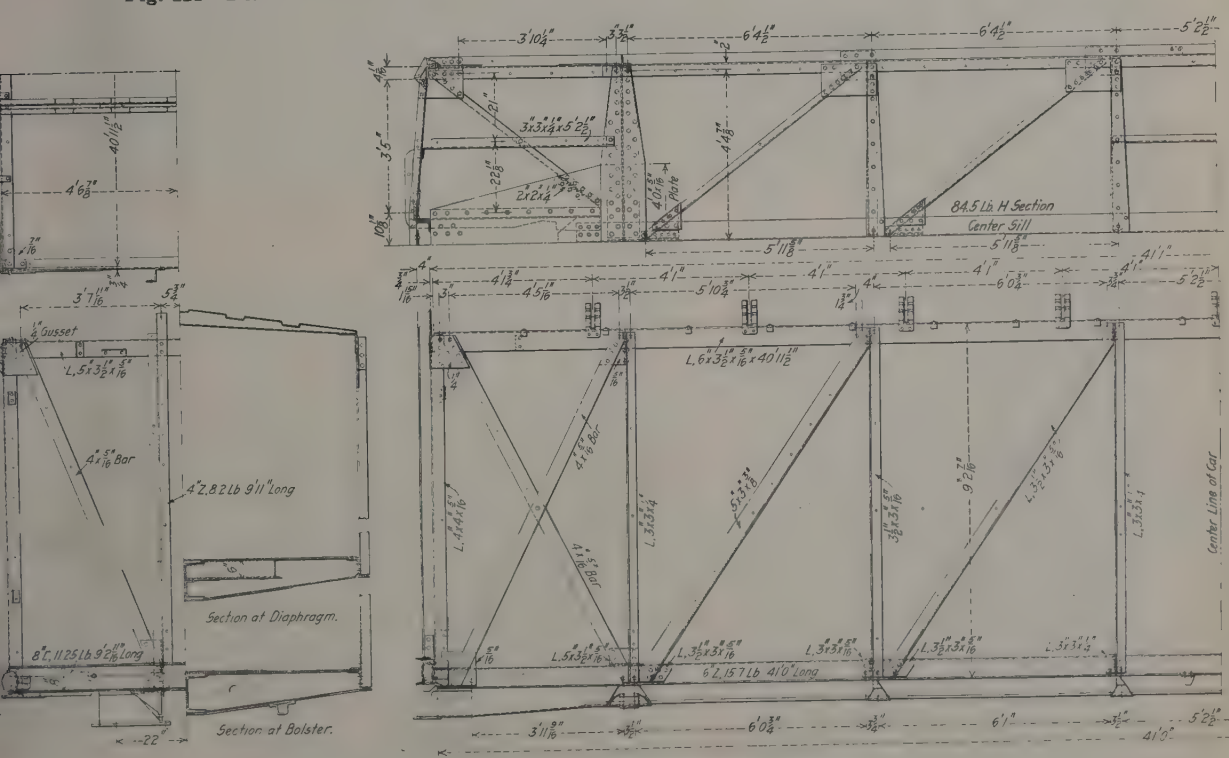


Fig. 222—Arrangement of Steel Body and Underframe of Norfolk & Western Refrigerator Car. See also Figs. 217-221.

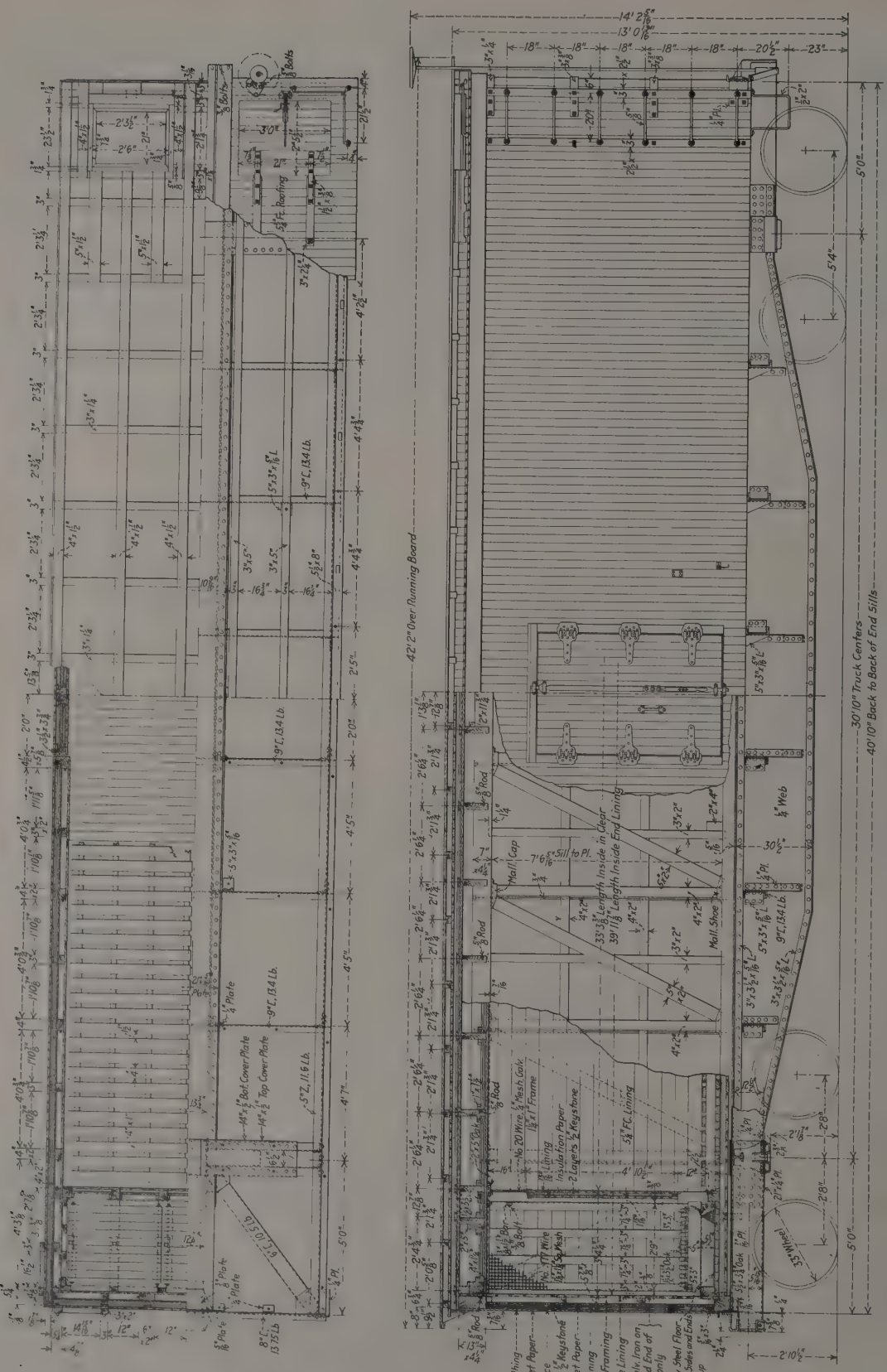
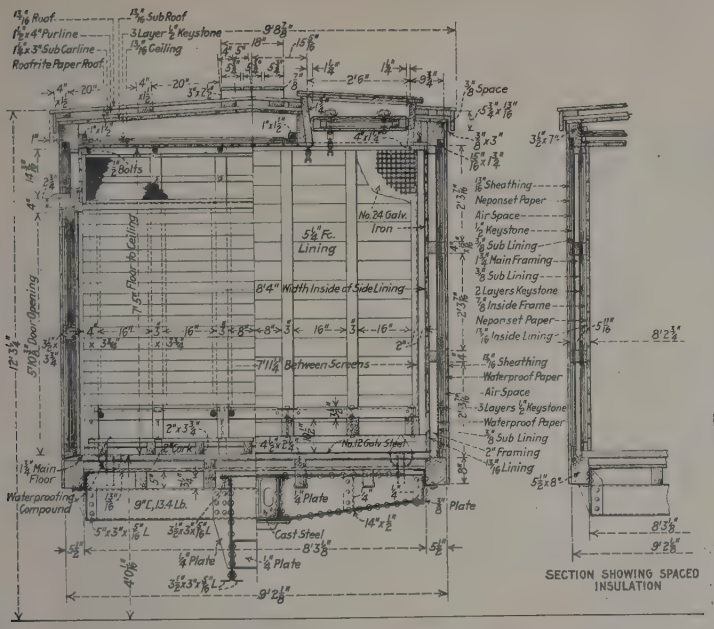


Fig. 223—Plan, Elevation, and Longitudinal Sections of Steel Underframe 30-Ton Capacity Refrigerator Car. Builder, American Car and Foundry Company.
(See also Fig. 224.)



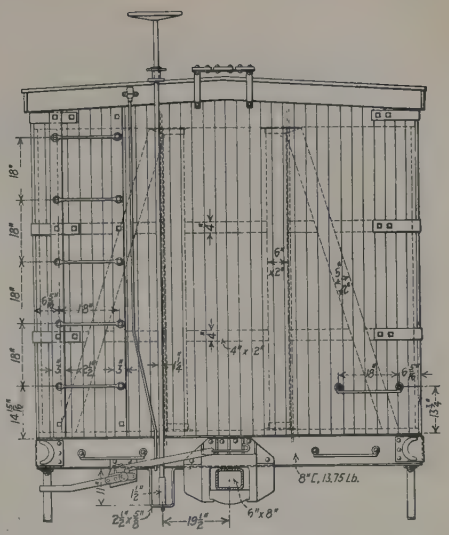


Fig. 224—Steel Underframe 30-Ton Capacity Refrigerator Car. See Fig. 223.

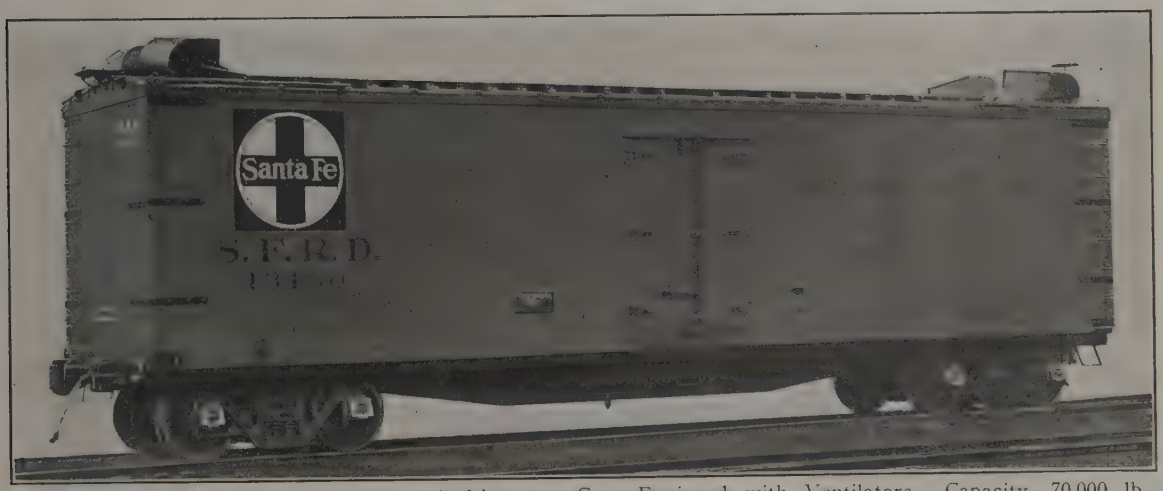


Fig. 225—Santa Fe Steel Underframe Refrigerator Car, Equipped with Ventilators. Capacity, 70,000 lb. Weight, 55,900 lb. Builder, American Car and Foundry Company.

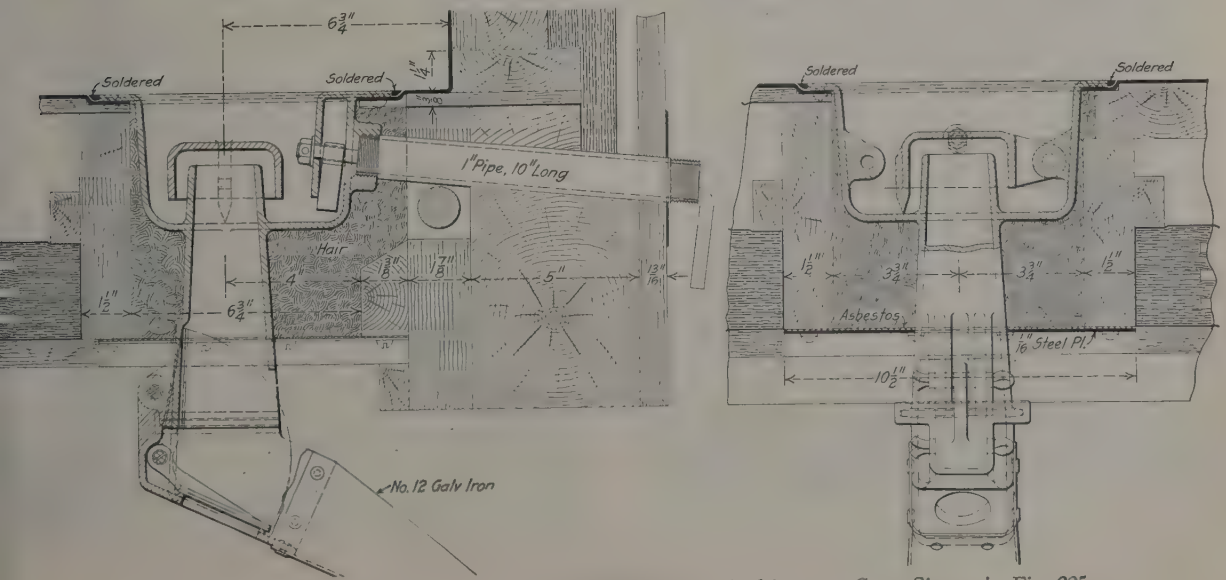


Fig. 226—Malleable Iron Double Trap and Drain for Santa Fe Refrigerator Car. Shown in Fig. 225.

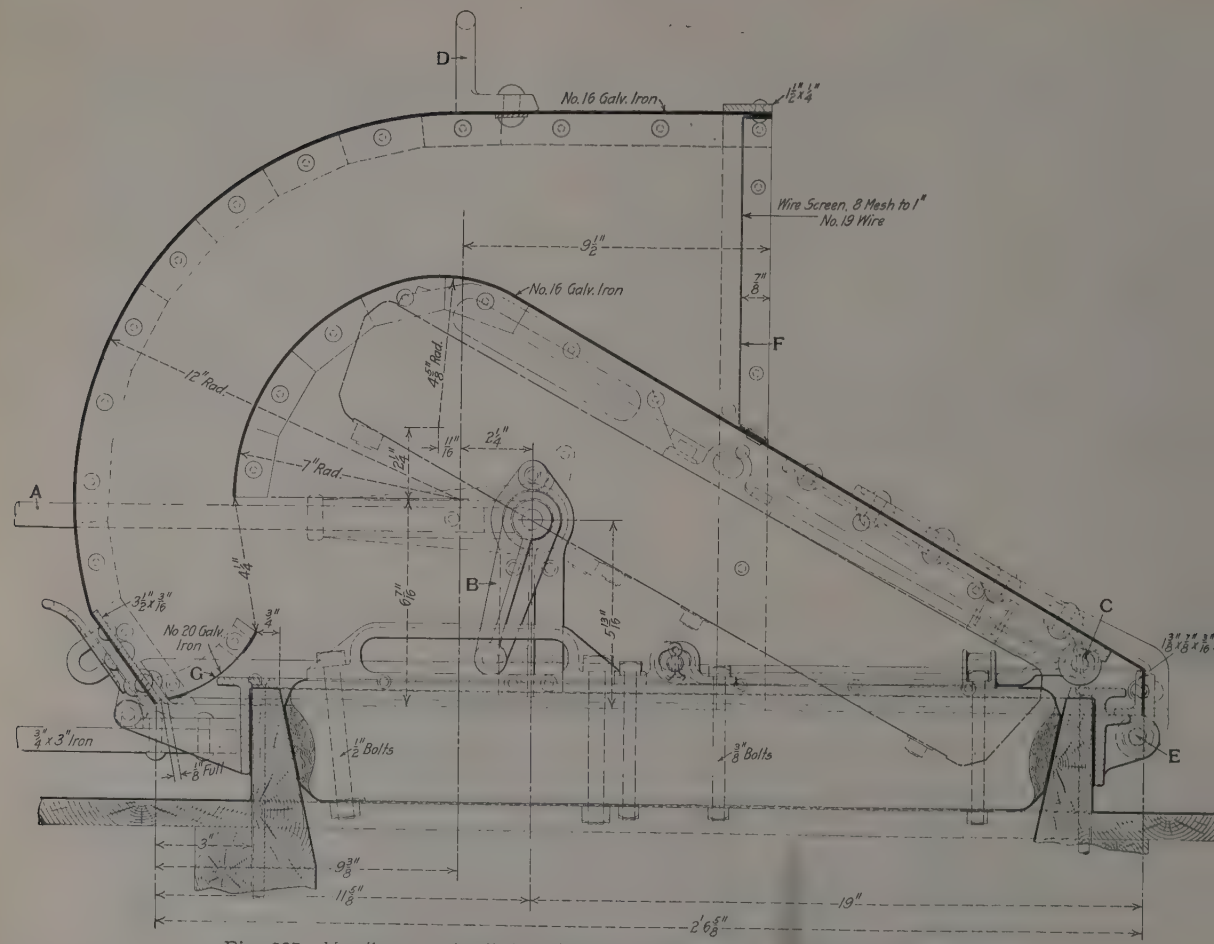


Fig. 227—Ventilator as Applied to Santa Fe Refrigerator Car Shown in Figs. 225-226.

Fig. 228—End View of Heater and Refrigerator Car Shown in Figs. 229-231.

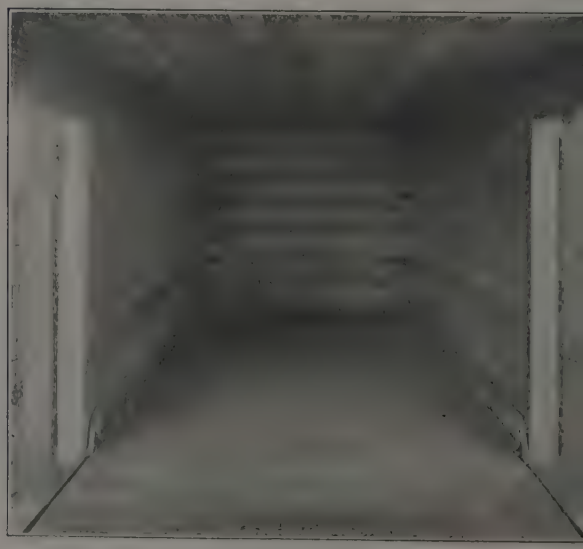


Fig. 229—Interior of Car Shown in Figs. 228 and 230-231.

Fig. 230—Automatic Heater and Refrigerator Car. Builder, Marsh Refrigerator Service Company.

(*See also Figs. 228-229, 231.*)

Grate
Generator
Pump
Generator Coil
Kettle
Pipe

G *Condenser*
H *Expansion Valve*
I *Refrigerating Coils*
J *Absorber*
K *Standpipe*
L *Temperature Exchanger*

M *Spray Nozzle*
N *Pump Exhaust Absorber*
O *Radiator*
P *Temperature Exchanger*
Q *Pump Regulator*
R *Check Valve*
S *Heating Coils*

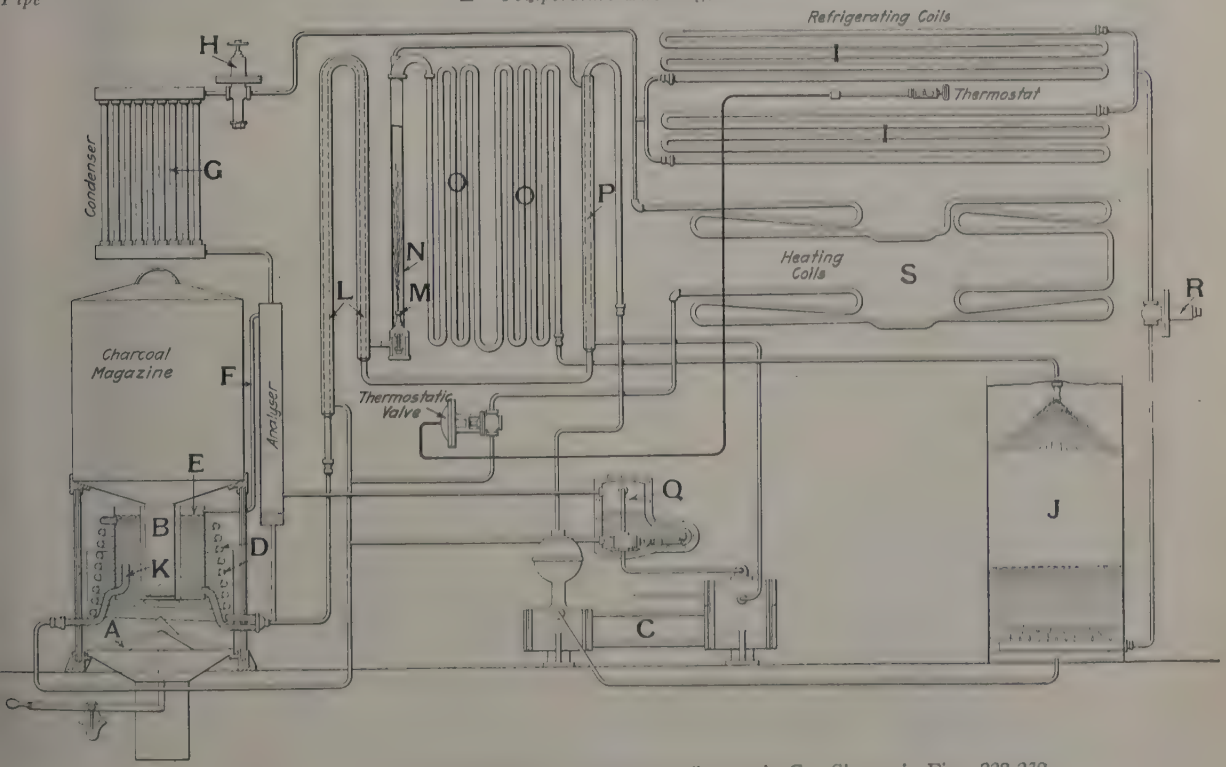


Fig. 231—Diagram of Automatic Heater and Refrigerator System in Car Shown in Figs. 228-230.

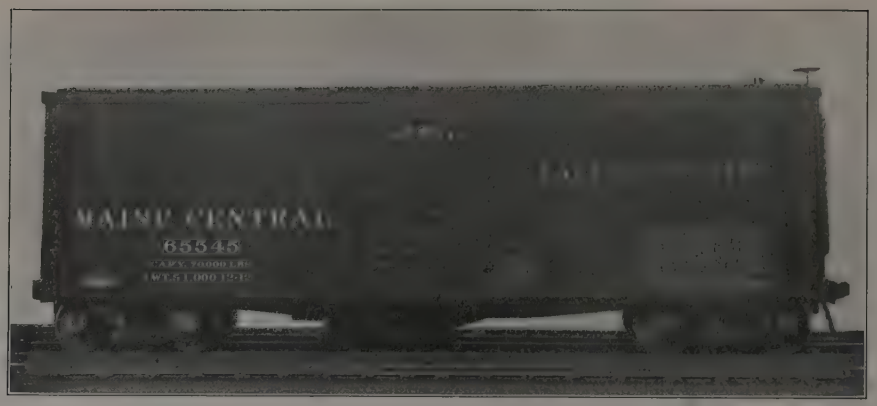


Fig. 232—Steel Underframe 35-Ton Capacity Box Car with Heater Equipment. Weight, 51,000 lb.; Inside Length, 34 ft. 9 in.; Inside Width, 8 ft.; Inside Height, 7 ft. 6 in. Builder, Laconia Car Company.

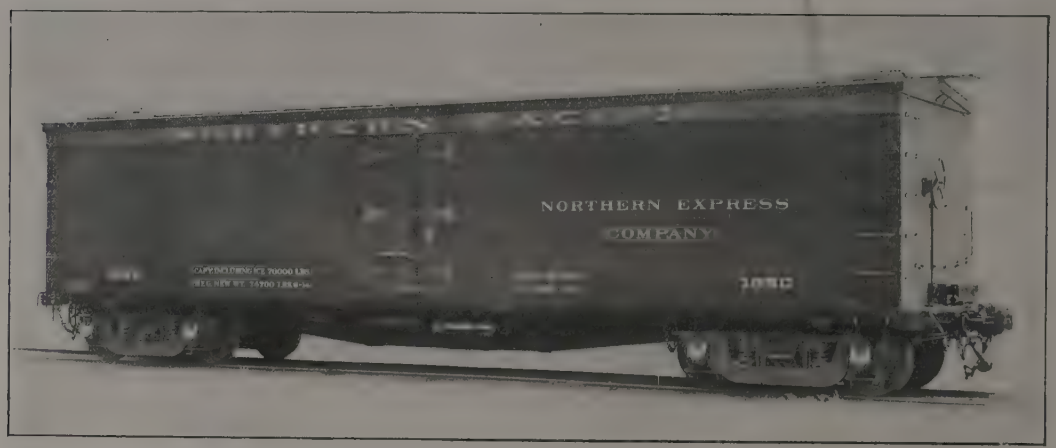


Fig. 233—Steel Underframe 35-Ton Capacity Express Refrigerator Car. Inside Length, 41 ft. 2 in.; Inside Width, 8 ft. 10 in.; Inside Height, 6 ft. 11 in. Builder, Pressed Steel Car Company.

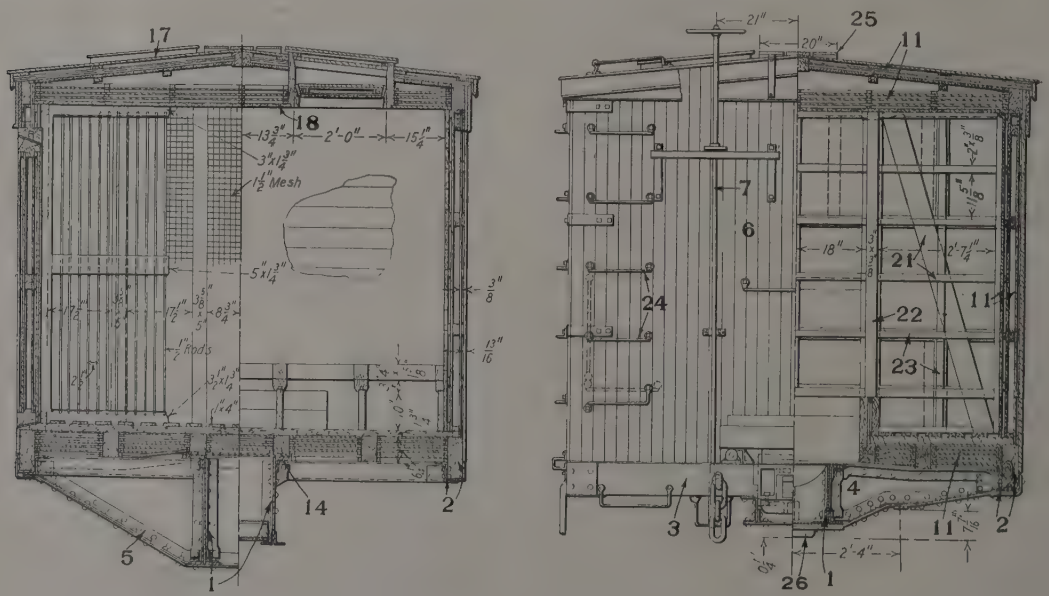


Fig. 234—End Elevation and Cross Sections of Northern Pacific Steel Underframe Refrigerator Car for Express Service. See also Figs. 233-234.

Names of Parts—Figs. 234-235.

1 *Center Sill*
2 *Side Sill*
3 *End Sill*
4 *Body Bolster*
5 *Crossbearer*
6 *Sheathing*
7 *Hand Brake Shaft*
8 *Hatch*
9 *Ice Bunker*
10 *Bulkhead*
11 *Insulation*
12 *Brace*
13 *Post*
14 *Floor Stringer*
16 *Floor Grating*
17 *Roof*
18 *Ceiling*
19 *Side Door*
20 *Main Floor*
21 *End Brace*
22 *End Post*
23 *Furring*
24 *Ladder*
25 *Running Board*
26 *Center Plate*

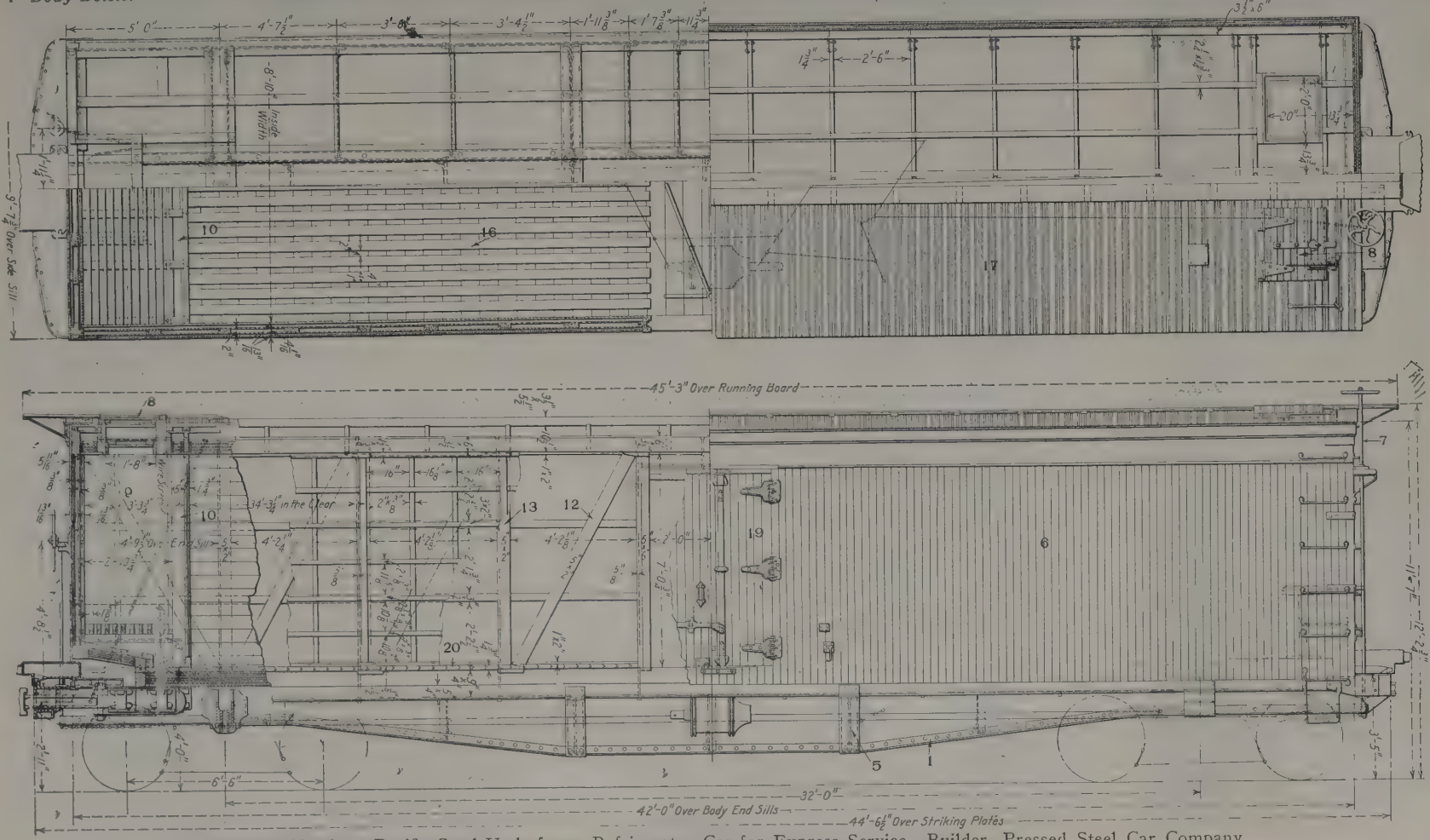


Fig. 235—Northern Pacific Steel Underframe Refrigerator Car for Express Service. Builder, Pressed Steel Car Company.
(See also Figs. 233-234.)

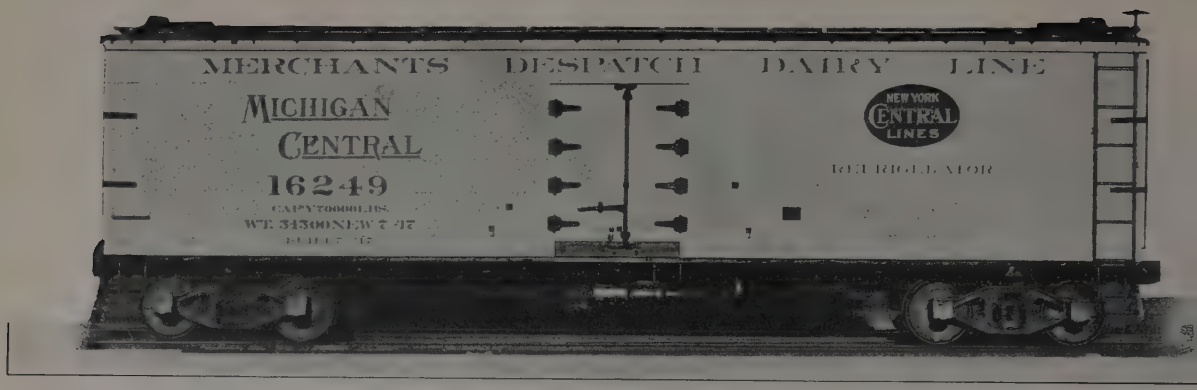


Fig. 236—Steel Underframe Refrigerator Car. Capacity, 70,000 lb., 2,026 cu. ft.; Inside Length, 40 ft. 5⅜ in.; Inside W 8 ft. 4⅞ in.; Weight, 51,500 lb. Builder, Merchants Despatch Transportation Company.

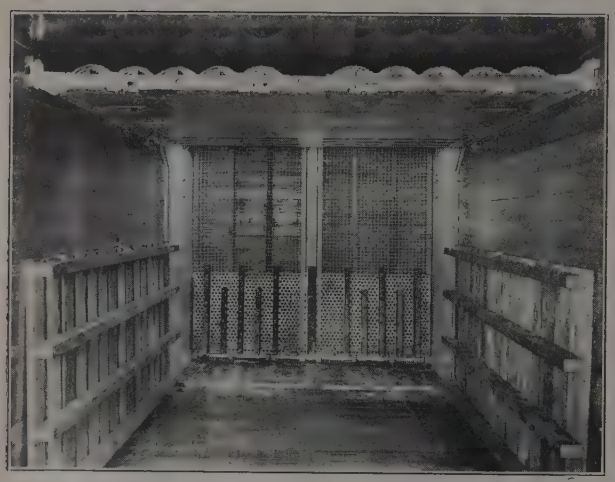


Fig. 237—Bulkhead Sections and Floor Racks Raised to Permit Loading Entire Length of Car Body

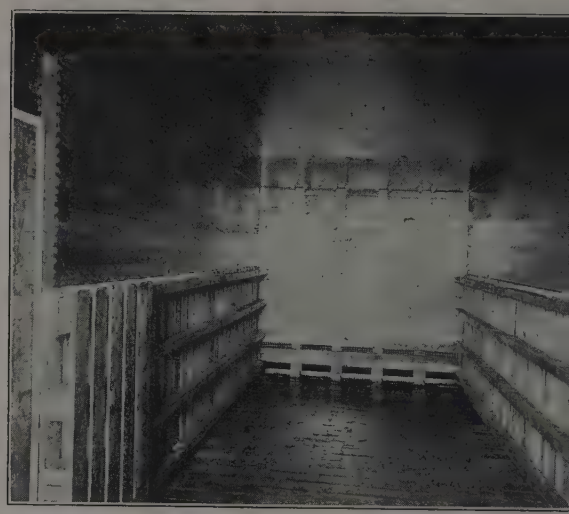


Fig. 238—Interior of Car With Stationary Bulkheads; F Racks Raised

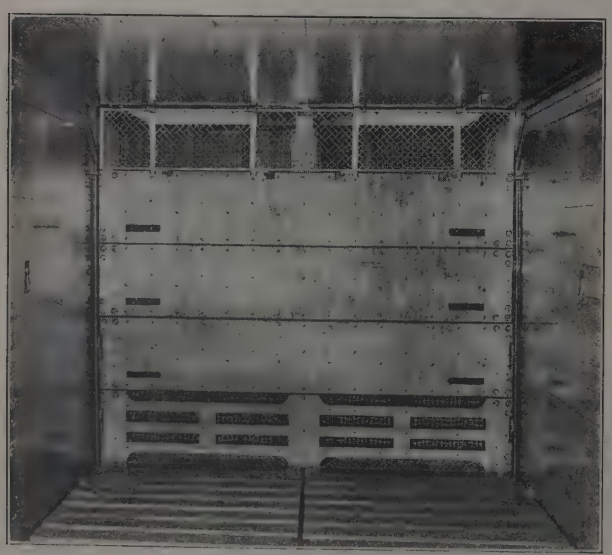


Fig. 239—Sectional Bulkhead and Floor Racks Down

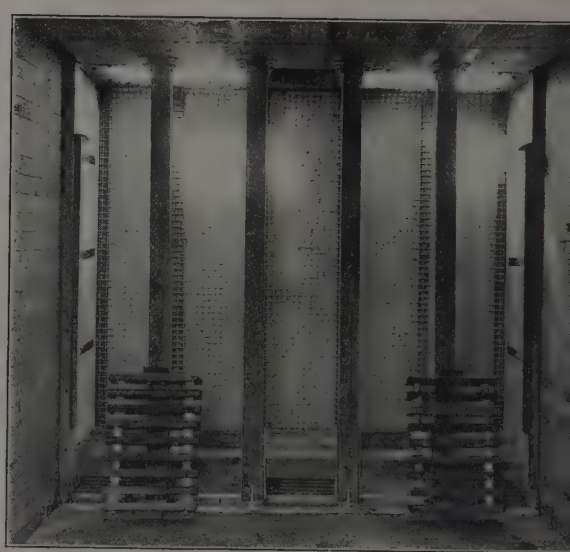


Fig. 240—Bunker Before Bulkhead Is Applied, Showing movable Ice Grates

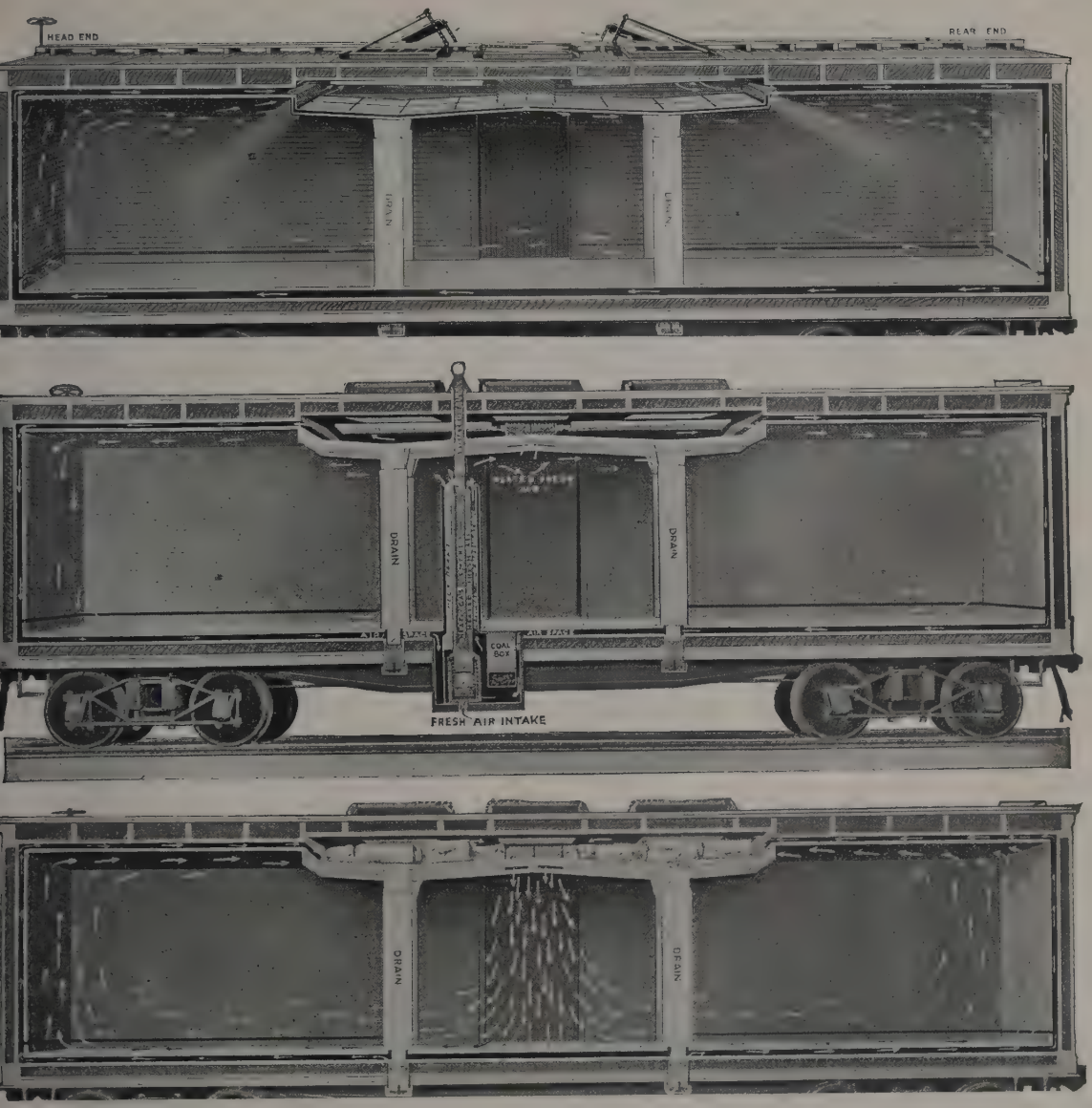


Fig. 241—Air Circulation in Moore Car When Arranged as Ventilated Car, Heater Car or Refrigerator.

Fig. 242—Interior View of Moore Ventilated, Heater, and Refrigerator Car.

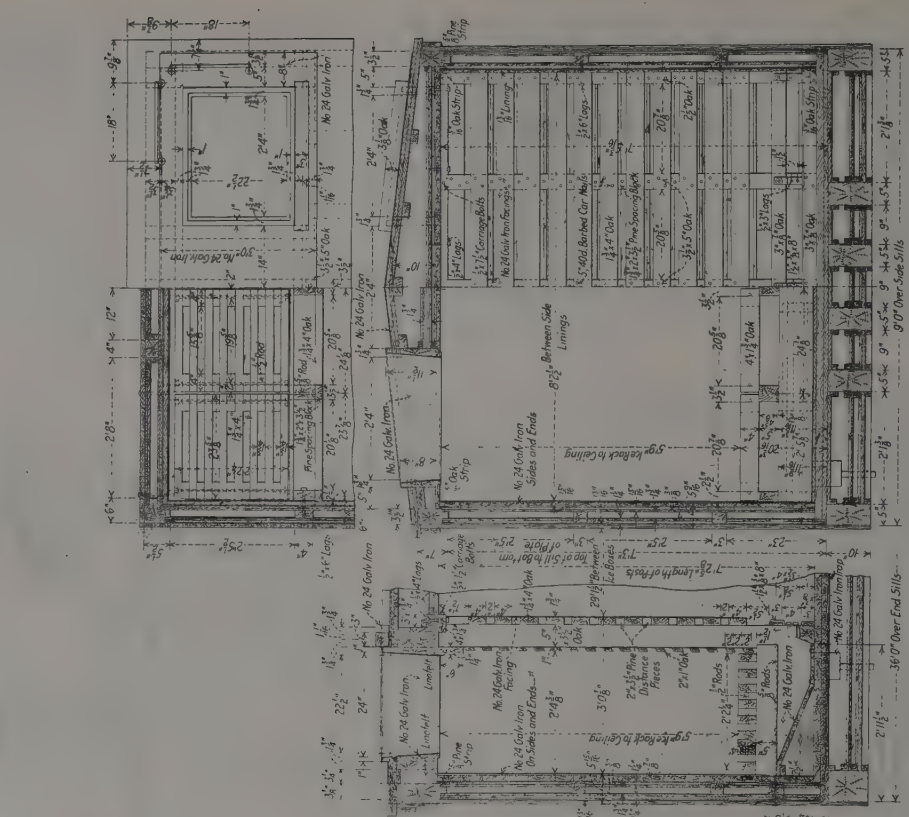


Fig. 244—Standard Ice Bunker. Marsh Refrigerator Service Company.

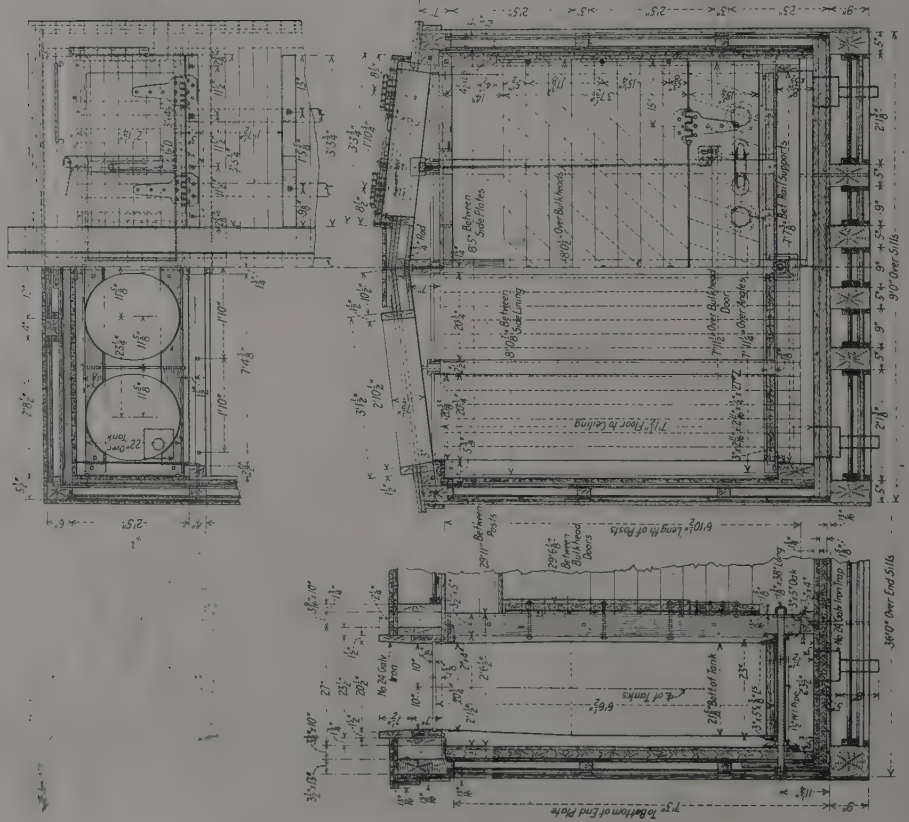


Fig. 243—Arrangement of Brine Ice Tank. Marsh Refrigerator Service Company

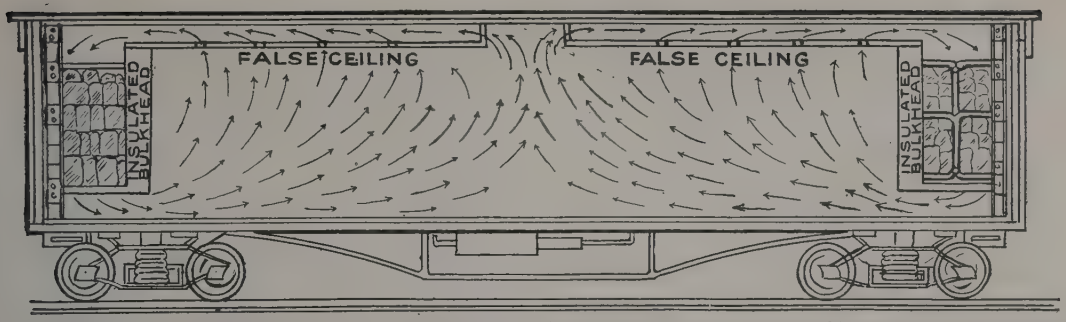


Fig. 245—Diagram of Refrigerator Car, Union Fibre Company's Patent System, Showing Air Circulation.

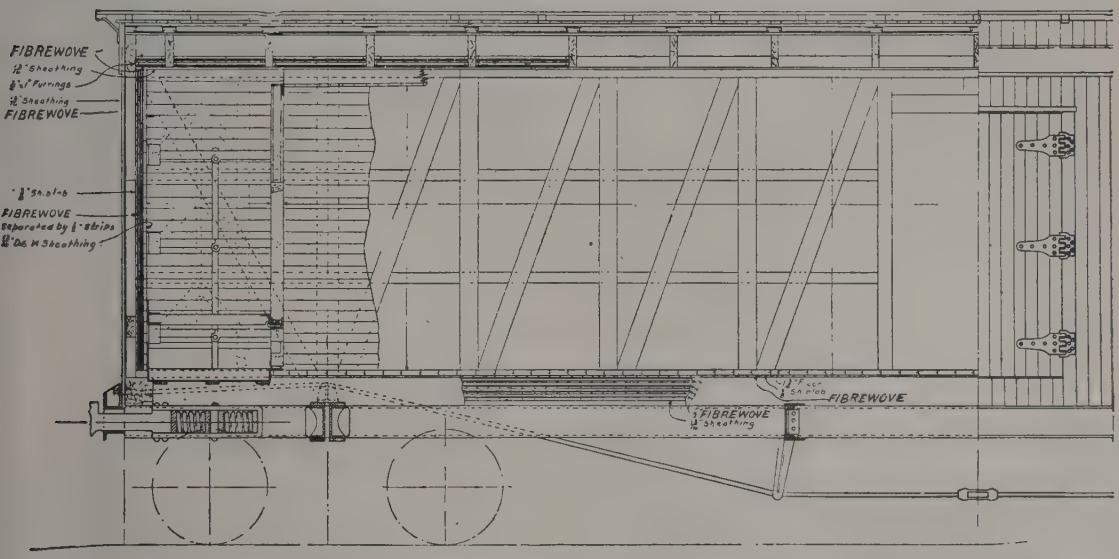
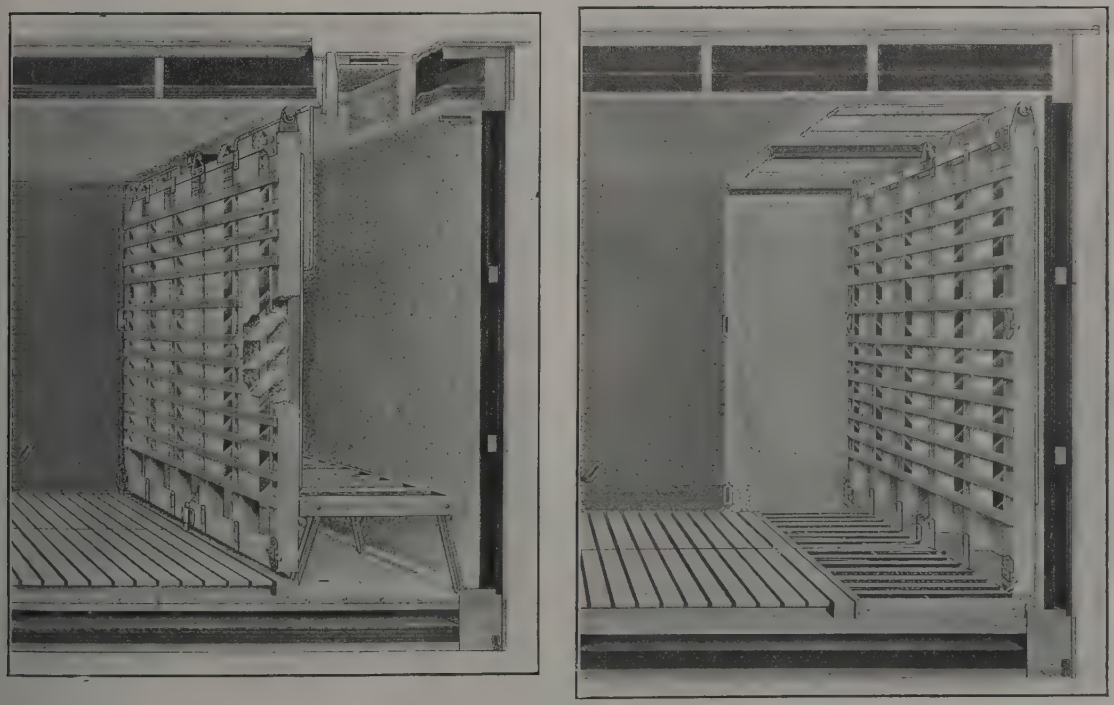
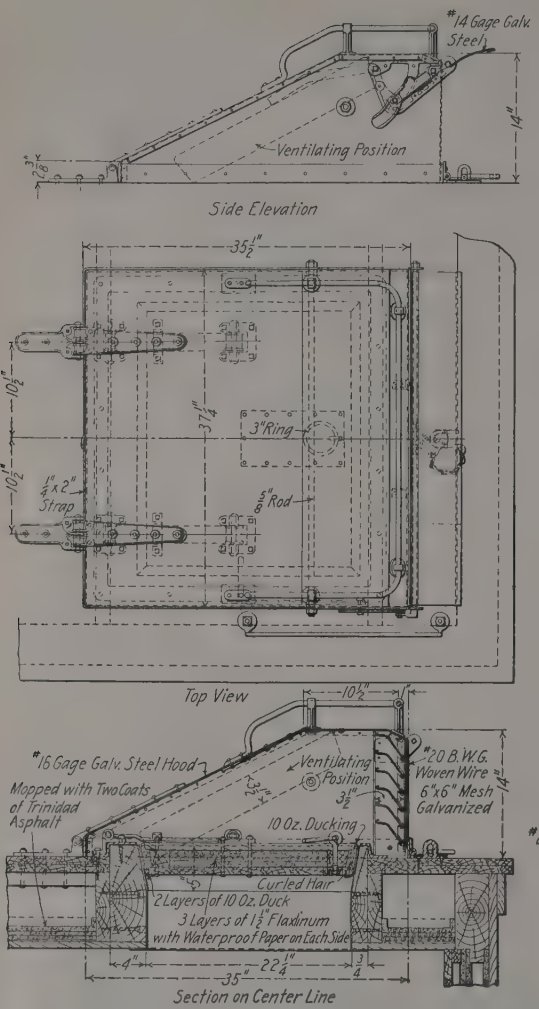


Fig. 246—Application of Fibrewove Insulating Paper to Refrigerator Car. Philip Carey Company.



Position For Icing. Folded Position.

Fig. 247—Ureco Folding Bulkhead for Refrigerator Cars. Union Railway Equipment Company.



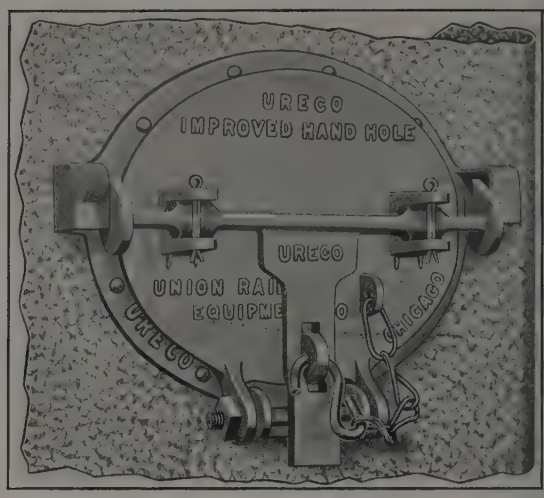


Fig. 249—Ureco Handhole for Brine Tanks. Union Railway Equipment Company.

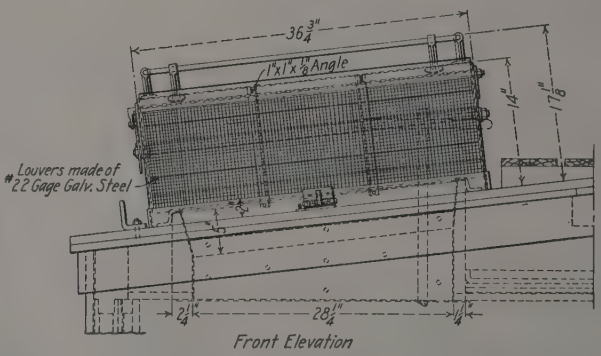


Fig. 248—Bohn Standard Ventilator and Plug for Refrigerator Cars. Bohn Refrigerator Company.

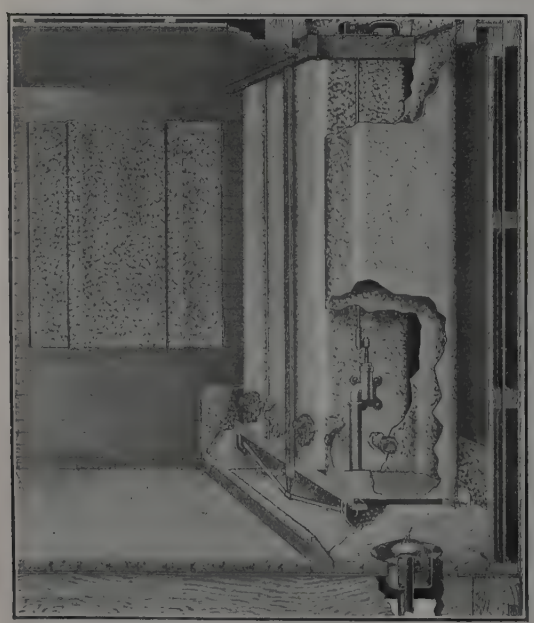


Fig. 250—Ureco Brine Retaining Valve for Refrigerator Car. Union Railway Equipment Company.

Fig. 251—Overhead Brine Tanks Showing Also Heater Pipes on Floor.

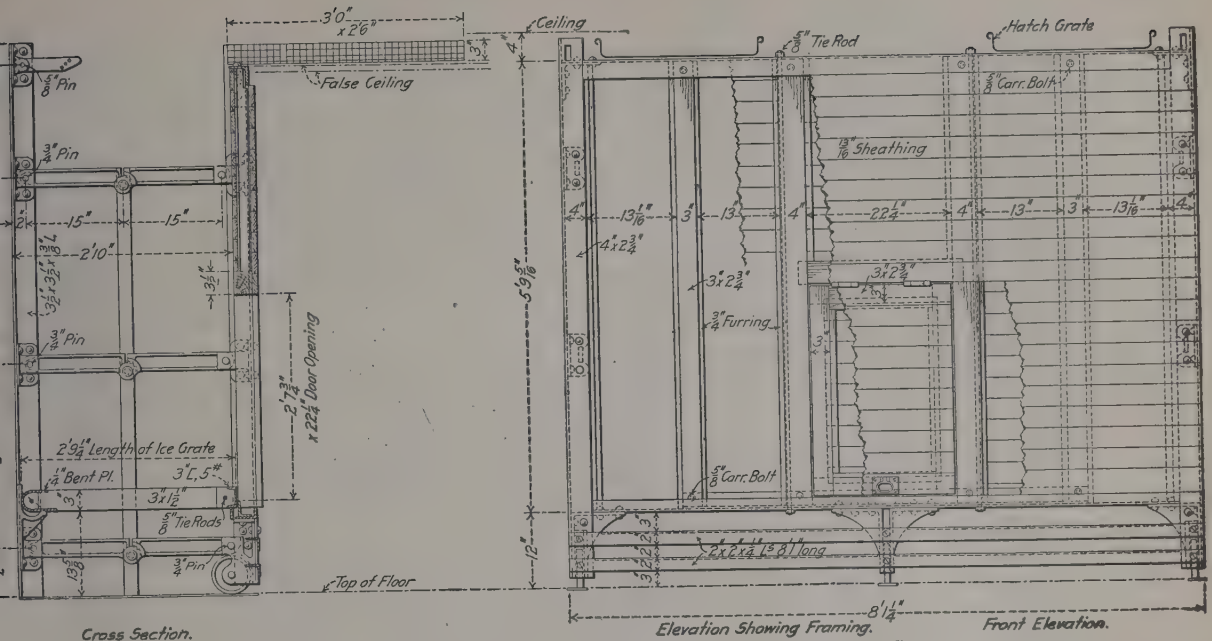
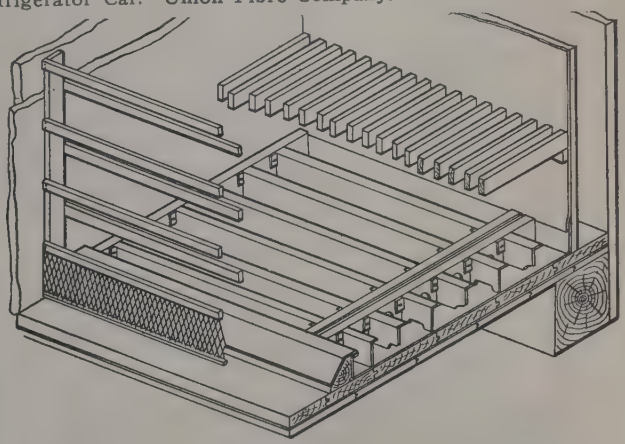
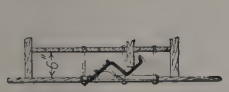


Fig. 252—Collapsible Ice Bunker for Refrigerator Car. **Union Fibre Company.**





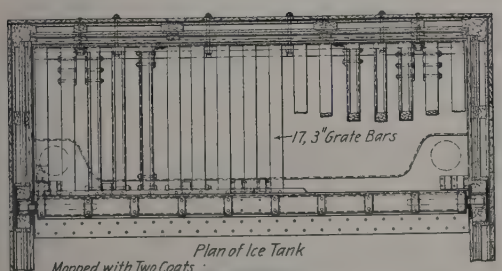


Fig. 253—Non-Splash Drip Pan for Collapsible Ice Bunker. **Union Fibre Company.**

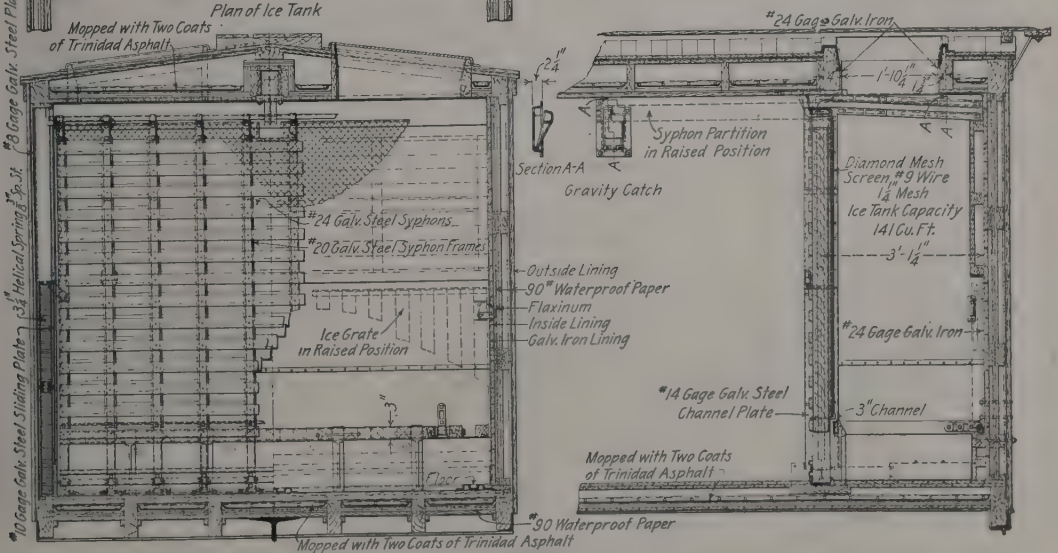
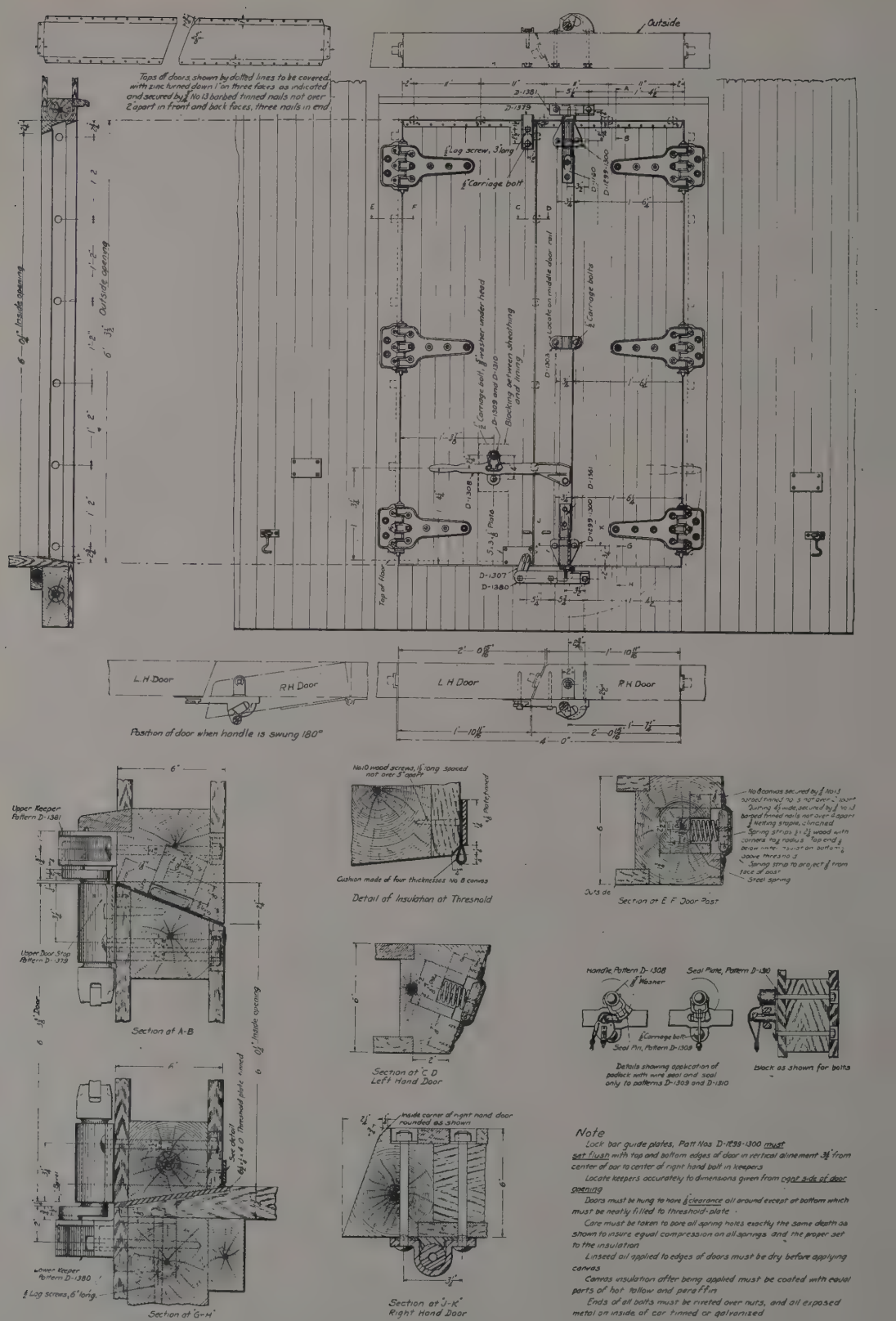


Fig. 254—Bohn Standard Collapsible Bulkhead for Refrigerator Cars. **Bohn Refrigerator Company.**


Outside
Tops of doors shown by dotted lines to be covered with zinc turned down 1" on three faces as indicated and secured by ¾" No 13 barbed tinned nails not over 2" apart in front and back faces, three nails in end
6'-0½" Inside opening
6'-3½" Outside opening
½" Carriage bolt
½" Log screw, 3" long
Locate on middle door rail
Blocking between sheathing and lining
½" Carriage bolts
½" Carriage bolt, ¾" washer under head
D-1309 and D-1310
5-3/8" Plate
Top of floor
D-1307
D-1380
L H Door
R H Door
Position of door when handle is swung 180°
No 10 wood screws, ½" long spaced not over 3" apart
¾" Perforated
Cushion made of four thicknesses No 8 canvas
Detail of Insulation at Threshold
No 8 canvas secured by ¾" No 13 barbed tinned nails not over 3" apart
Spring 4½" wide, secured by ¾" No 13 barbed tinned nails not over 6" apart
¾" Netting staple, clinched
Spring straps 3" x ¾" wood with corners rag rabbits ¾" deep into ... on bottom ... above threshold
Spring strap to project ¾" from face of seat
Steel spring
Section at E F Door Post
Upper Keeper Pattern D-1381
Upper Door Stop Pattern D-379
Section at A-B
Section at C D Left Hand Door
Handle, Pattern D-1308
¾" Washer
½" Carriage bolt
Seal Plate, Pattern D-1310
Seal Pin, Pattern D-1309
Details showing application of padlock with wire seal and seal only to patterns D-1309 and D-1310
Block as shown for bolts
See detail
Lower Keeper Pattern D-1380
½" Log screws, 6" long
Section at G-H
Inside corner of right hand door rounded as shown
Section at J-K Right Hand Door

Note

Lock bar guide plates, Patt Nos D-1298-1300 must set flush with top and bottom edges of door in vertical alinement ¾" from center of bar to center of right hand bolt in keepers

Locate keepers accurately to dimensions given from right side of door opening

Doors must be hung to have ¼" clearance all around except at bottom which must be neatly filled to threshold-plate

Care must be taken to bore all spring holes exactly the same depth as shown to insure equal compression on all springs and the proper set to the insulation

Linseed oil applied to edges of doors must be dry before applying canvas

Canvas insulation after being applied must be coated with equal parts of hot tallow and paraffin

Ends of all bolts must be riveted over nuts, and all exposed metal on inside of car tinned or galvanized

Fig. 255—Miner Refrigerator Car Door Fastener and Insulation.

W. H. Miner

(See also Page 235.)

Miner Refrigerator Car Door Fastener

The Miner Refrigerator Car Door Fastener is recognized as a most efficient method of opening and closing the doors of refrigerator cars. This device always operates with ease and precision because of the great leverage afforded by the handle.

When Miner elastic insulation is applied to the joints of the doors, this leverage provides the power necessary to properly close and insure an absolutely air-tight seal around the heavy wooden doors. The Miner fastener and insulation are most essential for conserving refrigeration needed for perishable products.

The vertical locking bar of the door fastener has an eccentric at each end thereof which operate as cams in tapered pockets in the upper and lower keepers. These keepers are securely fastened to the upper and lower door headers respectively. The locking bar is rotated by a pivoted handle which falls to a vertical position when the doors are opened.

The action of the device is extremely simple and the results are as follows: The left hand door should be closed in the usual manner and the button below it, fastened to the lower keeper, should be turned up thus holding the door in a fixed position (while the right hand door is being closed or opened); the right hand door is then swung toward the left until the ends of the locking bar engage the openings of the upper and lower keeper castings. This is readily accomplished without hammering the doors and they can easily be forced shut by simply operating the handle toward the left.

The opening of the door is accomplished by reversing the movement of the handle; the eccentric ends of the locking bar then engage the opposite sides of the keepers and easily force the door open.

When the Miner fastener is used it is impossible to pilfer the car without breaking the seal or padlock fastened to the sealing plate, which securely locks the hand lever when the doors are closed.

All parts of the device are proportioned to withstand the heaviest service. Miner Refrigerator Car Door Fasteners and Insulation are readily modified to suit any type of construction and these devices have been applied to more than 100,000 cars and are giving most efficient service. The great economy made possible by this form of construction, which prevents damage and expensive repairs, soon offsets the first cost of the device.

The materials used in the construction of the Miner Refrigerator Door Fastener and Elastic Insulation are invariably of the best quality. The installation of this device is always carefully planned and is inspected during the construction of the equipment at the car builder's plant.

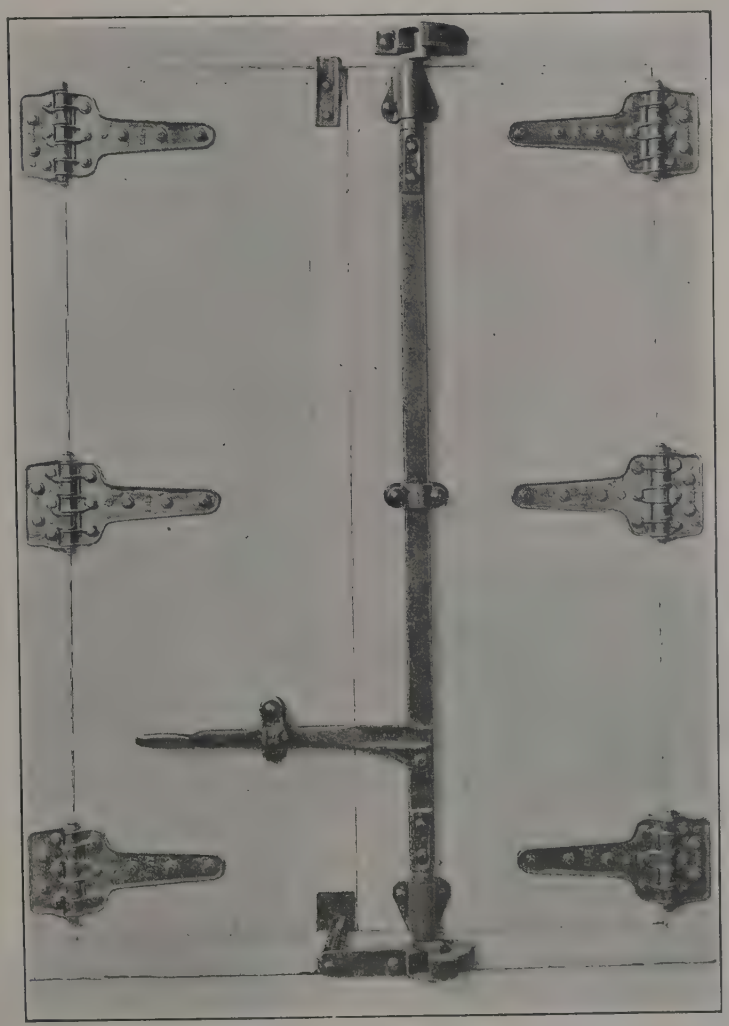


Fig. 256—Application of Miner Refrigerator Car Door Fastener

This appliance has been successfully modified to provide an efficient method of tightly closing the end doors of automobile and other types of special box cars. All of the economies and advantages of the Miner Door Fastener as applied to refrigerator equipment are in effect when this method is adapted to seal the doors of mail and package units which are transported on special container cars.

For other products and branch offices, see classified and alphabetical indexes.

W. H. MINER, CHICAGO, ILL.

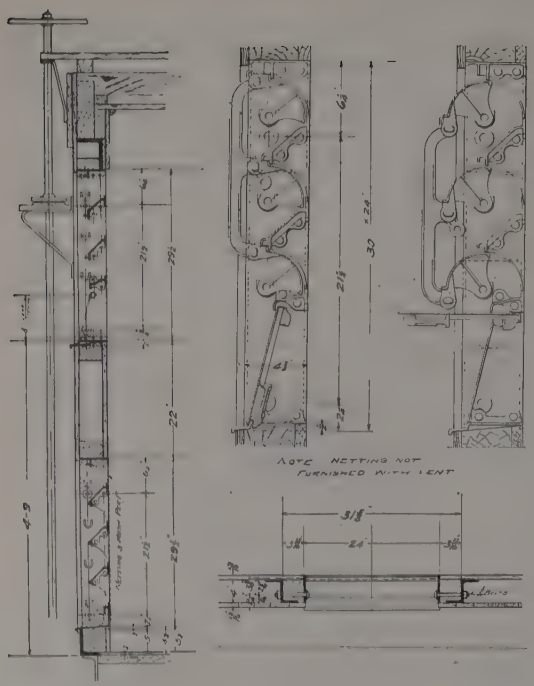


Fig. 257—Diagram Showing Application of Wine Combination Lumber Door and Ventilator.

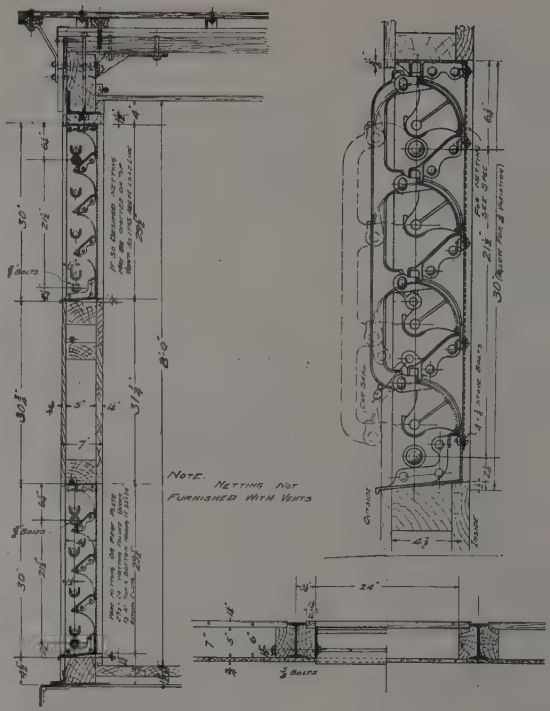


Fig. 258—Diagram Showing Application of Wine Burglar Proof Ventilator.

Fig. 259—Wine Combination Lumber Door and Ventilator.

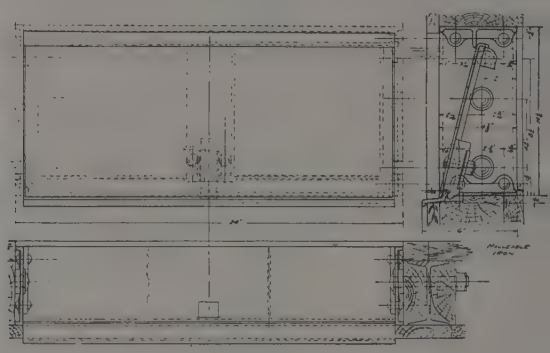


Fig. 260—Diagram of Wine Lumber Door in Closed Position.

Fig. 261—Wine Lumber Door in Open Position.

The Wine Railway Appliance Company.

(*See also Page 237.*)

Wine Box Car Ventilators

For the protection of fruit, vegetables and other perishable freight it is necessary to thoroughly ventilate box cars used in such service. The ventilators should be trongly constructed, easily installed and operated nd weather proof as well as burglar proof. For general service the ventilators as installed in the ends of box cars which may also be used in lumber service are provided with a large opening through which lumber—or other long material—can be handled.

The Wine Ventilator as shown in Fig. 262, is

Fig. 262—Wine Shutter Ventilator

made of the best grade malleable iron. All parts are straightened in dies before assembling and are then riveted together in a machine especially designed for the work. The shutters are easily opened by pulling, and closed by pushing the shutter handle. This ventilator is practically indestructible and is not injured by fire or by rough handling.

The Wine Ventilator is burglar proof as it is constructed with a strong metal frame into which is fitted a system of shutters for closing the openings. The shape of the shutters and openings is such that the ventilator is weather proof in both open and closed position. These shutters are so arranged that in addition to closing the openings they serve to direct more air into the car, thus increasing the ventilation; when open this ventilator causes a greater flow of air than is possible with ordinary ventilators.

The Wine Lumber Door Ventilator as shown at top of car in Fig. 264, is provided with an opening 8 in. by 22 in. for loading lumber and other long material. This type is interchangeable with the standard Wine Ventilator also shown at the bottom of the same car. The Lumber Door Ventilator has been especially designed for certain roads desiring an opening in the ends of their ventilated cars for the purpose of loading dressed lumber and other long materials.

Fig. 263—Wine Lumber Door

The Wine Lumber Door as shown in Fig. 263, is placed at the top of each end of box cars desired for loading long material. It automatically locks itself on the inside, making the door entirely

Fig. 264—Wine Ventilator and Combination Ventilator and Lumber Door Installed

burglar proof and, like the Wine Shutter Type of Ventilator is made of a malleable iron frame strongly braced and riveted. It is weather proof and has a clear opening of 8 in. by 22 in., through which material may be handled.

For other products and branch offices, see classified and alphabetical indexes.

THE WINE RAILWAY APPLIANCE COMPANY, TOLEDO, OHIO

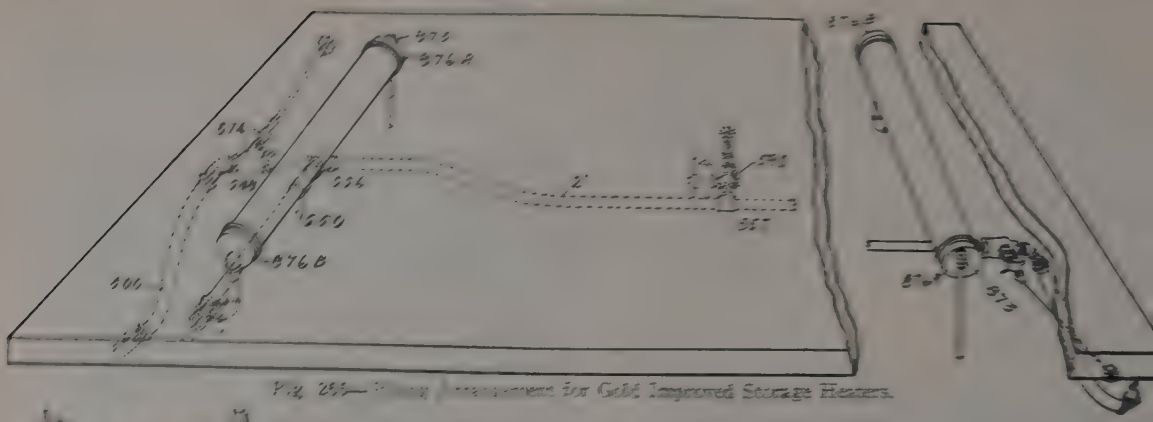
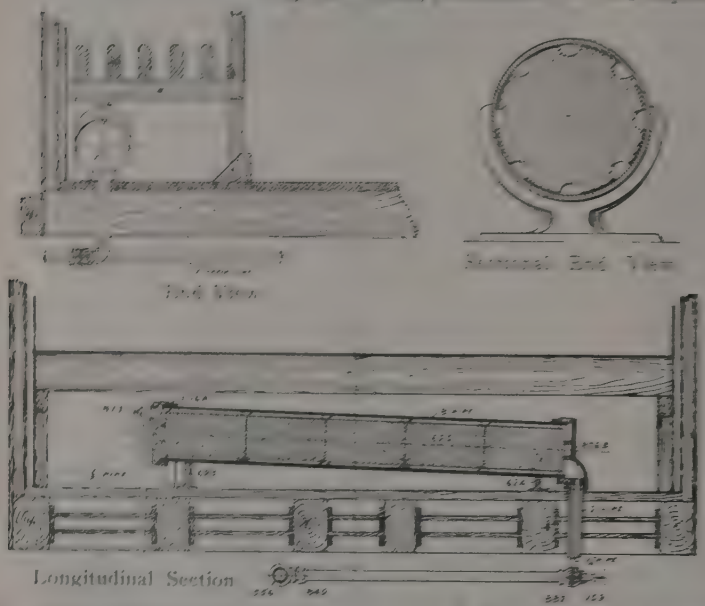


Fig. 265—[illegible] for Gold Improved Storage Heaters.



List of Parts, Figs. 265-266

500 [illegible]
548 [illegible]
550 [illegible]
556 [illegible]
557 [illegible]
620 [illegible]
623 [illegible]
624 [illegible]
840 [illegible]
874 [illegible]
590 [illegible]
873 [illegible]
876A [illegible]
876B [illegible]
882 [illegible]
1091 [illegible]

Fig. 266—Gold Improved Storage Heater for Use in Refrigerator Cars During Cold Weather.

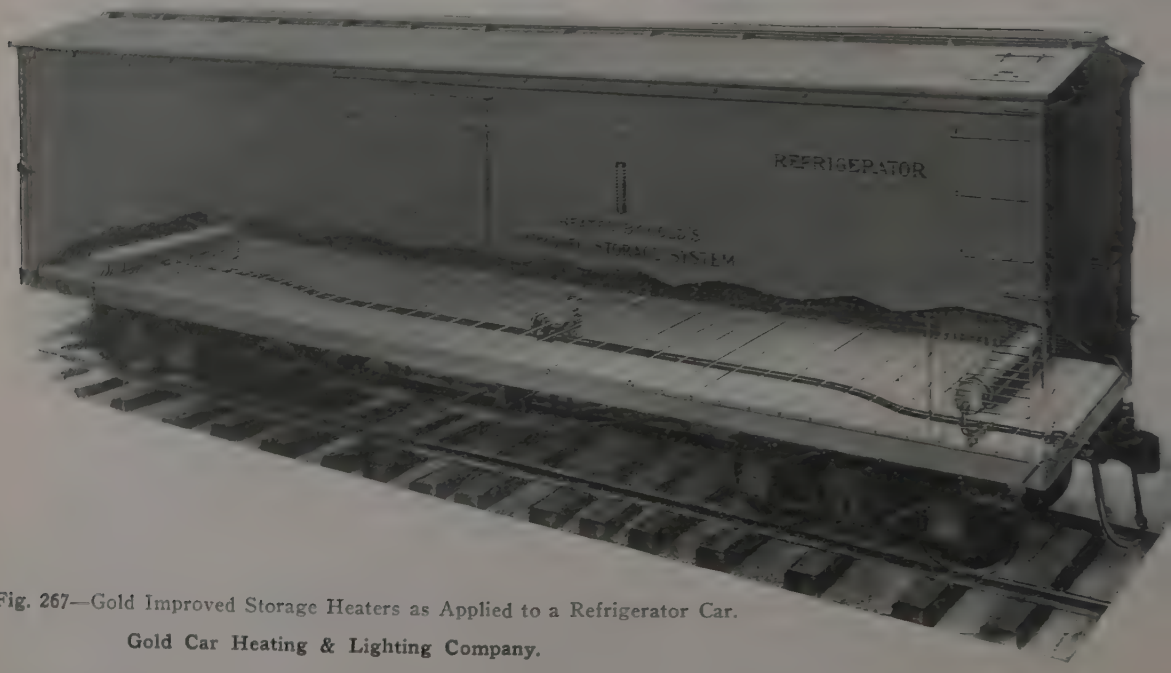


Fig. 267—Gold Improved Storage Heaters as Applied to a Refrigerator Car.

Gold Car Heating & Lighting Company.

Tank Cars

THE LARGE VOLUME OF FREIGHT in liquid or semi-liquid form transported by railroad, requires the use of a large number of tank cars. The products handled include: acids, alcohol, ammonia, oils, paints, milk, vinegar, pickles and many other products, some of which must be melted to a fluid form to facilitate loading into the tanks and again heated and melted for unloading. In 1922 there were 134,003 tanks in use, of which 120,872 were privately owned. These cars are classified by the American Railway Association, as on page 240 and as follows:

Classification of Tank Cars

CLASS "T."

"TM"—Tank car for general service. This car is for general oil or liquid service, and consists of a steel tank mounted on frame or mounted directly on cradles over truck bolsters. It is equipped with one or two safety release valves, and is emptied by valves or valve at bottom. At the top is a dome, with or without manhole, and openings through which the tank may be filled.

"TA"—Acid Tank. Of same general construction as oil tanks.

"TL"—Acid Tank. Of same general construction as oil tanks, but having lead lining.

"TG"—Tank car having glass or glass-lined tanks, for use in hauling mineral waters and other products.

"TS"—Tanks for special commercial service.

"TW"—Tank car having wooden tank instead of steel and used for water, pickles, etc.

"TMI"—Tank car built under the specifications for Class IV Tank Cars and insulated for handling casing-head gasoline, etc.

CLASS "X."

XT"—Box Car Tank. A box car without doors, metal lined, or inclosing tank for water or other liquids.

Certain products such as hydrochloric acid, muriatic acid, vinegar, etc., cannot be successfully handled in the ordinary metallic containers because of their chemical reaction. Such products have been handled successfully in wooden tanks mounted on flat cars, but the Bureau of Explosives recommends that in view of leakage with existing types of cars the [illegible] of a standard [illegible] for such equipment be taken up. A sub-committee of [illegible] representatives of the largest acid shippers, working in connection with the Bureau of Explosives, has recently investigated acid cars and wooden tanks having glass and rubber linings and which have been developed to meet such [illegible] by glass lining [illegible].

A preliminary report on [illegible] has been prepared for the transportation of [illegible] in tanks mounted on flat cars, and is [illegible] in a [illegible] car.

Cars having one or more glass lined and insulated tanks have also been built for use in transporting milk in bulk.

In 1913 a report was presented recommending certain specifications for the construction of tank equipment and the reconstruction of new equipment. These specifications were submitted to letter ballot and adopted as Recommended Practice.

The committee made a progress report in 1904; the specifications were revised in 1906, 1907, 1908 and 1909; and in 1910 they were advanced to Standard.

In 1910 they were advanced to Standard.

The report of the committee in the 1912 Proceedings, page 413, contains an appendix giving the results of tests made to determine what changes would be necessary in existing tank cars to provide for carrying natural gas gasoline. Another appendix on page 434 gives the results of a series of tests to determine the effect of a 2" magnesia lagging insulation on the tank. Other reports will be found in the 1913 Proceedings, page 522; 1914 Proceedings, page 337; and 1916 Proceedings, page 404.

In 1912 they were revised and new specifications added for special tank cars for the transportation of liquefied petroleum gas (casinghead gasoline) and of liquid chlorine gas.

In 1913 minor changes were made.

In 1914 the requirements for testing tanks and safety valves were revised and provision made for the certification of the tests to the Bureau of Explosives.

In 1916 the specifications covering existing tank cars, Classes I and II, were revised, and new specifications added for tank cars, Class III for general service, and for tank cars Class IV, for highly volatile inflammable liquid products, to be built after May 1, 1917.

In 1917 specifications for Classes I and II cars were revised to permit restricted use after January 1, 1918, of tanks tested to 40 lb. per square inch; detailed specifications for tank cars Class V, for transportation of liquid chlorine gas and liquid sulphur dioxide were added, and some minor changes made.

In 1918, owing to conditions brought about by the war, the requirement that flange quality steel be used in the construction of Class III tanks was suspended until July 1, 1919, and the requirements for hydraulic retests of all classes of tanks were suspended until January 1, 1920. Some modifications were made in Figs. 6, 9-A, 10-A and 13.

In 1920 changes were made in the following requirements: Classes I, II, III and IV—prohibiting projection below bottom outlet cap; definite requirements for breakage groove in bottom outlet casting; features which should be embodied in bottom outlet valves; material and design of plugs for closing openings in tank; tolerance as to capacity of tank requiring but one safety valve. Class I, II, III, IV and V- insertion of anchorage bolts from top, or use of bolt and nut lock, or rivets; adjustment of safety valves when necessary in connection with tests; the requirement of the American Society for Testing Material, Specifications for Boiler Plate Steel, Flange Quality, on Class III tank cars, effective June 1, 1920.

In 1921 changes were made in certain details of construction, viz.: safety valve, bottom discharge valve, dome closing arrangement, and anchorages of tank to underframe.

In 1922 further changes were recommended in the safety valves, bottom outlet valves, and the dome closing arrangement but as the changes were not yet approved by letter ballot they are not included in these specifications.

Revision of specifications for test of Class IV tanks was also recommended.

Recommendations were also made for heater pipe installation, there having been no previous standards or recommended practice. These recommendations were to be submitted for letter ballot but are included in this article as a matter of information.

Definition.

Tank Car.—Any car to which one or more metal tanks, used for the transportation of liquids or compressed gases, are permanently attached.

Note.—These specifications do not apply to cars having wooden or glass lined tanks; nor to gas transport cars with one or more tanks or containers permanently attached; nor to tanks enclosed in box or other house cars.

Section 23, Test of Tanks, does not apply to cars specialy designed for the transportation of solids, such as lime nitrogen.

To indicate to inspectors and others handling cars with wooden or glass lined tanks of cars specially designed for the transportation of solids that such cars do not come under the provisions on the Tank Car Specifications, the words "Wooden-lined Tank—Pressure Test not Required," or "Glass-lined Tank—Pressure Test Not Required," or "For Solids Only—Pressure Test Not Required," as the case may be, should be stenciled on the tank in place of the record of test of tank in the location shown in "Lettering and Marking of Cars."

Classification.

Tank cars shall be classified as follows:

Class I.—Tank cars for general service, with wooden or steel underframes or without underframes, built prior to 1903.

Class II.—Tank cars for general service, with steel underframes or without underframes, built between 1903 and May 1, 1917.

Class III.—Tank cars for general service, built after May 1, 1917.

Class IV.—Insulated tank cars for the transportation of volatile inflammable products whose vapor pressure at a temperature of 100° F. exceeds 10 lb. per sq. in., built after May 1, 1917.

Class V.—Insulated tank cars of specially heavy construction, built after January 1, 1918, for the transportation of liquid products whose properties are such as to involve danger of loss of life in the event of any leakage or rupture of the tank.

Designs for tank cars of Classes IV and V shall be submitted to and approved by the American Railroad Association before the cars are put into service.

If products are offered for transportation, the characteristics of which are such that they cannot properly be transported in any of these classes of cars, special specifications will be made by the American Railway Association, but in all such cases the designs of the cars shall be submitted to and be approved by the Association before the cars are put into service.

Service.

(a) Classes I, II and III tank cars, with tanks tested as prescribed by the specifications to 60 lb. per sq. in., shall be used for the transportation of the following products, because of their inflammable or corrosive nature, or their value:

Acid, Nitrating.
Acid, Sulphuric.
Alcohol, Denatured or Wood.
Alcohol, other than Denatured or Wood.
Ammoniacal Gas Liquor, Crude.
Aqua Ammonia.
Benzine.
Benzol.
Bisulphide of Carbon.
Carbon Tetrachloride.
Coal Tar Oil, Crude.
Coal Tar Naphtha, Light Oil.
Gas Drips, Crude.
Gasoline.
Glycerine.
Naphtha.
Naphtha Distillates.
*Paint or Varnish Dryers, Liquid.
*Paints, Compounded.
*Petroleum Crude Oil.
Rum, Denatured.
Toluol.
*Turpentine Substitutes.
Turpentine, Spirits of, or Wood Turpentine.

*If inflammable vapors are given off at or below 80° F.

(b) Classes I and II tank cars, with tanks tested as prescribed by the specifications to 40 lb. per sq. in., may be used for the transportation of other products whose vapor pressure at a temperature of 100° F. does not exceed 10 lb. per sq. in., and which do not give off inflammable vapors at or below a temperature of 80° F.

(c) Class IV tank cars, with tanks tested as prescribed by the specifications to 75 lb. per sq. in., shall be used for the transportation of volatile inflammable products whose vapor pressure at a temperature of 100° F. exceeds 10 lb. per sq. in.

Typical product of this description: Casinghead Gasoline (Liquefied Petroleum Gas).

(d) Class V tank cars, with tanks tested as prescribed by the specification to 300 lb. per sq. in., shall be used for the transportation of liquid products whose properties are such as to involve danger of loss of life in the event of leakage or rupture of the tank; provided that shipment of such products in tank cars is authorized by the Interstate Commerce Commission's Regulations Governing the Transportation of Dangerous Articles Other Than Explosives.

Liquid products of this description whose shipment has been so authorized are: Chlorine, Sulphur Dioxide.

Transportation Requirements.

(a) A tank car offered for movement over the lines of a railroad shall conform to the specifications corresponding to the product transported in the car.

(b) A tank which bears evidence of damage to the metal by fire shall be withdrawn from transportation service. Provided, however, that where the damage to the tank is local only, or confined to a section not exceeding 25 per cent of the tank surface, the damaged material may be replaced. Before car is returned to service after such replacement the tank and valves shall be again submitted to the prescribed tests and be properly stenciled.

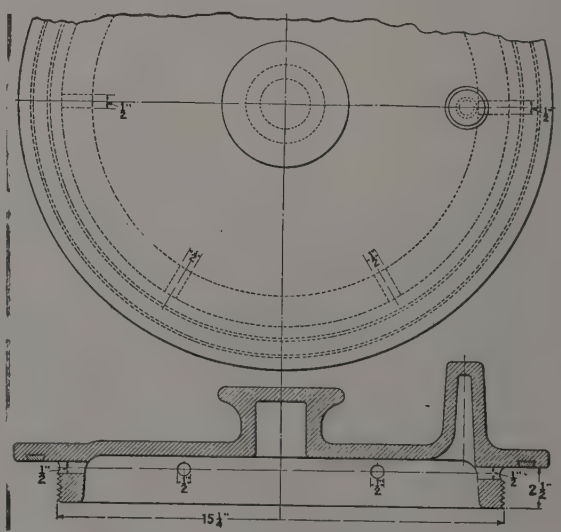


Fig. 268—Approved method of automatically venting pressure in tank upon starting removal of dome cover.

(c) A tank which does not meet the prescribed tests shall be withdrawn from transportation service.

SPECIFICATIONS FOR TANK CARS.

The design and construction of the tanks and cars throughout shall be at least as strong as required by the following detailed specifications.

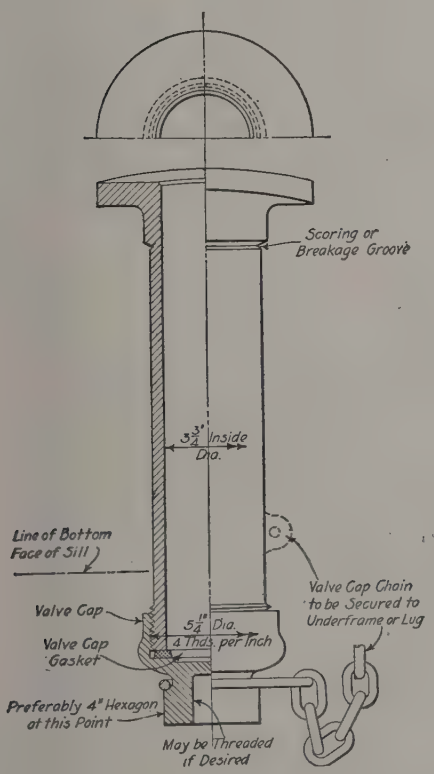
NOTE.—These specifications cover only such features of design and construction as are peculiar to tank cars. Other features are covered by the Standards and Recommended Practice of the American Railway Association, and the requirements of the Federal Government as to Safety Appliances, etc., applying to all classes of freight cars.

Class I Tank Cars

(Built prior to 1903.)

TANK.

1. *Bursting Pressure.*—Not specified.
2. *Material.*—Not specified.
3. *Riveting.*—Not specified.


Scoring or Breakage Groove
3¾" Inside Dia.
Line of Bottom Face of Sill
Valve Cap Chain to be Secured to Underframe or Lug
Valve Cap
5¼" Dia. 4 Thds. per Inch
Valve Cap Gasket
Preferably 4" Hexagon at this Point
May be Threaded if Desired

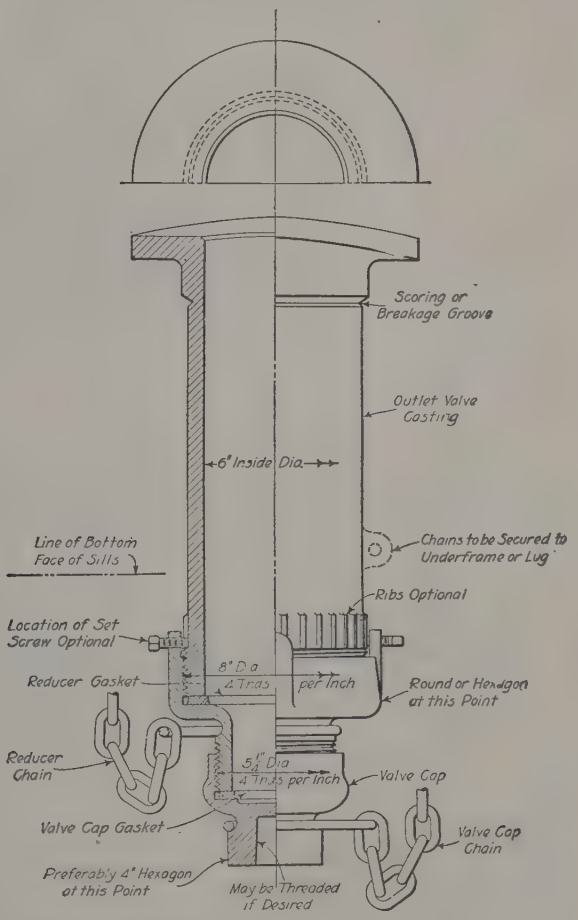

Scoring or Breakage Groove
Outlet Valve Casting
6" Inside Dia.
Line of Bottom Face of Sills
Chains to be Secured to Underframe or Lug
Ribs Optional
Location of Set Screw Optional
Reducer Gasket
8" Dia. 4 Thds. per Inch
Round or Hexagon at this Point
Reducer Chain
5¼" Dia. 4 Thds. per Inch
Valve Cap
Valve Cap Gasket
Valve Cap Chain
Preferably 4" Hexagon at this Point
May be Threaded if Desired

FIG. 269—ARRANGEMENT OF BOTTOM OUTLET.

NOTE.—Tanks built prior to 1903, having head blocks and head seams single riveted may continue in service until heads require repair or renewal, when they shall be double riveted; or, preferably, the tanks secured against end shifting by some means other than by the use of head blocks. (See Sec. 13 (b)).

4. *Calking.*—Not specified.

5. *Tank Heads.*—If tank heads less than 7/16 in. thick bear evidence of distress due to damage from contact with head blocks, they shall be reinforced at bottom by steel shoes not less than ⅜ in. thick, riveted to head and shell.

This requirement shall apply, also, where head blocks have been removed and the tank anchored to the underframe.

6. *Dome.*—(a) Where tank cars are fitted with cast-iron dome heads and covers not sufficiently strong to stand the 40-lb. or 60-lb. hydraulic test they shall be replaced by others of cast or pressed steel, or of malleable iron.

(b) The dome cover shall be secured either by screw joint, or by bolting, or by yoke with center screw.

NOTE.—When screwed dome cover is renewed, depth of inside ring of new cover shall be not less than 2½ in.; and suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided as shown in Fig. 268.

The joint of the dome cover shall be made tight against vapor pressure, and when necessary to insure this a satisfactory gasket shall be used.

For cars to be used for the transportation of inflammable liquids with flash points below 20° F., the mechanical arrangement for closing the dome cover shall either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure, or suitable vents that will be opened automatically by starting the operation of removing the dome cover, shall be provided. An approved method is shown by Fig. 268. Other methods may be used if approved by the American Railway Association.

7. *Bottom Outlet Valve.*—If tank is provided with bottom outlet:

(a) The valve shall preferably be designed to embody the features outlined on page 258.

(b) The outlet valve casting shall be so designed that breakage will not unseat the valve, the preferable construction being to cut (not cast) a "V" groove in the upper part of the casting at a point immediately below any part of the

valve, to a depth that will leave the thickness of the casting at the root of the "V" not over ⅜ in. as in Fig. 269.

(c) No nipples, valves, or other attachments shall project below the bottom outlet cap except while car is being unloaded.

Effective July 1, 1922, in the case of replacements on existing cars, the bottom outlet pipe when applied to tanks of cars with center sills shall not project below the bottom line of sills more than the threaded length necessary to permit the application and removal of the bottom outlet cap.

(d) Wooden and steel underframe tank cars shall have a longitudinal clearance for bottom outlet valve extension as follows:

Not less than six in. on each side of valve, if tank is secured from end shifting by means of head blocks.

Not less than three in. on each side of valve, if tank is secured by center anchorage.

(e) If bottom outlet valve is used, it is preferred that

wide by 10 in. deep, or the equivalent in strength. If the car is equipped with intermediate sills, the center sills shall not be less than 5 in. wide by 9 in. deep, or the equivalent in strength. Center sills shall not be spaced more than 18 in. apart.

(b) *Center Sill Filling Timber.*—Where draft timbers are underneath the center sills, the space between the center sills shall be filled in with timbers not less in depth than center sills, extending from end sill to the center of nearest cross-bearer or cross-timber, provided the latter is located not less than 4 ft. 6 in. from center of bolster. On cars where the draft arrangement is between center sills, the filler timber shall be extended to the cross-tie timber when the cars go to shop for repairs to center sills. Center sills and filling timbers shall be securely bolted together by means of ¾-in. bolts. On cars having center or intermediate sills not less than 10 in. wide by 10 in. deep, which may be made up of two 5 by 10 in. sills bolted together, the filling timbers may be omitted.

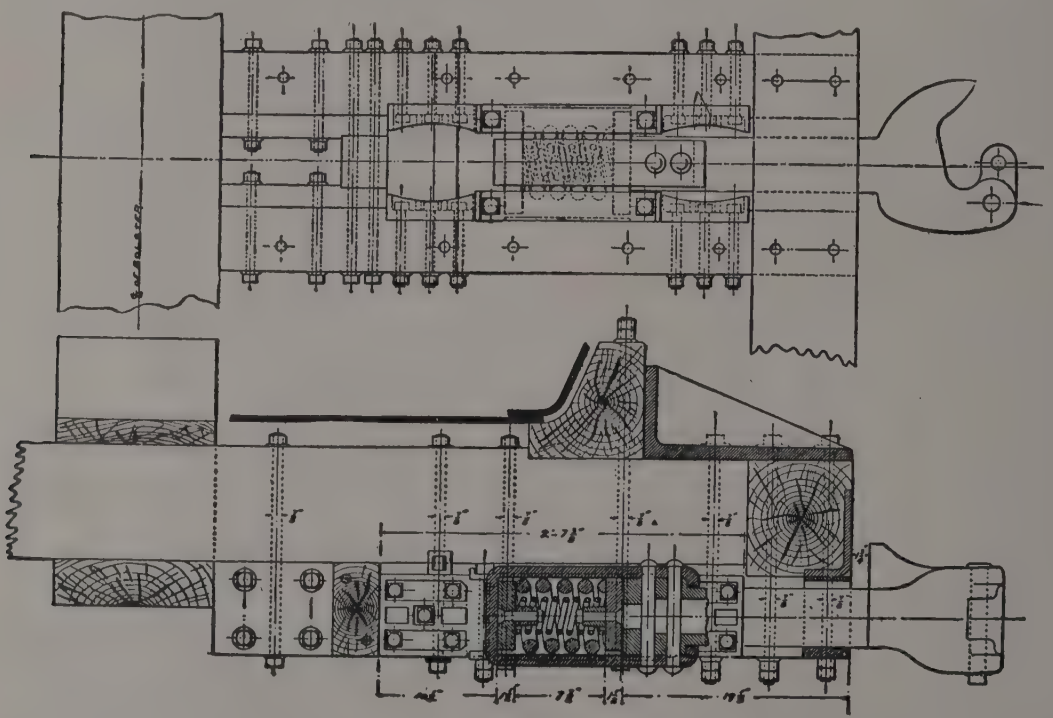


FIG. 270—MINIMUM REQUIREMENTS, DRAFT GEAR AND ATTACHMENTS, CLASS I TANK CAR WITH WOODEN UNDERFRAME.

the handle shall be within the tank or dome, but in the event that the rod is carried through the dome, leaking shall be prevented by packing and cap nut.

7-A. *Lagging.*—Not used with this class of car.

7-B. *Plugs for Openings.*—Where plugs are used to replace existing ones or to close new openings in the heads or other parts of tanks, they shall be solid, of a good grade of gray cast iron, standard pipe thread and taper, and of a length which will screw at least six threads inside the face of fitting or tank.

UNDERFRAME, ANCHORAGE, ETC.

8. Tank cars built prior to 1903 may have either wooden or steel underframes or reinforced shell.

9. *Cars with Wooden Underframes.*—(a) *Center Sills.* If cars are not equipped with intermediate sills, the underframe shall have two center sills, each not less than 5 in.

(c) *End Sills.*—End sills not reinforced by buffer blocks shall not be less than 9 in. wide by 10 in. deep. End sills 6 in. wide by 12 in. deep, reinforced with buffer blocks not less than 6 in. wide by 10 in. deep, and of sufficient length to overlap center sills, will be acceptable as a substitute for 9 by 10 in. end sills.

On existing cars, if buffer blocks are used for the purpose of reinforcing end sills which do not come within the specified requirements, the buffer blocks in no case shall be less than 4 in. thick, nor end sills less than 6 in. thick. The total strength of the end sill and buffer block shall be equal to the strength of the construction specified.

(d) *Draft Timbers.*—Draft timbers secured to inside of center sills and extending to cross-bearer or cross-timber will be accepted as a substitute for filling timbers referred to in paragraph (b). Where center sills are 9 in. wide by 10 in. deep, or over, and draft timbers are placed between

same, they need not extend farther back than body bolster, provided they are adequately secured to center sills by means of seven ⅞-in. bolts, or their equivalent, and butt against body bolster. Draft timbers located underneath the center sills shall not be less than 4 in. wide by 8 in. deep, and each draft timber shall be held to center sills, end sills, and buffer blocks by means of seven or more ⅞-in. bolts or six 1-in. bolts. Where an arrangement for supporting draft timbers is substituted for one or more bolts and the construction is of equal strength, the same will be acceptable. Draft timbers extending beyond bolster shall be secured to center sills by additional bolts.

9-A. *Cars with Steel Underframes.*—(a) Material. Not specified. (b) Center sills. Construction not specified.

Any underframe rebuilt shall conform to the requirements for new tank cars.

10. *Cars without Underframes.*—For cars without underframes built prior to 1903 the thickness of bottom sheet and the riveting were not specified.

11. *Bolsters.*—Cars with steel underframe shall be equipped with steel body and truck bolsters.

12. *Draft Gear.*—(a) Wooden Underframe Cars. The draft gear and draft attachments shall be at least as strong as the design shown in Fig. 270.

Car should be provided with draft gear stops gained into draft gear timbers or heeled on end sills, filler timber or body bolster, and secured with five ¾-in. bolts; but cars having stops gained into draft timbers or heeled on end sills, filler timber or body bolster, secured with three ¾-in. bolts, may be continued in service until such time as they go to shop for repairs, when five stop bolts must be provided.

In all cases, tail yokes or attachments of equal strength shall be used. Tail bolts, tail straps, or American continuous draft gear will not be accepted.

(b) Steel underframe cars and cars without underframes shall be equipped with draft gear of approved design, having a minimum capacity of 60,000 lb.

13. *Anchorage.*—(a) Head Blocks, Wooden Underframe Cars. Head blocks shall not be less than 10 in. wide unless reinforced by metal plates, and of sufficient depth to extend at least 6 in. above bottom of tank, and may be made of two pieces bolted together and bolted to underframe by means of not less than four ⅞-in. vertical bolts. They shall be cut out to suit curve of tank. The ends of each head block should preferably be tied to corresponding ends of head block at the other end of car by means of rods not less than 1 in. in diameter, with 1⅛-in. threaded ends, and each head block supported at center by means of a substantial casting securely bolted to end and center sills. Where the construction of the car does not permit of this fastening, the following may be substituted:

The ends of each head block tied to corresponding ends of head block at the other end of car by rods not less than 1 in. in diameter, with 1⅛-in. threaded ends, and each head block secured by two stay rods 1 in. in diameter, anchored to center sills;

Or, head block supported at center by means of a substantial casting securely bolted to end and center sills, and two 1-in. rods passing diagonally through head block toward bolster and secured to underframe;

Or, head secured by two stay rods 1⅜ in. in diameter, anchored to center sills;

Or, head block secured by two stay rods 1 in. in diameter, anchored to center sills, and two 1-in. rods passing diagonally through head block toward bolster and secured to underframe;

Or, head block secured by two stay rods 1 in. in diameter, anchored to center sills, and two straps not less than ¾ in. thick and 3 in. wide, passing over head blocks and securely fastened to underframe.

(b) When tanks are transferred from wooden to steel underframes they shall be secured against end shifting by some approved means other than by the use of head blocks. In such case the longitudinal anchorage of tank to underframe shall be of metal throughout and the minimum requirements shall be as follows:

Connection of anchorage to tank:

Shearing area of rivets, 25 sq. in..	For tanks of 8,500 gal. capacity or over.
Bearing area of rivets, 20 sq. in...	
Shearing area of rivets, 18 sq. in..	For tanks of less than 8,500 gal. capacity.
Bearing area of rivets, 14 sq. in...	

Connection of anchorage to underframe:

Shearing area of rivets or bolts, 12½ sq. in.....	For tanks of 8,500 gal. capacity or over.
Bearing area of rivets or bolts 10 sq. in.....	
Shearing area of rivets or bolts, 9 sq. in.....	For tanks of less than 8,500 gal. capacity.
Bearing area of rivets or bolt, 7 sq. in.....	

Where bolts are used for securing the anchorage rigidly to the frame, they shall be turned bolts and be driven in reamed holes. When, because of the construction, bolts can not be inserted from the top so that the nuts will be on the bottom, nut locks shall be applied to both bolts and nuts, or rivets shall be used.

(c) Dome Yokes, Tank Bands, Etc.—The tank shall be secured from turning on the underframe either by an anchorage or by dome yokes, and shall also be secured to underframe by tank bands.

If tank bands are used, there shall be two for tanks not more than 76 in. in diameter and four for tanks of greater diameter, or their equivalent.

The sectional area of tank bands shall at no place be less than ¾ of a sq. in. A threaded end 1⅛ in. in diameter or more, with a body consisting of a flat band 2 by ⅜ in., or equivalent section, or round iron 1 in. in diameter, will be accepted as meeting this requirement.

If the dome yoke is used, it may be a rod ¾ in. in diameter, or its equivalent, to which are secured the bands which are fastened to the underframe. The sectional area of dome yoke bands shall be the same as required for tank bands.

Where tanks are equipped with a greater number of tank bands than called for, the sectional area of all bands will be considered as meeting the requirements, if they equal the total sectional area of the bands specified.

Cars having no underframes, with tanks securely riveted to body bolsters, do not require dome yokes or tank bands.

14. *Push-pole Pockets.*—There shall be a push-pole pocket at each corner of the car. Where, from the construction of the car the push-pole pockets can not well be placed on the corners of the underframe, they shall be applied to the trucks, so placed above the journal boxes that the push-pole will push toward the center of the truck.

15. *Couplers.*—A. R. A. Standards and Recommended Practice.

16. *Brakes.*—Each car shall be equipped with air brakes of a capacity equal to not less than 70 per cent of the light weight of car, and at least one hand brake operating the brakes of both trucks. When any change is made in the

brake arrangement it shall be made to conform to A. R. A. Standards and Recommended Practice.

Adjustment of hand brake power shall comply with A. R. A. Circular S III No. 11, May 15, 1919, from the General Committee as in Fig. 280 on page 258.

17. *Trucks.*—Each truck shall have a strength equal to or greater than the strength of the axles used.

18. *Marking.*—When tank cars are repainted the marking shall be made to conform to "Lettering and Marking of Cars" as closely as the construction will permit.

19. *Safety Appliances.*—United States Safety Appliances.

Safety Valves and Safety Vents

Five-Inch Safety Valve, 1916 Design.

The Tank Car Specifications, as revised by the A. R. A. 1916, includes a design of spring follower with three lugs on the under side to engage the single nut on the end of the valve stem.

It was found in service that instead of the valve stem turning on its conical seat in the valve disk, when the disk was rotated to clear its face and seat of rust, etc., the stem turned in the nut and caused a change in the pressure setting of the valve.

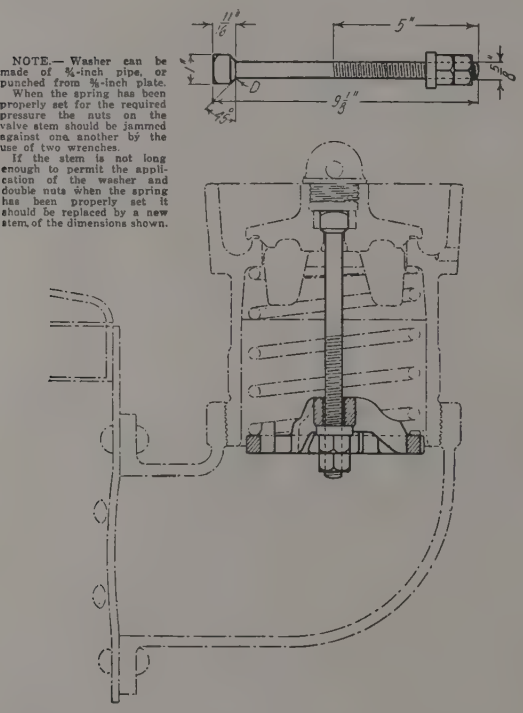

NOTE.— Washer can be made of ¾-inch pipe, or punched from ⅝-inch plate.
When the spring has been properly set for the required pressure the nuts on the valve stem should be jammed against one another by the use of two wrenches.
If the stem is not long enough to permit the application of the washer and double nuts when the spring has been properly set it should be replaced by a new stem of the dimensions shown.
5"
9⅞"

Fig. 271—5-in. safety valve, 1916 design.

The design of the follower was therefore changed in 1918 to eliminate these lugs and double jam nuts applied to prevent the stem turning in the nut when the valve disk is rotated.

In the meantime a number of these valves were put into service. To avoid the frequent adjustment necessary to maintain the proper setting of the valves with this design of spring follower, it is desirable that when the valves are removed from the car for the adjustment of the spring setting a washer be introduced between the bottom of the follower and the nut, so that the lugs will not engage the nut; and that two nuts be applied, jammed against one another by the use of two wrenches, to prevent unscrewing when the valve disk is rotated. It may be found that the present stem is not long enough to permit the application of the washer and two nuts after the valve has been properly set, in which case a new stem of the dimensions shown should be used.

Fig. 271 shows the application of the water and nuts to the 1916 design.

20. *Safety Valves.*—(a) Tanks carrying products that give off volatile inflammable vapors at or below a tempera-

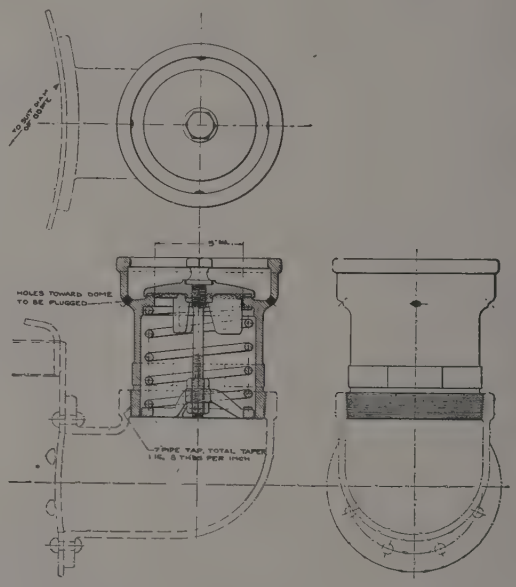


Fig. 272—5-in. safety valve, original design.

ture of 20° F., and have a vapor pressure of not more than 10 lb., per sq. in. at a temperature of 100° F. (see Note), shall be equipped with 5-in. safety valves of approved design. Existing safety valves of the design shown by Fig. 272, equipped with a 25-lb. spring, will be accepted, but new safety valves shall be of the design shown by Fig. 273 on page 245. Safety valves shall be set to open at a pressure of 25 lb. per sq. in., a tolerance of 3 lb. above or below this pressure being allowed.

Note.—Typical liquid products of this description are: Benzine, Benzol, Carbon Bisulphide, Ether, Gascline, Hydrocarbon (gas drips), Naphtha.

(b) Tanks carrying products that give off volatile inflammable vapors above 20° F., and at or below 150° F., and have a vapor pressure of not more than 10 lb. per sq. in. at a temperature of 100° F. (see Note), shall be equipped with 5-in. safety valve of approved design. Existing safety valves of the design shown by Fig. 272, and now in use will be accepted, but new safety valves hereafter applied shall be of the design shown in Fig. 273. Safety valves may be set to open at a pressure of 12 lb. per sq. in., a tolerance of 1 lb. above or below this pressure being allowed. Tanks with safety valves set at 25 lb. may also be used for such products.

Note—Typical liquid products of this description are: Alcohol, Acetone, Distillates, Gas Oil, Illuminating Oil, Kerosene, Refined Oil, Turpentine, Turpentine Substitute, Toluol.

(c) One valve shall be provided for a tank of a capacity of 6,500 gal. or less, with a tolerance of not over 150 gal. to take care of variations due to workmanship in

construction, and two valves for a tank of a capacity of more than 6,500 gal. plus the tolerance.

Where tanks carrying such products are divided into compartments, each compartment shall be provided with a safety valve.

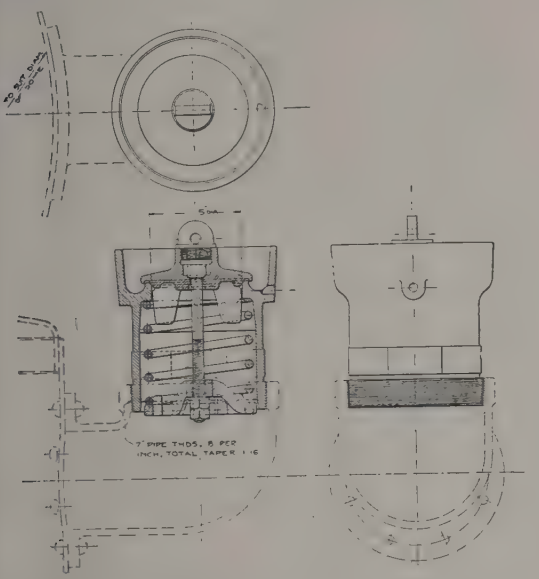


FIG. 273—5-IN. SAFETY VALVE, STANDARD, APPLIED TO SIDE OF DOME.

21. *Safety Vents.*—(a) Tanks carrying volatile non-inflammable products whose vapor pressure at a temperature of 100° F. does not exceed 25 lb. per sq. in. (see Note) need not be equipped with safety valves, but if not so

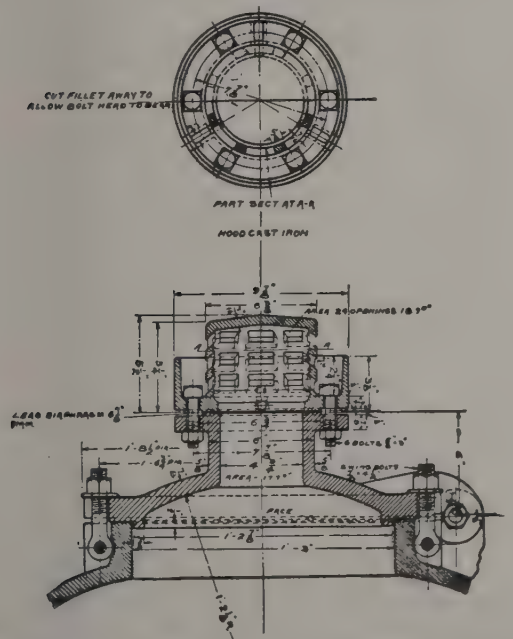


FIG. 274—5-IN. SAFETY VENT, WITH FRANGIBLE LEAD DISK.

equipped, shall be provided with a 5-in. vent depending on a frangible lead disk for safety, which vent shall be of approved design, as shown by Fig. 274, the frangible lead disk to be of a thickness that will insure rupture at a pressure not higher than 30 lb. per sq. in.

NOTE.—Typical liquid products of this description are: Ammonia Liquor, Ammonia Water.

(b) Tanks carrying non-volatile products or products that do not give off inflammable vapors at or below a temperature of 150° F. (see Note), need not be equipped with safety valves, but if not so equipped, shall be provided with an open vent equal to not less than 2 in. in diameter, of approved design as in Fig. 275.

NOTE.—Typical liquid products of this description are: Calcium Chloride, Caustic Soda, Cottonseed Oil, Fish Oil, Glucose, Lard Oil, Linseed Oil, Molasses, Silicate of Soda, Sulphuric Acid, Mixed Sulphuric and Nitric Acids, Tannery Products, Vinegar.

Provided, that where vent is used, and it is necessary to avoid evaporation or splashing of the liquid, or contamination by moisture, the vent shall be closed with a frangible disk of lead or other suitable material, of a thickness that will insure rupture at a pressure not higher than 30 lb. per sq. in. Fig. 275.

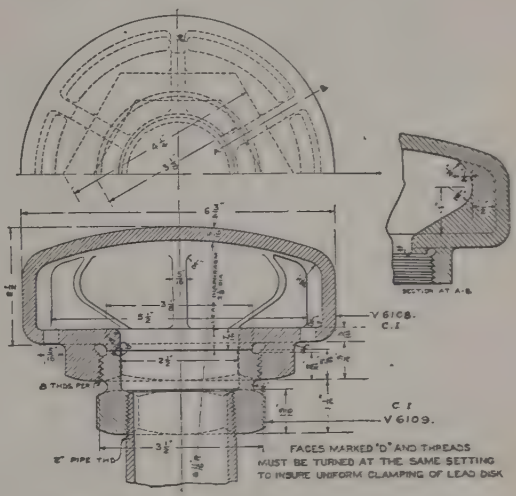


FIG. 275—2-IN. SAFETY VENT, WITH FRANGIBLE DISK.

TESTS.

22. *Certification of Tests.*—Tests of all tanks and their safety valves shall be certified by the party making the tests to the owner of the tank car and to the Chief Inspector, Bureau of Explosives, in the form prescribed by the Bureau.

23. *Tests of Tanks.*—Tanks shall be tested at intervals of not over five years.

Any tank damaged to the extent of requiring patching or renewal of one or more sheets, or extensive reriveting or recalking of seams, shall be retested before being returned to service.

Tanks shall be tested to a pressure of either 40 or 60 lb. per sq. in.

All tests shall be made by completely filling the tank with water, or other approved liquid safe to use, of a temperature which shall not exceed 70° F. during the test, and applying the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than ten minutes without leak or evidence of distress after the tank has been calked tight.

When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

24. *Tests of Safety Valves.*—Safety valves shall be tested and, if necessary, adjusted at intervals of not over two years.

The test may be made without the removal of the valve from the car, provided the valve unseats at a total pres-

sure corresponding with the area of the seat multiplied by the required pressure as in Fig. 276.

When valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank, in accordance with the American Railway Association Standard Marking for Freight Cars.

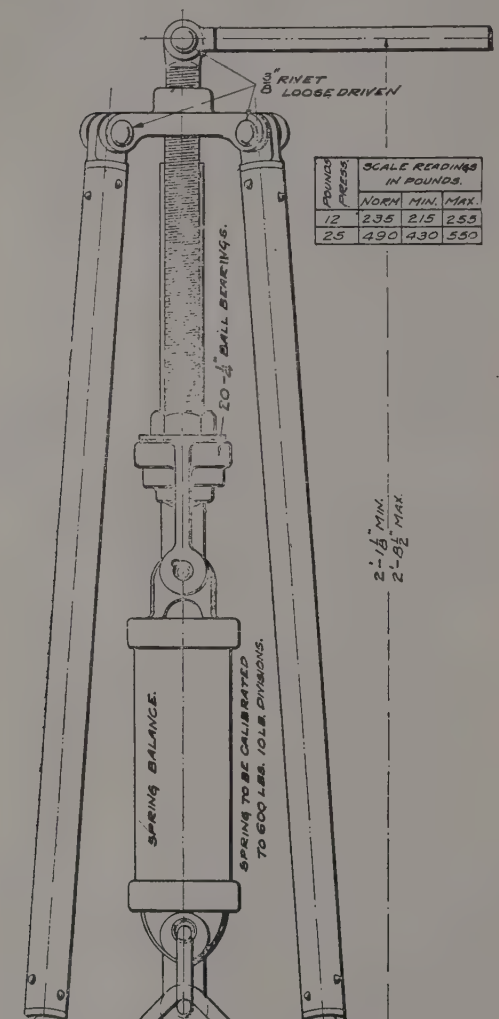


FIG. 276—APPARATUS FOR TESTING SAFETY VALVES WHILE IN PLACE ON CAR.

INSPECTION.

25. *Inspection.*—All tank cars at home on a railroad shall be inspected by inspectors in the employ of that railroad company, and when such tank cars meet the requirements of the American Railway Association Standard Specification for Class I Tank Cars, the legend "M. C. B. Construction" ("A. R. A. Spec. I" when cars are restenciled), with the initials of the railroad company making such inspection, and the date the inspection is made, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Class II Tank Car

(Built between 1903 and May 1, 1917.)

TANK.

1. *Bursting Pressure.*—Steel or iron tanks constructed subsequent to 1903 shall be designed for a bursting pressure of not less than 240 lb. per sq. in.

2. *Material.*—Not specified.

3. *Riveting.*—All longitudinal and head seams shall be double riveted, with the exception that where head blocks are not used head seams need not be double riveted.

NOTE.—Tanks having head blocks and head seams single riveted, may continue in service until heads require repair or renewal, when they shall be double riveted; or, preferably, the tanks secured against end shifting by some means other than by the use of head blocks. (See Section 13 (a)).

4. *Calking.*—Not specified.

5. *Tank Heads.*—If tank heads less than 7/16 in. thick bear evidence of distress due to damage from contact with head blocks, they shall be reinforced at bottom by steel shoes not less than ⅜ in. thick, riveted to head and shell.

This requirement shall apply, also, where head blocks have been removed and the tank anchored to the underframe.

6. *Dome.*—(a) Where tank cars are fitted with cast-iron dome heads and covers not sufficiently strong to stand the 60-lb. hydraulic test, they shall be replaced by others of cast or pressed steel, or of malleable iron.

(b) The dome cover shall be secured either by screw joint, or by bolting, or by yoke with center screw.

NOTE.—When screwed dome cover is renewed, depth of inside ring of new cover shall be not less than 2½ in.; and suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided as in Fig. 268 on page 240.

The joint of the dome cover shall be made tight against vapor pressure, and when necessary to secure this a satisfactory gasket shall be used.

For cars to be used for the transportation of inflammable liquids with flash points below 20° F., the mechanical arrangement for closing the dome cover shall either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure, or suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided. An approved method is shown by Fig. 268. Other methods may be used if approved by the American Railway Association.

7. *Bottom Outlet Valve.*—If tank is provided with bottom outlet:

(a) The valve shall preferably be designed to embody the features outlined on page 258.

(b) The outlet valve casting shall be so designed that breakage will not unseat the valve, the preferable construction being to cut (not cast) a "V" groove in the upper part of the casting at a point immediately below any part of the valve, to a depth that will leave the thickness of the casting at the root of the "V" not over ⅜ in. Fig. 269 on page 241.

(c) No nipples, valves, or other attachments shall project below the bottom outlet cap except while car is being unloaded.

Effective July 1, 1922, in the case of replacements on existing cars, the bottom outlet pipe when applied to tanks of cars with center sills shall not project below the bottom line of sills more than the threaded length necessary to

ermit application and removal of the bottom outlet cap.

(d) Steel underframe tank cars shall have a longitudinal learance for bottom outlet valve extension, as follows:

Not less than 6 in. on each side of valve, if tank is se-ured from end shifting by means of head blocks.

Not less than 3 in. on each side of valve, if tank is se-ured by center anchorage.

(e) If bottom outlet valve is used, it is preferred that the andle shall be within the tank or dome, but in the event hat the rod is carried through the dome, leaking shall be revented by packing and cap nut.

7-A. *Lagging.*—Not used with this class of car.

7-B. *Plugs for Openings.*—Where plugs are used to

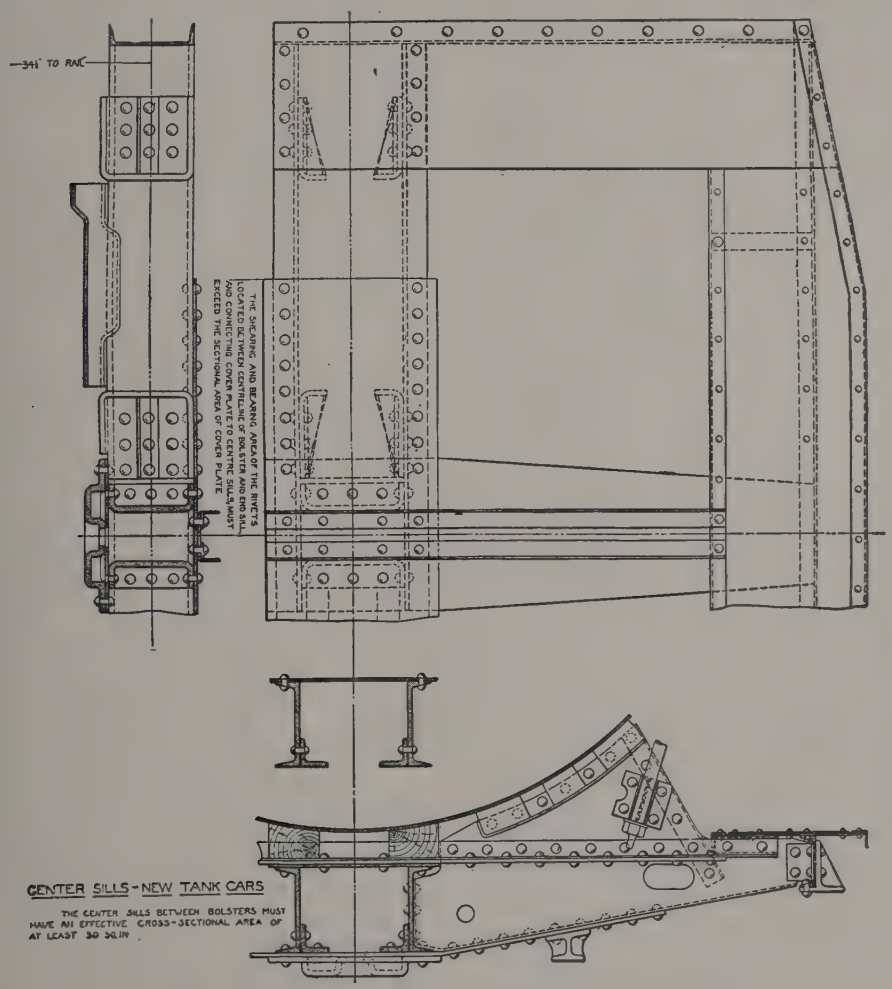

—34" TO RAIL—
THE SHEARING AND BEARING AREA OF THE RIVETS LOCATED BETWEEN CENTERLINE OF BOLSTER AND END SILL AND CONNECTING COVER PLATE TO CENTRE SILLS MUST EXCEED THE SECTIONAL AREA OF COVER PLATE
CENTER SILLS - NEW TANK CARS
THE CENTER SILLS BETWEEN BOLSTERS MUST HAVE AN EFFECTIVE CROSS-SECTIONAL AREA OF AT LEAST 30 SQ.IN.

FIG. 277.—CENTER-SILL CONSTRUCTION, CLASS II TANK CAR.

replace existing ones or to close new openings in the heads or other parts of tanks, they shall be solid, of a good grade of gray cast iron, standard pipe thread and taper, and of a length which will screw at least six threads inside the face of fitting or tank.

UNDERFRAME, ANCHORAGE, ETC.

8. Tank cars built subsequent to 1903 shall have either steel underframe or reinforced shell.

9. *Cars with Underframe.*—(a) Material. Not specified.

(b) *Center Sills.*—For cars built after 1906 the center sill construction of the underframe between bolsters shall have an effective cross-sectional area of at least 30 sq. in.,

distributed as shown in Fig. 277, or an equivalent section.

Any underframe rebuilt shall conform to the requirements for new tank cars.

10. *Cars without Underframe.*—For cars built after 1906 tank shell at bottom shall be at least 5/8 in. thick, and all circumferential seams in bottom sheet, except head seams, shall be double riveted.

11. *Bolsters.*—Cars shall be equipped with steel body and truck bolsters.

12. *Draft Gear.*—Cars shall be equipped with a draft gear of approved design—mininum capacity of 60,000 lb.

13. *Anchorage.*—(a) *Longitudinal.* The longitudinal anchorage of the tank shall be thoroughly substantial, to prevent injurious end shifting. The preferable method of securing tank against end shifting is by anchorage at the center, or at the bolster, or by securing it to the underframe by some means other than by the use of head blocks. The method of anchorage shall be one approved by the American Railway Association.

If the longitudinal anchorage is by means of head blocks, each head block shall be bolted to underframe or head block casting by not less than two bolts. The head block shall be cut out to suit curve of tank, and be supported at center by means of a substantial casting securely riveted to center sills.

For cars built after 1909 and for cars changed after

January 1, 1917, from head blocks to approved anchorage, the minimum requirements for longitudinal anchorage of tank to underframe shall be as follows:

Connection of anchorage to tank:

Shearing area of rivets, 25 sq. in..... } For tanks of 8,500 gal.
Bearing area of rivets, 20 sq. in..... } capacity or over.
Shearing area of rivets, 18 sq. in..... } For tanks of less than
Bearing area of rivets, 14 sq. in..... } 8,500 gal. capacity.

Connection of anchorage to underframe:

Shearing area of rivets or bolts, 12½ sq. in. } For tanks of 8,500 gal.
Bearing area of rivets or bolts, 10 sq. in.. } capacity or over.
Shearing area of rivets or bolts, 9 sq. in.. } For tanks of less than
Bearing area of rivets or bolts, 7 sq. in.. } 8,500 gal. capacity.

Where bolts are used for securing the anchorage to the frame, they shall be turned bolts and be driven in reamed holes. When, because of the construction, bolts can not be inserted from the top so that the nuts will be on the bottom, nut locks shall be applied to both bolts and nuts, or rivets shall be used.

(b) *Dome Yokes, Tank Bands, Etc.*—The tank shall be secured from turning on the underframe either by an anchorage or by dome yokes, and shall also be secured to underframe by tank bands, or other approved means of equal strength and security.

If tank bands are used, there shall be two for tanks not more than 76 in. in diameter, and four for tanks of greater diameter, or their equivalent.

The sectional area of tank bands shall at no place be less than ¾ of a sq. in. A threaded end 1⅛ in. in diameter or more, with a body consisting of a flat band 2 by ⅜ in., or equivalent section, or round iron 1 in. in diameter, will be accepted as meeting this requirement.

If dome yoke is used, it may be a rod ¾ in. in diameter, or its equivalent, to which are secured the bands which are fastened to the underframe. The sectional area of dome yoke bands shall be the same as required for tank bands.

Where tanks are equipped with a greater number of tank bands than called for, the sectional area of all bands will be considered as meeting the requirements, if they equal the total sectional area of the bands specified.

Cars having no underframes, with tanks securely riveted to body bolsters, do not require dome yokes or tank bands.

14. *Push-pole Pockets.*—There shall be a push-pole pocket at each corner of the car. Where, from the construction of the car, the push-pole pockets can not well be placed on the corners of the underframe, they shall be applied to the trucks, so placed above the journal boxes that the push-pole will push toward the center of the truck.

15. *Couplers.*—A. R. A. Standards and Recommended Practice.

16. *Brakes.*—Each car shall be equipped with air brakes of a capacity equal to not less than 70 per cent of the light weight of car, and at least one hand brake operating the brakes of both trucks. When any change is made in the brake arrangement it shall be made to conform to A. R. A. Standards and Recommended Practice.

Adjustment of hand brake power shall comply with A. R. A. Circular S III No. 11, May 15, 1919, from the General Committee.

17. *Trucks.*—Each truck shall have a strength equal to or greater than the strength of the axles used.

18. *Marking.*—When tank cars are repainted the marking shall be made to conform to "Lettering and Marking" as closely as the construction will permit.

19. *Safety Appliances.*—United States Safety Appliances, or United States Safety Appliances, Standard.

Safety Valves and Safety Vents.

20. *Safety Valves.*—(a) Tanks carrying products that give off volatile inflammable vapors at or below a tempera perature of 20° F., and have a vapor pressure of not mor than 10 lb. per sq. in. at a temperature of 100° F. (se Note), shall be equipped with 5-in. safety valves of ap proved design. Existing safety valves of the design show by Fig. 272 with 25-lb. spring, will be accepted, but ne safety valves shall be of the design shown by Fig. 273 o page 245. Safety valves shall be set to open at a pres sure of 25 lb. per sq. in., a tolerance of 3 lb. above or belo this pressure being allowed.

Note.—Typical liquid products are: Benzine, Benzol, Carbon Bisu phide, Ether, Gasoline, Hydrocarbon (gas drips), Naptha.

(b) Tanks carrying products that give off volatile in flammable vapors above 20° F., and at or below 150° F., an have a vapor pressure of not more than 10 lb. per sq. in at a temperature of 100° F. (see Note), shall be equippe with 5-in. safety valves of approved design. Existing safet valves of the design shown by Fig. 272 on page 244 wi be accepted, but new safety valves shall be of the desig shown by Fig. 273 on page 245. Safety valves may b set to open at a pressure of 12 lb. per sq. in., a toleranc of 1 lb. above or below this pressure being allowed. Tank with safety valves set at 25 lb. may also be used for suc products.

Note.—Typical liquid products of this description are: Alcoho Acetone, Distillates, Gas Oil, Illuminating Oil, Kerosene, Refine Oil, Turpentine, Turpentine Substitute, Toluol.

(c) One valve shall be provided for a tank of a capacit of 6500 gal. or less, with a tolerance of not over 150 gallon to take care of variations due to workmanship in construc tion, and two valves for a tank of a capacity of more tha 6500 gal. plus the tolerance.

Where tanks carrying such products are divided int compartments each compartment shall be provided with safety valve.

21. *Safety Vents.*—(a) Tanks carrying volatile non inflammable products whose vapor pressure at a temperatur of 100° F. does not exceed 25 lb. per sq. in. (see Note need not be equipped with safety valves; but if not s equipped, shall be provided with a 5-in. vent depending o a frangible lead disk for safety, which vent shall be o approved design, as shown by Fig. 274 on page 245, th disk to be of a thickness that will insure rupture at a pres sure not higher than 30 lb. per sq. in.

Note.—Typical liquid products of this description are: Ammoni Liquor, Ammonia Water.

(b) Tanks carrying non-volatile products, or product that do not give off inflammable vapors at or below a tem perature of 150° F. (see Note) need not be equipped wit safety valves, but, if not so equipped, shall be provide with an open vent equal to not less than 2 in. in diamete of approved design, Fig. 275 on page 245.

Note.—Typical liquid products of this description are: Calciu Chloride, Caustic Soda, Cottonseed Oil, Fish Oil, Glucose, Lard Oi Linseed Oil, Molasses, Silicate of Soda, Sulphuric Acid, Mixe Sulphuric and Nitric Acids, Tannery Products, Vinegar.

Provided, that where vent is used, and it is necessar to avoid evaporation or splashing of the liquid, or con tamination by moisture, the vent shall be closed with frangible disk of lead, or other suitable material, of a thick ness that will insure rupture at a pressure not higher tha 30 lb. per sq. in., as in Fig. 275.

Tests.

22. *Certification of Tests.*—Tests of all tanks and thei safety valves shall be certified by the party making th tests to the owner of the tank car and to the Chief Inspector Bureau of Explosives, in the form prescribed by the Bureau

23. *Tests of Tanks.*—Tanks shall be tested before bein put into service, again at the expiration of ten years, an after that at intervals of not over five years; with the ex

ception that where tanks are used for the transportation of such corrosive products that deterioration is to be expected in a shorter time, the first test period for such tanks shall be reduced to five years. Tanks requiring this five-year test shall be those used for the transportation of chemicals, such as acids, ammonia, liquors, etc., and such other products as hereafter may be specified.

Any tank damaged to the extent of requiring patching or renewal of one or more sheets, or extensive reriveting or recalking of seams, shall be retested before being returned to service.

Tanks shall be tested to a pressure of either 40 or 60 lb. per sq. in.

All tests shall be made by completely filling the tank with water or other approved liquid safe to use, of a temperature which shall not exceed 70° F. during the test, and applying the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than ten minutes without leak or evidence of distress after the tank has been calked tight.

When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

24. *Tests of Safety Valves.*—Safety valves shall be tested and, if necessary, adjusted at intervals of not over two years.

The test may be made without the removal of the valve from the car, provided the valve unseats at a total pressure corresponding with the area of the seat multiplied by the required pressure, Fig. 276 on page 246.

When the valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

INSPECTION.

25.—*Inspection.*—All tank cars at home on a railroad shall be inspected by inspectors in the employ of that railroad company, and when such tank cars meet the requirements of the American Railway Association Standard Specification for Class II Tank Cars, the legend "M. C. B. Construction" ("A. R. A. Spec. II," when cars are restenciled), with the initials of the railroad company making such inspection, and the date the inspection is made, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Class III Tank Car

(Built after May 1, 1917.)

TANK.

1. *Bursting Pressure.*—The calculated bursting pressure, based on the lowest tensile strength of the plate or casting and the efficiency of the steam or attachment, shall not be less than 300 lb. per sq. in.

2. *Material.*—(a) For cars built after April 1, 1920, all plates for tank and dome shall be of steel complying with the American Society for Testing Materials Specifications for Boiler Plate Steel, Flange Quality.

The use of material other than steel will be permitted where desirable because of the nature of the product to be transported; provided that the tank shall be subject to the same requirement as to bursting pressure, and that the thicknesses of the plates shall be increased to correspond to those specified in the case of steel, based upon the lowest tensile strength of the material, and be approved by the American Railway Association.

(b) Rivets shall comply with the American Railway Association Specifications for Rivet Steel and Rivets for Passenger and Freight Equipment Cars.

(c) Minimum thicknesses (thickness at rivet seam) of plates shall be as follows:

Diameter of Tanks	Bottom Sheet	Shell Sheet	Dome Sheet	Tank Heads	Dome Heads
60 in. or under.....	7/16 in.	1/4 in.	5/16 in.	1/2 in.	5/8 in.
Over 60 in. to 78 in...	7/16 in.	5/16 in.	3/8 in.	1/2 in.	5/8 in.
Over 78 in. to 96 in....	1/2 in.	3/8 in.	7/16 in.	1/2 in.	5/8 in.

For tanks without underframe the minimum thickness of bottom sheet shall be 5/8 in.

For tanks built in rings the thickness specified for bottom sheet shall apply to the entire cylindrical shell.

For car with underframe the minimum width of bottom sheet of tank shall be 60 in., but in all cases the width shall be sufficient to bring the entire width of the longtiudinal seam, including overlaps, above the cradle.

3. *Riveting.*—(a) All seams shall be double riveted, with the exception of the dome head seam, which may be single riveted.

Seams shall be riveted metal to metal without the interposition of other material.

(b) For double riveting the size and pitch of rivets shall be as follows:

Thickness of Plate	Diameter of Rivet	Longitudinal Pitch	Back Pitch
1/4 in.	5/8 in.	2 1/2 to 2 3/4 in.	1 1/2 to 1 3/4 in.
5/16 in.	5/8 in.	2 1/2 to 2 3/4 in.	1 1/2 to 1 3/4 in.
	3/4 in.	See Note	
3/8 in.	3/4 in.	2 3/4 to 3 in.	1 3/4 to 2 in.

NOTE.—For longitudinal seams with 3/4 in. rivets, 2 3/4 logitudinal pitch is necessary to insure 70 per cent strength of seam.

The efficiency of the seam shall be not less than 70 per cent of the strength of the thinnest plate.

For single riveting the size and pitch of rivets shall be as follows:

Thickness of Plate	Diameter of Rivet	Pitch
5/16 in.	5/8 in.	1 3/4 to 2 in.
7/16 in.	3/4 in.	1 7/8 to 2 1/8 in.

(c) The extreme calking edge distance, measured from center line of rivet hole, shall not be less than one and one-half times the diameter of the hole, and not more than one and one-half times the diameter of the hole plus 1/4 in.

The angle of the calking edges shall be between 60 and 70 degrees with the flat surface of the plate.

Exception.—*Welding.* Tanks with seams welded by such welding process as may be approved by the American Railway Association may be used experimentally in transportation service.

Such tanks shall be stenciled "Experimental—Welded Seams" between the marking "A. R. A. Spec. III" and the date of the inspection.

4. *Calking.*—Seams shall be calked both inside and outside. The purpose of the inside calking is to prevent access of contents of tank to the seams. Calking may be done by electric welding process.

Split calking shall not be permitted.

5. *Tank Heads.*—Tank heads shall be dished to a radius of 10 ft., for pressure on concave side.

In the case of compartment cars each compartment shall have two heads, convex outward.

6. *Dome.*—(a) The tank shall have a dome with a minimum capacity, measured from the inside top of shell of tank to the top of dome, of not less than two per cent of the total capacity of the tank, that is, the shell and dome capacity conmbined. (See Exception 2 (a).)

(b) Dome head shall be of steel plate, or the dome head and ring in one casting may be of cast steel.

Dome ring and cover shall be of cast or pressed steel or of malleable iron.

If of steel plate dome head shall be dished to 8 ft. radius.

The opening in shell for dome shall not exceed 22 by 28 in. (See Exceptions 1 (a) and 2 (b).)

(c) The dome cover shall be secured either by screw joint, or by bolting, or by yoke with center screw.

If screwed dome cover is used, the depth of inside ring of cover shall not be less than 2½ in.

The joint of the dome cover shall be made tight against vapor pressure, and when necessary to secure this a satisfactory gasket shall be used.

For cars to be used for transportation of inflammable liquids with flash points below 20° F. the mechanical arrangement for closing the dome cover shall either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure, or suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided. Other methods may be used if approved by the American Railway Association. An approved method is shown by Fig. 268 on page 240.

Exceptions.—1. A larger opening in the shell for dome may be made where it is desirable because of the nature of the product to be transported; provided that the shell be reinforced in an approved manner to compensate for the larger opening.

2. In the case of tank cars used exclusively for the transportation of acids:

(a) The dome capacity may be not less than one per cent of the total capacity of the tank; that is, the shell and dome capacity combined;

(b) The opening in shell for dome may be cut out to full size of dome; provided that if the longitudinal diameter of the opening exceeds one-third of the width of the center course the thickness of the center course shall be increased sufficiently to compensate for the excess opening.

7. *Bottom Outlet Valve.*—If tank is provided with bottom outlet:

(a) The valve shall preferably be designed to embody the features outlined on page 258.

(b) The outlet valve casting shall be so designed that breakage will not unseat the valve, the preferable construction being to cut (not cast) a "V" groove in the upper part of the casting at a point immediately below any part of the valve, to a depth that will leave the thickness of casting at the root of the "V" not over ⅜ in. as in Fig. 269 on page 241.

(c) The bottom of the main portion of the outlet valve casting, or some fixed attachment thereto, shall have external "V" threads 5¼ in. in diameter, and a pitch of four threads to the inch as in Fig. 269.

Where a 6-in. bottom outlet valve is used, the bottom outlet valve casting shall be designed to have a diameter of 8 in. over threads, and a pitch of four threads to the inch, in addition to connections as in Fig. 269.

Cars used for the transportation of acids or other corrosive substances, if fitted with bottom outlet valve castings, need not have threads as above, but may be designed for the use of a bolted cover, to insure a tight joint. A suitable gasket shall be used when necessary.

Effective July 1, 1922, in the case of new cars and replacements on existing cars, the bottom outlet pipe when applied to tanks of cars with center sills shall not project below the bottom line of sills more than the threaded length necessary to permit the application and removal of the bottom outlet cap.

All outlet valve casting caps and attachments shall be secured to the car to prevent loss.

No nipples, valves, or other attachments shall project below the bottom outlet cap except while car is being unloaded.

(e) Where the tank is anchored rigidly to the underframe there shall be a longitudinal clearance of not less than 3 in. on each side of the bottom outlet valve casting. Where the anchorage used provides for a limited longitudinal movement of the tank, there shall be a clearance of not less than 3 in. on each side of the bottom outlet valve casting when the tank has reached the limit of longitudinal movement provided for by such anchorage. There shall be a transverse clearance of not less than ½ in. on each side of the bottom outlet valve casting.

(f) If bottom outlet valve is used, it is preferred that the handle shall be within the tank or dome, but in the event that the rod is carried through the dome, leaking shall be prevented by packing and cap nut.

7-A. *Lagging.*—Not used with this class of car.

7-B. *Plugs for Openings.*—Where plugs are used in the heads or other parts of new tank cars, or as replacements in case of existing cars, they shall be solid, of a good grade of gray cast iron, standard pipe thread and taper, and of

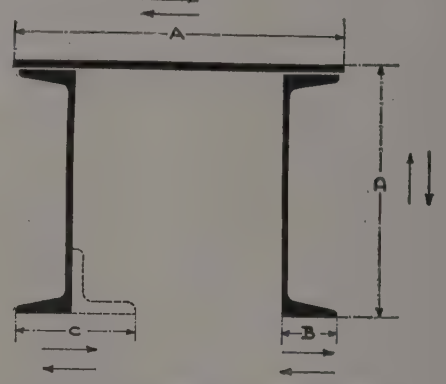

A
A
C
B
ARROW HEADS SHOW DIRECTION IN WHICH BUCKLING MAY TAKE PLACE.
BRACE MAY CONSIST OF CASTINGS SUPPORTING THE MEMBERS AGAINST BUCKLING, OR COVER PLATES, OR LATTICE WORK, OR REINFORCING BY MEANS OF ANGLES ETC..

FIG. 278.—CENTER SILL. CLASSES III, IV, AND V TANK CARS

a length which will screw at least six threads inside the face of fitting or tank.

UNDERFRAME, ANCHORAGE, ETC.

8. Tank cars may be built either with or without underframes.

9. *Cars with Underframes.*—Material, (a) Underframes shall be of steel which complies with the American Railway Association Specifications for Structural Steel, Steel Plate and Steel Sheets for Freight Equipment Cars.

(b) Rivets shall comply with the American Railway Association Specifications for Rivet Steel and Rivets for Passenger and Freight Equipment Cars.

(c) Underframes shall be equipped with cast or forged steel center plates. Malleable iron may be used for other details, such as striking plates, draft lugs, side bearings, push-pile pockets, etc. Steel and malleable iron castings shall comply with the American Railway Association Specifications for these materials.

9-A. *Center Sills.*—The center sill construction shall meet the following requirements:

Minimum center sill area between points of impact, 30 sq. in.

Ratio, stress to end load, not more than 0.05.

Length of center or draft sill members between braces shall not be more than 20 times the depth of the member,

measured in the direction in which buckling may take place as shown in Fig. 278.

Continuous sills having cover plates are preferable.

If other construction is used, the effective cross-sectional area, including connections, must be at least as strong as continuous sills.

9-B. *Draft Attachments.*—The strength value of the draft attachments and the center sill construction shall be equivalent to at least 12½ sq. in. of steel in tension and compression, 8 sq. in. rivet bearing area, and 15 sq. in. in shear. Ratio of unit stress to end load shall not exceed 0.12.

NOTE.—Until the A. R. A. Standards for coupler yoke and coupler key are changed to conform to the requirements of Section 9-B, the present A. R. A. Standards for coupler yoke and coupler key will be accepted as a minimum.

(See Master Car Builder's Association Recommended Practice for Center Sills for New Cars, and report of Committee on Car Construction, page 389, 1914 Proceedings.)

10. *Cars without Underframes.*—Cars without underframes shall have shell reinforced in thickness as provided for in Section 2 (c).

11. *Body Bolsters.*—Body bolsters shall be of steel castings or of the built-up type, thoroughly substantial, and sufficient in strength to take at least one-half the total weight of loaded tank car on each side bearing.

12. *Draft Gear.*—Cars shall be equipped with a draft gear having a minimum capacity of 150,000 lb.

13. *Anchorage.*—(a) Longitudinal. The tank shall be secured against end shifting by anchorage at the center, or at the bolster, or be secured to the underframe by some means other than by the use of head blocks. The method of anchorage shall be one approved by the American Railway Association.

The longitudinal anchorage of tank to underframe shall be of metal throughout, and the minimum requirements shall be as follows:

Connection of anchorage to tank:

Shearing area of rivets	30 sq. in.
Bearing area of rivets	24 sq. in.

Connection of anchorage to underframe:

Shearing area of rivets or bolts	15 sq. in.
Bearing area of rivets or bolts	12 sq. in.

When bolts are used for securing the anchorage rigidly to the underframe they shall be turned bolts and be driven in reamed holes. When, because of the construction, bolts can not be inserted from the top so that the nuts will be on the bottom, nut locks shall be applied to both bolts and nuts, or rivets shall be used.

Where either tank or underframe has more than one connection, if these connections hold the tank rigidly to the underframe, the total rivet or bolt value shall be 20 per cent in excess of the requirements specified; if the connections do not hold the tank rigidly to the underframe, the total rivet or bolt value shall be double that specified.

(b) *Dome Yokes, Tank Bands, Etc.*—The tank shall be secured from turning on the underframe either by an anchorage or by dome yokes, and shall also be secured to underframe by tank bands, or other approved means of equal strength and security.

If tank bands are used, there shall be two for tanks not more than 78 in. in diameter, and four for tanks of greater diameter.

The sectional area of tank bands shall at no place be less than 1 sq. in. A threaded end 1⅜ in. in diameter or more, with a body consisting of a flat band 2 by ½ in., or equivalent section, or round iron 1⅜ in. in diameter, will be accepted as meeting this requirement.

If the dome yoke is used, it may be a rod 1 in. in diameter, or its equivalent, to which are secured the bands which are fastened to the underframe. The sectional area of dome yoke bands shall be the same as required for tank bands.

Cars having no underframe, with tank securely riveted to body bolsters, do not require dome yokes or tank bands.

14. *Push-pole Pockets.*—There shall be a push-pole pocket at each corner of the car. Where, from the construction of the car, the push-pole pockets can not well be placed on the corners of the underframe, they shall be applied to the body bolsters.

15. *Couplers.*—A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

16. *Brakes.*—A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

Adjustment of hand brake power shall comply with A. R. A. Circular S III No. 11, May 15, 1919, from the General Committee.

17. *Trucks.*—The truck as a whole shall be equal in strength to the carrying capacity of axles. Wheels, axles, journal boxes, bearings, center plates, etc., shall be in accordance with A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

18. *Marking.*—A. R. A. Standard Marking for Freight Cars.

18-A. *Placard Boards.*—Cars shall be equipped with suitable boards for attaching placards prescribed by the Interstate Commerce Commission. These boards shall be of sufficient size to permit placards to be applied with the opposite points of the diamond in vertical and horizontal positions, respectively.

19. *Safety Appliances.*—Safety appliances shall be in accordance with American Railway Association specifications therewith, which conform to the United States Safety Appliances, Standard.

Safety Valves and Safety Vents.

20. *Safety Valves.*—(a) Tanks carrying products that give off volatile inflammable vapors at or below a temperature of 150° F., and have a vapor pressure of not more than 10 lb. per sq. in. at a temperature of 100° F. (see Note), shall be equipped with 5-in. safety valves of approved design, Fig. 273 on page 245, or Fig. 279 on page 252, which shall be set to open at a pressure of 25 lb. per sq. in., a tolerance of 3 lb. above or below this pressure being allowed.

NOTE.—Typical liquid products of this description are: Alcohol, Acetone, Benzine, Benzol, Carbon, Bisulphide. Distillates, Ether, Gas Oil, Gasoline, Hydrocarbon (gas drips), Illuminating Oil, Kerosene, Naphtha, Refined Oil, Toluol, Turpentine, Turpentine Substitute.

(b) One valve shall be provided for a tank of a capacity of 6500 gal. or less, with a tolerance of not over 150 gal. to take care of variations due to workmanship in construction, and two valves for a tank of a capacity of more than 6500 gal. plus the tolerance.

Where tanks carrying such products are divided into compartments, each compartment shall be provided with a safety valve.

21. *Safety Vent.*—Tanks carrying non-volatile products or products that do not give off inflammable vapors at or below 150° F. (see Note) need not be equipped with safety valves, but if not so equipped, shall be provided with one open vent equal to not less than 2 in. in diameter, of approved design as in Fig. 275 on page 245.

Provided, that where vent is used and it is necessary to avoid evaporation or splashing of the liquid, or contami-

nation by moisture, the vent shall be closed with a frangible disk of lead or other suitable material, of a thickness that will insure rupture at a pressure not higher than 30 lb. per sq. in. as in Fig. 275.

NOTE.—Typical liquid products of this description are: Calcium Chloride, Caustic Soda, Cottonseed Oil, Fish Oil, Glucose, Lard Oil, Linseed Oil, Molasses, Silicate of Soda, Sulphuric Acid, Mixed Sulphuric and Nitric Acids, Tannery Products, Vinegar.

TESTS.

22. *Certification of Tests.*—Tests of all tanks and their safety valves shall be certified by the party making the tests to the owner of the tank car and to the Chief Inspector, Bureau of Explosives, in the form prescribed by the Bureau.

23. *Test of Tanks.*—Tanks shall be tested before being

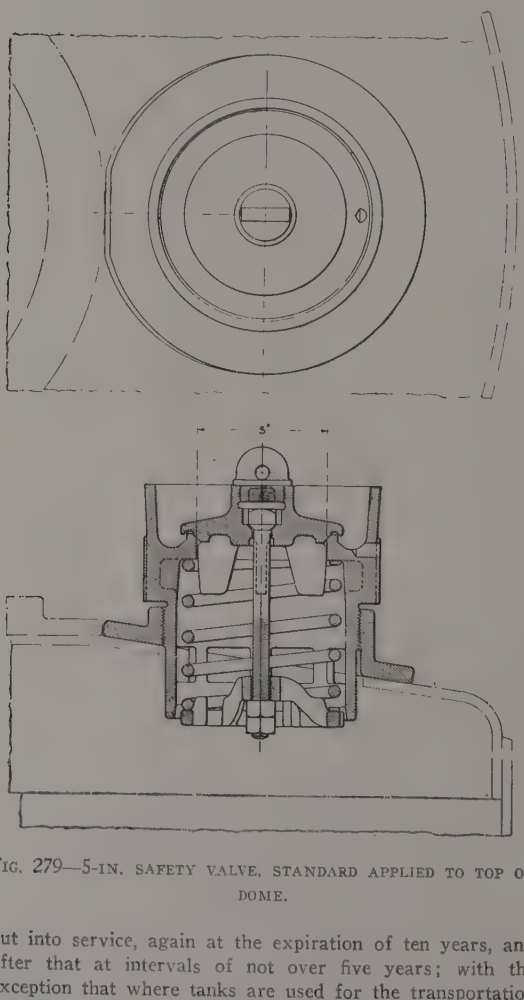


FIG. 279—5-IN. SAFETY VALVE, STANDARD APPLIED TO TOP OF DOME.

put into service, again at the expiration of ten years, and after that at intervals of not over five years; with the exception that where tanks are used for the transportation of such corrosive products that deterioration is to be expected in a shorter time, the first test period for such tanks shall be reduced to five years. Tanks requiring this five-year test shall be those used for the transportation of chemicals, such as acids, ammonia, liquors, etc., and such other products as hereafter may be specified.

Any tank damaged to the extent of requiring patching or renewal of one or more sheets or extensive reriveting or recalking of seams, shall be retested before being returned to service.

Tanks shall be tested to a pressure of 60 lb. per sq. in. All tests shall be made by completely filling the tank with water, or other approved liquid safe to use, of a temperature which shall not exceed 70° F. during the test, and applying the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than ten minutes without leak or evidence of distress after the tank has been calked tight.

When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

24. *Tests of Safety Valves.*—Safety valves shall be tested and, if necessary, adjusted at intervals of not over two years, those on new cars to be tested and adjusted before the cars are placed in service.

The test may be made without the removal of the valve from the car, provided the valve unseats at a total pressure corresponding with the area of the seat multiplied by the required pressure as in Fig. 276 on page 246.

When valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

INSPECTION.

25. *Inspection.*—Tank cars shall be inspected as to their construction and equipment before being placed in service, by inspectors in the employ of the car builder or the car owner.

The car builder shall furnish to the car owner and to the Chief Inspector, Bureau of Explosives, before the car is placed in service, a certificate in the form given on page 258, that such car complies in all details with the requirements of the American Railway Association Standard Specification for Class III Tank Car, which are in effect.

When the car and its equipment meet the requirements of the Specifications, the legend "A. R. A. Spec. III," with the initials of the party whose inspectors made the inspection, and the date of the inspection, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Class IV Tank Car

(Built after May 1, 1917.)

Designs for this class of car shall be submitted to and approved by the American Railway Association.

NOTE.—The requirements of the Specification for Class IV Tank Car as to Safety Valves, Tests of Safety Valves and Tanks, and Marking (when cars are repainted) shall apply also to insulated tank cars built under "Specification for Special Tank Car for Carrying Volatile Inflammable Products with a Vapor Pressure of Over Ten Pounds Per Square Inch at a Temperature of 100° F.," adopted by the Master Car Builders' Association in 1912, which the Class IV Specification supersedes.

TANKS.

1. *Bursting Pressure.*—The calculated bursting pressure, based on the lowest tensile strength of the plate or casting and the efficiency of the seam or attachment, shall be not less than 300 lb. per sq. in.

2. *Material.*—(a) All plates for tank and dome shall be of steel complying with the American Society for Testing Materials Specifications for Boiler Plate Steel, Flange Quality.

(b) Rivets shall comply with the American Railway Association Specifications for Boiler Rivet Steel and Rivets for Passenger and Freight Equipment Cars.

(c) Minimum thicknesses (thickness at rivet seam) of plates shall be as follows:

Diameter of Tanks	Bottom Sheet	Shell Sheet	Dome Sheet	Tank Heads	Dome Heads
60 in. or under.....	7/16 in.	1/4 in.	5/16 in.	1/2 in.	5/8 in.
Over 60 in. to 78 in..	7/16 in.	5/16 in.	5/16 in.	1/2 in.	5/8 in.
Over 78 in. to 96 in..	1/2 in.	3/8 in.	5/16 in.	1/2 in.	5/8 in.

For tanks without underframes the minimum thickness of bottom sheet shall be 5/8 in.

For tanks built in rings the thickness specified for bottom sheet shall apply to the entire cylindrical shell.

For car with underframe the minimum width of bottom sheet of tank shall be 60 in., but in all cases the width shall be sufficient to bring the entire width of the longitudinal seam, including overlaps, above the cradle.

3. *Riveting.*—(a) All seams shall be double riveted, with the exception of the dome head seam, which may be single riveted.

Seams shall be riveted metal to metal, without the interposition of other material.

(b) For double riveting the size and pitch of rivets shall be as follows:

Thickness of Plate	Diameter of Rivet	Longitudinal Pitch	Back Pitch
1/4 in.	5/8 in.	2 1/2 to 2 3/4 in.	1 1/2 to 1 3/4 in.
	5/8 in.	2 1/2 to 2 3/4 in.	
7/16 in.	3/4 in.	See Note	1 1/2 to 1 3/4 in.
3/8 in.	3/4 in.	2 3/4 to 3 in.	1 3/4 to 2 in.

Note.—For longitudinal seams with 3/4-in. rivets, 2 3/4-in. longitudinal pitch is necessary to insure 70 per cent strength of seam.

The efficiency of the seam shall be not less than 70 per cent of the strength of the thinnest plate.

For single riveting the size and pitch of rivets shall be as follows:

Thickness of Plate	Diameter of Rivet	Pitch
7/16 in.	5/8 in.	1 3/4 to 2 in.
3/8 in.	3/4 in.	1 7/8 to 2 1/8 in.

(c) The extreme calking edge distance, measured from center line of rivet hole, shall not be less than one and one-half times the diameter of the hole, and not more than one and one-half times the diameter of the hole plus 1/4 in.

The angle of the calking edges shall be between 60 and 70 degrees with the flat surface of the plate.

4. *Calking.*—Seams shall be calked both inside and outside. The purpose of the inside calking is to prevent access of contents of tank to the seams. Calking may be done by the electric welding process.

Split calking shall not be permitted.

5. *Tank Heads.*—Tank heads shall be dished to a radius of 10 ft., for pressure on concave side.

In the case of compartment cars each compartment shall have two heads, convex outward.

6. *Dome.*—(a) The tank shall have a dome with a minimum capacity, measured from the inside top of shell of tank to the top of dome, of not less than 2 per cent of the total capacity of the tank, that is, the shell and dome capacity combined.

(b) Dome head shall be of steel plate, or the dome head and ring in one casting may be of cast steel.

Dome ring and cover shall be of cast or pressed steel or of malleable iron.

If of steel plate, dome head shall be dished to a radius of 8 ft.

The opening in shell for dome shall not exceed 22 by 28 in.

(c) For cars built after July 1, 1922, the dome cover, if external, shall be secured by bolts; or if internal, by yoke and screw.

The joint of the dome cover shall be made tight against vapor pressure, and when necessary to secure this a satisfactory gasket shall be used.

For cars to be used for the transportation of inflammable liquids with flash points below 20° F. the mechanical arrangement for closing the dome cover shall either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure or suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided. The method used to be approved by the American Railway Association.

7. *Bottom Outlet Valve.*—If tank is provided with bottom outlet:

(a) The valve shall preferably be designed to embody the features outlined on page 258.

(b) The outlet valve casting shall be so designed that breakage will not unseat the valve, the preferable construction being to cut (not cast) a "V" groove in the upper part of the casting at a point immediately below any part of the valve, to a depth that will leave the thickness of the casting at the root of the "V" not over 3/8 in. as shown in Fig. 269 on page 241.

(c) The bottom of the main portion of the outlet valve casting, or some fixed attachment thereto, shall have external "V" threads 5 1/4 in. in diameter, and a pitch of four threads to the inch.

Where a 6-in. bottom outlet valve is fused, the bottom outlet valve casting shall be designed to have a diameter of 8 in. over threads, and a pitch of four threads to the inch, in addition to connections as shown in Fig. 269.

Effective July 1, 1922, in the case of new cars and replacements on existing cars, the bottom outlet pipe when applied to tanks of cars with center sills shall not project below the bottom line of sills more than the threaded length necessary to permit the application and removal of the bottom outlet cap.

All outlet valve casting caps and attachments shall be secured to the car to prevent loss.

No nipples, valves, or other attachments shall project below the bottom outlet cap except while car is being unloaded.

(e) Where the tank is anchored rigidly to the underframe there shall be a longitudinal clearance of not less than 3 in. on each side of the bottom outlet valve casting. Where the anchorage used provides for a limited longitudinal movement of the tank, there shall be a clearance of not less than 3 in. on each side of the bottom outlet valve casting when the tank has reached the limit of longitudinal movement provided for by such anchorage. There shall be a transverse clearance of not less than 1/2 in. on each side of the bottom outlet valve casting.

(f) If bottom outlet valve is used, it is preferred that the handle shall be within the tank or dome, but in the event that the rod is carried through the dome, leaking shall be prevented by packing and cap nut.

7-A. *Lagging.*—The barrel, ends and dome of tank, with the exception of the seating of the tank on the bolster and the seating of the pads of the fixtures, shall be lagged with 85 per cent carbonate of magnesia; or compressed cork board properly molded to fit; or hair felt, felted in sections and covered with a coating not soluble in gasoline; or other approved equivalent. The lagging shall have a thickness of 2 in., and the whole shall be covered with a jacket of metal 1/8 in. in thickness. Tank shall be well painted before being lagged and inside of jacket shall be painted before it is applied, with paint not affected by gasoline. Openings through the lagging shall be flashed around projections to prevent admission of water.

7-B. *Plugs for Openings.*—Where plugs are used in the heads or other parts of new tank cars, or as replacements in case of existing cars, they shall be solid, of a good grade of gray cast iron, standard pipe thread and taper, and of a length which will screw at least six threads inside the face of fitting or tank.

Underframe, Anchorage, Etc.

8. Tank cars may be built either with or without underframes.

9. *Cars with Underframes.—Material.* (a) Under-

frames shall be of steel which complies with the American Railway Association Specifications for Structural Steel, Steel Plate and Steel Sheets for Freight Equipment Cars.

(b) Rivets shall comply with the American Railway Association Specifications for Rivet Steel and Rivets for Passenger and Freight Equipment Cars.

(c) Underframes shall be equipped with cast or forged steel center plates. Malleable iron may be used for other details, such as striking plates, draft lugs, side bearings, push-pole pockets, etc. Steel and malleable iron castings shall comply with the American Railway Association specifications for these materials.

9-A. *Center Sills.*—The center sill construction shall meet the following requirements:

Minimum center sill area between points of impact, 30 sq. in.

Ratio, stress to end load, not more than 0.05.

Length of center or draft sill members between braces shall not be more than twenty times the depth of the member, measured in the direction in which buckling may take place as in Fig. 278 on page 250.

Continuous sills having cover plates are preferable.

If other construction is used, the effective cross-sectional area, including connections, must be at least as strong as continuous sills.

9-B. *Draft Attachments.*—The strength value of the draft attachments and the center sill construction shall be equivalent to at least 12½ sq. in. of steel in tension and compression, 8 sq. in. of rivet bearing area, and 15 sq. in. in shear. The ratio of unit stress to end load shall not exceed 0.12.

NOTE.—Until the A. R. A. Standards for coupler yoke and coupler key are changed to conform to the requirements of Section 9-B, the present A. R. A. Standards for coupler yoke and coupler key will be accepted as a minimum.

(See Master Car Builders' Association Recommended Practice for Center Sills for New Cars. Also report of Committee on Car Construction, page 389, 1914 Proceedings.)

10. *Cars without Underframes.*—Cars without underframes shall have shell reinforced in thickness as provided for in Sec. 2 (c).

11. *Body Bolsters.*—Body bolsters shall be of steel castings or of the built-up type, thoroughly substantial, and sufficient in strength to take at least one-half the total weight of loaded tank car on each side bearing.

12. *Draft Gear.*—Cars shall be equipped with a draft gear having a minimum capacity of 150,000 lb.

13. *Anchorage.*—(a) *Longitudinal.* The tank shall be secured against end shifting by anchorage at the center, or at the bolster, or be secured to the underframe by some means other than by the use of head blocks. The method of anchorage shall be one approved by the American Railway Association.

The longitudinal anchorage of tank to underframe shall be of metal throughout, and the minimum requirements shall be as follows:

Connection of anchorage to tank:

Shearing area of rivets	30 sq. in.
Bearing area of rivets	24 sq. in

Connection of anchorage to underframe:

Shearing area of rivets or bolts	15 sq. in.
Bearing area of rivets or bolts	12 sq. in

When bolts are used for securing the anchorage rigidly to the underframe, they shall be turned bolts and be driven in reamed holes. When, because of the construction, bolts can not be inserted from the top so that the nuts will be on the bottom, nut locks shall be applied to both bolts and nuts, or rivets shall be used.

Where either tank or underframe has more than one connection, if these connections hold the tank rigidly to the underframe, the total rivet or bolt value shall be 20 per cent in excess of the requirements specified; if the connections do not hold the tank rigidly to the underframe, the total rivet or bolt value shall be double that specified.

(b) *Dome Yokes, Tank Bands, Etc.*—The tank shall be secured from turning on the underframe either by an anchorage or by dome yokes, and shall also be secured to underframe by tank bands, or other approved means of equal strength and security.

If tank bands are used, there shall be two for tanks not more than 78 in. in diameter, and four for tanks of greater diameter.

The sectional area of tank bands shall at no place be less than 1 sq. in. A threaded end 1⅜ in. in diameter or more, with a body consisting of a flat band 2 by ½ in., or equivalent section, or round iron 1⅛ in. in diameter, will be accepted as meeting this requirement.

If the dome yoke is used, it may be a rod 1 in. in diameter, or its equivalent, to which are secured the bands which are fastened to the underframe. The sectional area of dome yoke bands shall be the same as required for tank bands.

Cars having no underframes, with tanks securely riveted to body bolsters, do not require dome yokes or tank bands.

14. *Push-pole Pockets.*—There shall be a push-pole pocket at each corner of the car. Where, from the construction of the car, the push-pole pockets can not well be placed on the corners of the underframe, they shall be applied to the body bolsters.

15. *Couplers.*—A. R. A. Standards and Recommended Practice, as is the case of other classes of freight equipment cars.

16. *Brakes.*—A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

Adjustment of hand brake power shall comply with A. R. A. Circular S III No. 11, May 15, 1919, from the General Committee as in Fig. 280 on page 258.

17. *Trucks.*—The truck as a whole shall be equal in strength to the carrying capacity of axles. Wheels, axles, journal boxes, bearings, center plates, etc., shall be in accordance with A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

18. *Marking.*—A. R. A. Standard Marking for Freight Cars.

18-A. *Placard Boards.*—Cars shall be equipped with suitable boards for attaching placards prescribed by the Interstate Commerce Commission. These boards shall be of sufficient size to permit placards to be applied with the opposite points of the diamond in vertical and horizontal position, respectively.

19. *Safety Appliances.*—Safety appliances shall be in accordance with American Railway Association specifications therewith which conform to the United States Safety Appliances Standard.

SAFETY VALVES AND SAFETY VENTS.

20. *Safety Valves.*—(a) Tanks shall be equipped with 5-in. safety vales of approved design as shown in Fig. 279 on page 252, which shall be set to open at a pressure of 25 lb. per sq. in., a tolerance of 3 lb. above or below this pressure being allowed.

(b) One valve shall be provided for a tank of a capacity of 6,500 gal. or less, with a tolerance of not over 150 gal. to take care of variations due to workmanship in construction, and two valves for a tank of a capacity of more than 6,500 gal. plus the tolerance.

Where tanks are divided into compartments, each compartment shall be provided with a safety valve.

21. *Safety Vent.*—Not used with this class of car.

TESTS.

22. *Certification of Tests.*—Tests of all tanks and their safety valves shall be certified by the party making the tests to the owner of the tank car and to the Chief Inspector, Bureau of Explosives, in the form prescribed by the Bureau.

23. *Tests of Tanks.*—Tanks shall be tested before being put into service, and after that at intervals of not over five years.

Any tank damaged to the extent of requiring patching or renewal of one or more sheets, or extensive reriveting or recalking of seams, shall be retested before being returned to service.

Tanks shall be tested to a pressure of 75 lb. per sq. in.

All tests shall be made by completely filling the tank with water of a temperature which shall not exceed 70° F. during the test, and applying the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than ten minutes without leak or evidence of distress after the tank has been calked tight.

When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

24. *Tests of Safety Valves.*—Safety valves shall be tested and, if necessary, adjusted at intervals of not over one year, those on new cars to be tested and adjusted before the cars are placed in service.

The test may be made without the removal of the valve from the car, provided the valve unseats at a total pressure corresponding with the area of the seat multiplied by the required pressure as in Fig. 276 on page 246.

When valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

INSPECTION.

25. *Inspection.*—Tank cars shall be inspected as to their construction and equipment before being placed in service, by inspectors in the employ of the car builder or the car owner.

The car builder shall furnish to the car owner and to the Chief Inspector, Bureau of Explosives, before the car is placed in service, a certificate in the form given on page 47, that such car complies in all details with the requirements of the American Railway Association Standard Specification for Class IV Tank Car.

When the car and its equipment meet the requirements of the Specifications, the legend "A. R. A. Spec. IV," with the initials of the party whose inspectors made the inspection, and the date of the inspection, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Class V Tank Car

(Effective January 1, 1918.)

Designs for this class of car, including details, the approval of which is specifically required, shall be submitted to and approved by the American Railway Association.

NOTE.—The requirements of the Specification for Class V Tank Car as to pressure at which safety valves shall be set to open, Tests of Safety Valves and Tanks, and Marking (when cars are repainted), shall apply also to insulated tank cars built under "Specifications for Special Tank Cars for Transportation of Liquefied Chlorine Gas (also Sulphur Dioxide)," adopted by the Master Car Builders' Association in 1912, which the Class V Specification supersedes.

TANK.

NOTE.—It is so vitally important, because of the character of the commodities to be shipped in these cars, that the tank shall be absolutely tight, that riveted tanks will not be permitted, and all seams shall be welded.

1. *Bursting Pressure.*—The calculated bursting pressure, based on the lowest tensile strength of the plate, shall be not less than 960 lb. per sq. in.

2. *Material.*—(a) All plates for tank, and for dome if dome is made of plate, shall be of steel complying with the American Society for Testing Materials Specifications for Steel Plates for Forge Welding. For the purpose of welding, the lowest carbon content consistent with the strength prescribed for this quality is desired.

(b) Minimum thicknesses of plates shall be as follows:

Diameter of Tank	Shell Sheet	Tank Heads	Dome Sheet (if plate)
60 in. or under.....	¾ in.	¾ in.	¾ in.

3. *Welding.*—All seams, including longitudinal, circumferential and dome seams, and the connection of the anchorage to the shell, shall be welded by the water-gas process, hammered or rolled, the seams to be annealed after welding, or such other welding process as may be approved.

4. *Calking.*—No calking shall be permitted.

5. *Tank Heads.*—Tank heads shall be dished to a radius of not over 5 ft., for pressure on the concave side.

6. *Dome.*—(a) The coefficients of expansion of the products for the transportation of which this class of car is required are such that it is not practicable to provide dome capacity sufficient to take care of their expansion, which must be allowed for in the tank.

Therefore, the inside diameter of the dome should not be greater than is necessary to permit access to the tank, and the proper arrangement of the inlet, outlet and safety valves. The inside height of the dome need not exceed the thickness of the insulation.

(b) Dome shell and dome head or cover shall be of steel plate or steel casting.

(c) Dome cover shall be secured by through bolts or studs. The joint of the dome cover shall be of approved form, tight against vapor pressure, and when necessary to secure this a satisfactory gasket shall be used.

7. *Inlet and Outlet Valves.*—(a) These valves shall be of the flange type, and shall be made of material not subject to destruction by the lading.

(b) The valves shall be directly bolted to seatings on the dome cover, and shall be protected from accidental injury by a cast-steel housing.

(c) Provision shall be made for plugging the pipe connections of the valves.

(d) The designs of the valves, their arrangement in the dome head, and the design of the housing shall be submitted for approval.

(e) There shall be no inlet or outlet connections other than those on the dome head covered by the housing; but for cleaning purposes one bottom opening closed by a plug screwed from within will be permitted.

7-A. *Lagging.*—The tank must be completely lagged with compressed cork board, molded to fit, or other approved equivalent. The lagging shall have a thickness of not less than 4 in., and the whole shall be covered with a jacket of metal ⅛ in. in thickness. Tank shall be well painted before being lagged and inside of jacket shall be painted before being applied.

UNDERFRAME, ANCHORAGE, ETC.

8. Tank cars shall be built with underframe.

9. *Underframe. Material.*—(a) Underframes shall be of steel which complies with the American Railway Association Specifications for Structural Steel, Steel Plate and Steel Sheets for Freight Equipment Cars.

(b) Rivets shall comply with the American Railway Association Specifications for Rivet Steel and Rivets for Passenger and Freight Equipment Cars.

(c) Underframes shall be equipped with cast or forged steel center plates. Malleable iron may be used for other details, such as striking plates, draft lugs, side bearings, push-pole pockets, etc. Steel and malleable iron castings shall comply with the American Railway Association Specifications for these materials.

9-A. *Center Sills.*—The center sill construction shall meet the following requirements: Minimum center sill area between points of impact, 30 sq. in.

Ratio, stress to end load, not more than 0.05.

Length of center or draft sill members between braces shall not be more than twenty times the depth of the member, measured in the direction in which buckling may take place as shown in Fig. 278 on page 250.

Continuous sills having cover plates are preferable.

If other construction is used, the effective cross-sectional area, including connections, must be at least as strong as continuous sills.

9-B. *Draft Attachments.*—The strength value of the draft attachments and the center sill construction shall be equivalent to at least 12½ sq. in. of steel in tension and compression, 8 sq. in. of rivet bearing area, and 15 sq. in. in shear. The ratio of unit stress to end load shall not exceed 0.12.

NOTE.—Until the A. R. A. Standards for coupler yoke and coupler key are changed to conform to the requirements of Section 9-B, the present A. R. A. Standards for coupler yoke and coupler key will be accepted as a minimum.

(See Master Car Builders' Association Recommended Practice for Center Sills for New Cars, and Report of Committee on Car Construction, page 389, 1914 Proceedings.)

10. *Cars without Underframes.*—Shall not be permitted.

11. *Body Bolsters.*—Body bolsters shall be of steel castings or of the built-up type, thoroughly substantial, and sufficient in strength to take at least one-half the total weight of loaded tank on each side bearing.

12. *Draft Gear.*—Cars shall be equipped with a draft gear having a minimum capacity of 150,000 lb.

13. *Anchorage.*—(a) *Longitudinal.* The tank shall be secured against end shifting by anchorage at the center, or at the bolster, or be secured to the underframe by some means other than by the use of head blocks. The method of anchorage shall be one approved by the American Railway Association.

The longitudinal anchorage of tank to underframe shall be of metal throughout, and the minimum requirements shall be as follows:

Connection of anchorage to underframe:

Shearing area of rivets or bolts.....15 sq. in.
Bearing area of rivets or bolts.....12 sq. in.

When bolts are used for securing the anchorage rigidly to the underframe, they shall be turned bolts and be driven in reamed holes.

When, because of the construction, bolts can not be inserted from the top so that the nuts will be on the bottom, nut locks shall be applied to both bolts and nuts, or rivets shall be used.

Where either tank or underframe has more than one connection, if these connections hold the tank rigidly to the underframe, the total rivet or bolt value shall be 20 per cent in excess of the requirements specified; if the connections do not hold the tank rigidly to the underframe, the total rivet or bolt value shall be double that specified.

(b) *Dome Yokes, Tank Bands, Etc.* The tank shall be secured from turning on the underframe, either by an anchorage or by dome yokes, and shall also be secured to underframe by tank bands or other approved means of equa strength and security.

If tank bands are used, there shall be two for tanks no more than 78 in. in diameter.

The sectional area of tank bands shall at no place be les than 1 sq. in. A threaded end 1⅜ in. in diameter or more with a body consisting of a flat band 2 by ½ in., or equivalent section, or round iron 1⅛ in. in diameter, will b accepted as meeting this requirement.

If the dome yoke is used, it may be a rod 1 in. i diameter, or its equivalent, to which are secured the band which are fastened to the underframe. The sectional area of dome yoke bands shall be the same as required for tank bands.

14. *Push-pole Pockets.*—There shall be a push-pole pocket at each corner of the car. Where, from the construction of the car, the push-pole pockets can not well be placed on the corners of the underframe, they shall be applied to the body bolsters.

15. *Couplers.*—A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

16. *Brakes.*—A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

Adjustment of hand brake power shall comply with A. R. A. Circular S III No. 11, May 15, 1919, from the General Committee.

17. *Trucks.*—The truck as a whole shall be equal in strength to the carrying capacity of the axles. Wheels, axles, journal boxes, bearings, center plates, etc., shall be in accordance with A. R. A. Standards and Recommended Practice, as in the case of other classes of freight equipment cars.

NOTE.—The amendment of Section 16, Brakes, in each specification, does not in any way affect the requirement in the second paragraph of this section that:

Adjustment of hand brake power shall comply with A. R. A. circular No. S III-11, May 15, 1919, from the General Committee.

The effective date for the adjustment of brake power on existing cars was extended one year by Circular No. S III-196, vi., to July 1, 1922.

18. *Marking.*—American Railway Association Standard Marking for Freight Cars with the additional marking, "Chlorine Gas (or Sulphur Dioxide, as the case may be) Tank Car—Tank and Valve Must Be Tested Every Two Years," on each side of tank below dome.

18-A. *Placard Boards.*—Cars shall be equipped with suitable boards for attaching placards prescribed by the Interstate Commerce Commission. These boards shall be of sufficient size to permit placards to be applied with the opposite points of the diamond in vertical and horizontal positions, respectively.

19. *Safety Appliances.*—Safety appliances shall be in accordance with American Railway Association specifications therewith, which conform to the United States Safety Appliances, Standard.

Fastenings for safety appliances must not be screwed or riveted to the shell of tank; they shall be either welded to the tank or secured to pads on the jacket or to suitable tank bands.

SAFETY VALVES AND SAFETY VENTS.

20. *Safety Valve.*—(a) Tank shall be equipped with one safety valve, which shall be set to open at a pressure of 200 lb. per sq. in., a tolerance of 5 lb. above or below this pressure being allowed.

(b) Valve shall preferably be of the flanged type, and made of material not subject to destruction by the lading.

(c) The valve shall be directly bolted to seating on the

dome cover, and shall be protected from accidental injury by the cast-steel housing prescribed in Section 7.

(d) The design of valve and its arrangement in the dome head shall be submitted for approval.

21. *Safety Vent.*—Not used with this class of car.

Tests.

22. *Certification of Tests.*—Tests of tanks and their safety valves shall be certified by the party making the tests to the owner of the tank car and to the Chief Inspector, Bureau of Explosives, in the form prescribed by the Bureau.

23. *Tests of Tanks.*—Tanks shall be tested before being put into service, and after that at intervals of not over two years.

Any tank damaged to the extent of requiring patching or renewal of one or more sheets, shall be retested before being returned to service.

Tanks shall be tested to a pressure of 300 lbs. per sq. in.

All tests shall be made by completely filling the tank with water, or other approved liquid safe to use, of a temperature which shall not exceed 70° F. during the test, and applying the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than thirty minutes without any leak whatever. Calking to stop leaks developed during the test will not be permitted.

When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

24. *Tests of Safety Valves.*—Safety valves shall be tested and, if necessary, adjusted at intervals of not over two years, those on new cars to be tested and adjusted before the cars are placed in service.

When valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Inspection.

25. *Inspection.*—Tank cars shall be inspected as to their construction and equipment before being placed in service, by inspectors in the employ of the car builder or the car owner.

The car builder shall furnish to the car owner and to the Chief Inspector, Bureau of Explosives, before the car is placed in service, a certificate in the form given on page 47, that such car complies in all details with the requirements of the American Railway Association Standard Specification for Class V Tank Car.

When the car and its equipment meet the requirements of the specification, the legend "A. R. A. Spec. V," with the initials of the party whose inspectors made the inspection, and the date of the inspection, shall be stenciled on the tank in accordance with the American Railway Association Standard Marking for Freight Cars.

Method of Testing Safety Valves in Place on Car.

In testing safety valves with the device shown by Fig. 276 on page 246, the tripod is set on the rim of the valve and the forging at lower end of spring balance is slipped under the knob of the valve, on valves equipped with knobs, or the hook at lower end of spring balance is attached to eyelet of valve, on valves so equipped, by inserting hook through eyelet. The spring balance is graduated in ten (10) lb. readings. The pressure is applied by operating screw at top of device.

The Normal Scale Readings correspond to the pressure at which the valve when properly set will open. The Minimum and Maximum Scale Readings are the limits within which the valves must open when being tested to come within the tolerance of 1 lb. for the 12-lb. setting and 3 lb. for the 25-lb. setting above or below the normal pressure per sq. in. at which the valve is supposed to open. Example:

A valve set to open at 12 lb. pressure per sq. in. should open when the scale reads 235 lb. (Normal), and does not require adjustment if it opens between the scale readings of 215 lb. (Minimum) and 255 lb. (Maximum). Any valve which, when tested, fails to open between the Minimum and Maximum Scale Readings for the 12 and 25 lb. pressure, according to the lb. pressure at which the valve is set, must be adjusted to the Normal Scale Reading.

Scale Reading in Pounds for Valves Set to Open at 12 and 25 Lb. Pressure per Sq. In.

Valve Setting Lb. Per Sq. In	Lb. Pressure Per Sq. In. Scale Readings in Lb. Normal	Minimum	Maximum
12	235	215	255
25	490	430	550

Spring balances are to be tested once every six months to prove the accuracy of the scales.

Circular S III—No. 11

Adjustment of Brake Power on Tank Cars

The question is raised as to whether the hand brake power on tank cars shall be 70 per cent of the light weight of the car as specified in Circular No. 22 of December 20, 1917, or 60 per cent as referred to in Circular No. 29 of March 20, 1918.

The recommended practice of the Association provides that the minimum air brake power for freight equipment should be 60 per cent of the light weight of the car, based on a cylinder pressure of 50 lb. per sq. in.

An 8-in. brake cylinder has a value of practically 2500 lb. at 50-lb. pressure and the value of a 10-in. cylinder at 50-lb. pressure is—for all practical purposes—3950 lb., and all parties concerned should use these cylinder values as a basis in proportioning the levers in the air brake system for the percentage of braking power recommended for the air brake.

Adjustment of Hand Brake Power.

With the body and truck levers properly proportioned for 60 per cent braking power, as specified in the foregoing, and based on the formulæ and diagrams shown herein, the hand brake wheel or hand brake ratchet lever, brake staff at chain, and the hand brake leverage between brake staff and cylinder, shall be so proportioned that a force of 125 lb. at the rim of the brake wheel or three inches from outer end of hand brake ratchet lever will develop an equivalent load "W" at the brake cylinder piston of not less than 2500 lb. and 3950 lb. respectively for cars having 8-in. and 10-in. cylinders. This will insure a minimum hand brake power at the shoes of 60 per cent of the empty car weight.

Note.—Maximum pull on $\frac{7}{8}$ in. brake chain shall not exceed one-half proof load or 2,400 lb.

A single sheave wheel applied to end of hand brake rod should be treated as 2-to-1 lever in figuring the hand brake power.

When equipped with a hand brake ratchet lever in place of the hand brake wheel, the length of the hand brake ratchet lever should be not less than 20 inches from the center of the brake staff to the end of the hand brake ratchet lever.

All new equipment built after July 1, 1919, shall have the brake power adjusted in accordance with the foregoing.

By July 1, 1921, existing cars not conforming to this standard should have the brake hand lever changed.

This circular supersedes Circulars Nos. 22, 25 and 29,

dated respectively December 20, 1917, January 24 and March 20, 1918.

Fig. 280 shows the adjustment of brake power on tank cars.

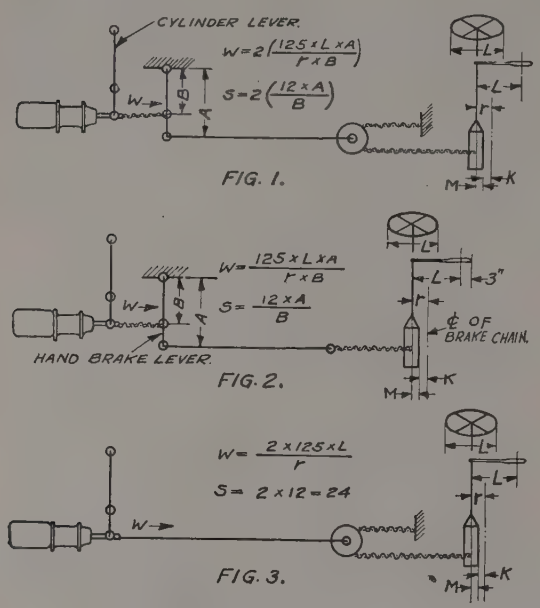


FIG. 280—ADJUSTMENT OF BRAKE POWER ON TANK CARS

W = Equivalent pull in lb. at Brake Cylinder Piston Rod.
125 = Assumed lb. pull on rim of Brake Wheel, or on Hand Brake Lever 3 in. from outer end.
L, r, A, & B. = Dimensions in inches.
r = M + K.
M = Radius in inches, of Brake Staff Drum.
K = Distance, in inches, from face of Brake Staff Drum center line of Brake Chain. For 1/16-in. Brake Chain. K = ½ in.
S = Minimum chain slack, in inches, to be taken up on Brake Staff.
12 = Piston travel in inches.
Note:—Dimension B not to be less than 11 in.

Certificate of Construction*

OF

CLASS..... TANK CARS.

It is hereby certified that.....(Number)..... Tank Cars, numbered..... built by.....(Name of builder)..... at.....(Location of works)....., and completed .....(Date).....for.....(Name of buyer) .....were designed by said builder and conform in factors of strength, materials (see Note) and workmanship, and in all features of construction, equipment and marking to the requirements of the American Railway Association Specifications for Tank Cars, Class....., Revised 1920, and amendments thereto; that the tanks and safety valves (if tanks are equipped with safety valves) have been tested and test certified to the car owner and to the Bureau of Explosives, as required by said specifications, and that the capacity, principal dimensions and equipment of each car as follows:

Capacity: Tank, ...gallons; dome, ... gallons.
Length over striking plates, ...
Extreme width. ..... Extreme height. .....
Distance, center to center of trucks, ...
Has type of anchorage to underframe been approved by American Railway Association?
Tank, inside diameter, ...
Tank length, center to center of outer row of head rivets, ...
Equipment:

(a) Safety Valve: .....(Number).....; located on { side / top } of dome, and set to open at pressure of.....lb. per sq. in.

(b) Safety Vent: .....(Number).....; size of opening, ...

(c) Provision for automatically venting internal pressure upon starting to remove dome cover, as shown by Fig. 1 of specifications, ...

Class { IV / V } Car: Have all features of car been approved by American Railway Association?.....

Signature: .....(Name of Builder)..... .....(By) ....(Title) .....

.....(Place)....., ...(Date)....., 19.....

NOTE.—Builder must furnish certificate that materials comply as to chemical analysis and physical qualities with the requirements of the specifications prescribed for them.

*One copy of this certificate to be sent to Chief Inspector, Bureau of Explosives, 30 Vesey street, New York city, and one copy to car owner.

Features of Bottom Outlet Valve

The experiences gained in tank car operation have indicated certain features which are desirable. These are offered as a general guide in designing such valves but are not requirements of the specifications. They are as follows:

1. The valve seat should be independent of the outlet chamber so that if the outlet chamber flange is accidentally torn off the tank the contents of the tank will not escape.
2. The construction should be such that the tank may be completely emptied through the valve.
3. In order that the valve may not lift from its seat, in the event of an accident separating the discharge chamber from the shell, the valve should have no wings or stem projecting below the bottom of the tank.
4. The valve must remain seated under vapor and liquid pressure within the tank.
5. The valve chamber or valve should not distort because of the changing contour of the shell due to lading, expansion or other usual causes.
6. The valve should not tighten on its seat under the vibratory action of the stem.
7. The design should be such as not to create a tendency to lock or wedge the valve on its seat.
8. It should not be possible to displace the valve on its seat because of the movement of the car, vibration of the tank or the effect of the movement of the liquid contents of the tank.
9. The design should not permit side-lifting of the valve because of uneven spring tension.
10. The design should not permit displacement of the valve through pressure from below.
11. The valve should operate from the interior of the tank; but, in the event the rod is carried through the dome, leaking shall be prevented by packing in stuffing box and cap nut.
12. The valve operating gear must have means of compensating for variations in the vertical diameter of the tank produced by expansion, weight of the liquid contents or other usual causes.
13. The valve and seat should be so designed as to permit expansion of freezing liquids.
14. The valve and seat should be readily removable for repairs, including grinding.

15. It is desirable that the design of valve operating mechanism shall be such that the dome cover can not be applied until the valve is closed.

Heater Pipes

After consultation with the American Petroleum Institute the following is recommended as part of the Tank Car Specifications:

Heating systems in new tank cars and new installations in existing tank cars shall comply with the following general principles:

1. Heater pipes and fittings shall be not less than 2 in. extra heavy, and shall be secured so as to permit the necessary expansion and contraction and to provide for self drainage.

2. Cast iron, malleable iron, or cast steel return bends shall not be used, return bends may be forged or made by bending the pipe and using threaded sleeve couplings, forged unions, or welded joints. A minimum number of connections shall be used.

3. Single or multiple heater systems may be installed—the latter is preferable.

4. The steam inlet preferably should be through the top of tank or through the dome; the outlet may be either in the end or through the bottom of the tank; but both shall be safeguarded by an approved form of cock, cap, or plug. Where the discharge is through the bottom of the tank, no part of the pipe shall extend below the bottom of underframe.

Where inlet or outlet pipes pass through the shell of tank, the opening shall be reinforced by suitable pads riveted on inside or outside. The pipe connection preferably shall be expanded or welded, or both, into pad. The outside connection shall not be an integral part of the heater, but shall be secured to the pad by an approved design.

5. On new installations the heater pipes shall be tight at a hydraulic pressure of 200 lbs. per sq. in. The same test shall be applied whenever the tank is retested.

6. In a compartment-tank each compartment shall be treated as a separate tank and comply with the foregoing requirements.

7. Designs of heater systems shall be submitted to the American Railway Association for approval.

Safety Appliances for Tank Cars

All tank cars built after May 1, 1917, or old tanks placed on new steel underframes after that date must be equipped with safety appliances in accordance with the following specifications. The arrangement conforms to the United States Safety Appliances Standard.

End of Car.

Shall be constructed with a platform similar to flat cars. Maximum height of platform from top of rail shall be fifty (50) in.

Hand-Brakes.

Number.—Same as for "Box and Other House Cars."

Dimensions.—Same as for "Box and Other House Cars."

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—Each hand-brake shall be so located that it can be safely operated while car is in motion. The brake-shaft shall be located on end of car to the left of center.

Manner of Application.—Same as specified for "Box and Other House Cars."

Running-boards.

Number.—One continuous running-board around sides and ends. End platform shall form continuation of side running-board.

Dimensions.—Minimum thickness one and three-quarters (1¾) in. Minimum width on sides, ten (10) in.

Location.—Continuous around sides and ends of cars. End platform shall form continuation of side running-board.

Manner of application.—Outside edge of side running-board shall extend not less than seven (7) in. beyond bulge of tank, safety hand-railing and dome ladder. In case of large tanks, where road limits will not permit the clearances specified, the outer edge of running-boards shall extend not less than seven (7) in. beyond bulge of tank and the foot of ladder shall have a clearance of at least seven (7) in. from outer edge of running-board.

Outside edge of end-platform shall extend not less than seven (7) in. beyond bulge of tank-head and safety hand-railing.

Running-boards shall be supported to prevent sagging. Where running-boards are spliced joints must be flush and both ends supported.

Running-boards shall be securely fastened to platform and running-board supports.

Sill Steps.

Number.—Same as specified for "Box and Other House Cars."

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—When located on side sill: Same as specified for "Box and Other House Cars." When located on running-board: One (1) near each end on each side, flush with outside edge of running-board, so that there shall be not more than eighteen (18) in. from end of car to center of tread of sill step. Tread shall be not more than twenty-four (24), preferably not more than twenty-two (22) in. above the top of rail.

Manner of Application.—When located on side sill: Same as specified for "Box and Other House Cars." When located on running-board: Steps exceeding eighteen (18) in. in depth shall have an additional tread and be laterally braced. Sill steps shall be securely fastened with not less than one-half (½) in. bolts with nuts outside (when possible) and riveted over, or with one-half (½) in. rivets.

Side Handholds.

Number.—Eight (8).

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—Four (4) horizontal: One (1) on face of each side sill near each end on tank cars with side sills; or one (1) near each end on each side of car over sill step, on running-board, projecting downward or outward. Clearance of outer end of handhold shall be not more than twelve (12) in. from end of car.

Four (4) vertical: One (1) as near as possible over each sill step, securely fastened to tank or tank band.

Manner of Application.—Same as specified for "Box and Other House Cars."

End Handholes.

Number—Four (4).

Dimensions.—Same as for "Box and Other House Cars."

Location.—Horizontal: One (1) near each side of each end of car on face of end sill; or one (1) near each side on each end of car on platform, projecting downward or outward. Clearance of outer end of handhole shall be not more than sixteen (16) in. from side of car.

Manner of Application.—Same as specified for "Box and Other House Cars."

Safety Railings.

Number.—One (1) continuous running around sides and ends of tank.

Dimensions.—Minimum diameter, seven-eighths (⅞) of an in., wrought iron or steel rod or one and one-quarter (1¼) in. pipe. Minimum clearance, two and one-half (2½) in.

Location.—Running around sides and end of tank, not less than thirty-six (36) nor more than fifty-four (54) in. above platform or running-board.

Manner of Application.—Safety-railings shall be securely fastened to tank or tank bands with a minimum of four brackets for each side of tank and one bracket on head at each end of tank, and secured against end shifting.

Uncoupling Levers.—Same as specified for "Box and Other House Cars."

End Ladder Clearance.—No part of car above end sills within thirty (30) in. from side of car, except buffer block, brake-shaft, brake-shaft brackets, brake wheel, running-boards or uncoupling lever shall extend to within twelve (12) in. of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same, above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

LADDER, DOME PLATFORM, DOME PLATFORM HANDHOLD AND DOME HANDHOLD.

Number.—One (1) ladder, one (1) dome platform, one (1) dome platform handhold and one (1) dome handhold.

Dimensions.—Ladder: Ladder stiles three-eighths by two (⅜ by 2) in. or equivalent, wrought iron or steel.

Ladder treads, minimum diameter, five-eighths (⅝) of an in., wrought iron or steel.

Minimum clear length of tread, fourteen (14) in.

Maximum spacing of treads, nineteen (19) in. Safety railing will be considered a ladder tread.

Minimum clearance of treads and ladder stiles, two (2), preferably two and one-half (2½) in.

Dome Platform.—Minimum width, seven (7) in.; minimum thickness one and three-quarters (1¾) in.

Dome Platform Brackets.—Three-eighths by one and one-half (⅜ by 1½) in., or equivalent, wrought iron or steel.

Dome Platform and Dome Handholds.—Minimum diameter, five-eighths (⅝) of an in., wrought iron or steel.

Minimum clear length, fourteen (14) in., preferably sixteen (16) in.

Minimum clearance, two (2), preferably two and one-half (2½) in.

Location.—On brake mast side of car leading to dome. When car is equipped with more than one dome, the step board shall be lengthened so that all dome covers will be accessible from same; or, ladder, dome platform and handholds provided leading to each dome.

Dome platform handhold to be applied in line with ladder, not more than two (2) in. back from outside edge of platform, projecting downward and outward with horizontal portion of handhold flush with or extending one (1) in. beyond edge of platform. Top ladder rung will be considered dome platform handhold if located within not less than two (2) or more than three (3) in. from bottom of dome platform. Dome handhold to be applied to dome over dome platform in line with ladder.

Manner of Application.—Ladders shall be securely fastened at bottom to running-board with not less than one-half (½) in. bolts with nuts underneath and riveted over, or with not less than one-half (½) in. rivets. Ladders shall be secured at top of safety railing or to underside of dome platform. If fastened to dome platform the stiles shall be secured with not less than one-half (½) in. bolts riveted over nuts, or with one-half (½) in. rivets.

The dome platform shall be supported by wrought iron or steel brackets, which shall be securely fastened to tank or tank bands.

Dome platform handholds same as specified for "Box and Other House Cars."

Dome handholds shall be securely fastened.

NOTE.—In lieu of dome platform specified, any efficient design of platform encircling dome will be acceptable.

Manner of Application of Safety Appliances on Tanks Covered with Jackets.—On tanks covered with jackets, metal pads should be attached to the shell proper with studs or rivets, to which brackets should be fastened for securing the safety appliances attached to the tanks; or, the safety appliances (with the exception of the running-board brackets and dome-platform brackets) may be secured to the jackets reinforced with metal pads at point of attachment, which pads shall extend at least two in. from center line of rivet holes. The running-board brackets shall be attached to the underframe. The dome-platform brackets shall be attached to suitable bands. When the safety appliances are attached to the jacket covering of the tank the jacket shall be tightened so that there will be no danger of its slipping around.

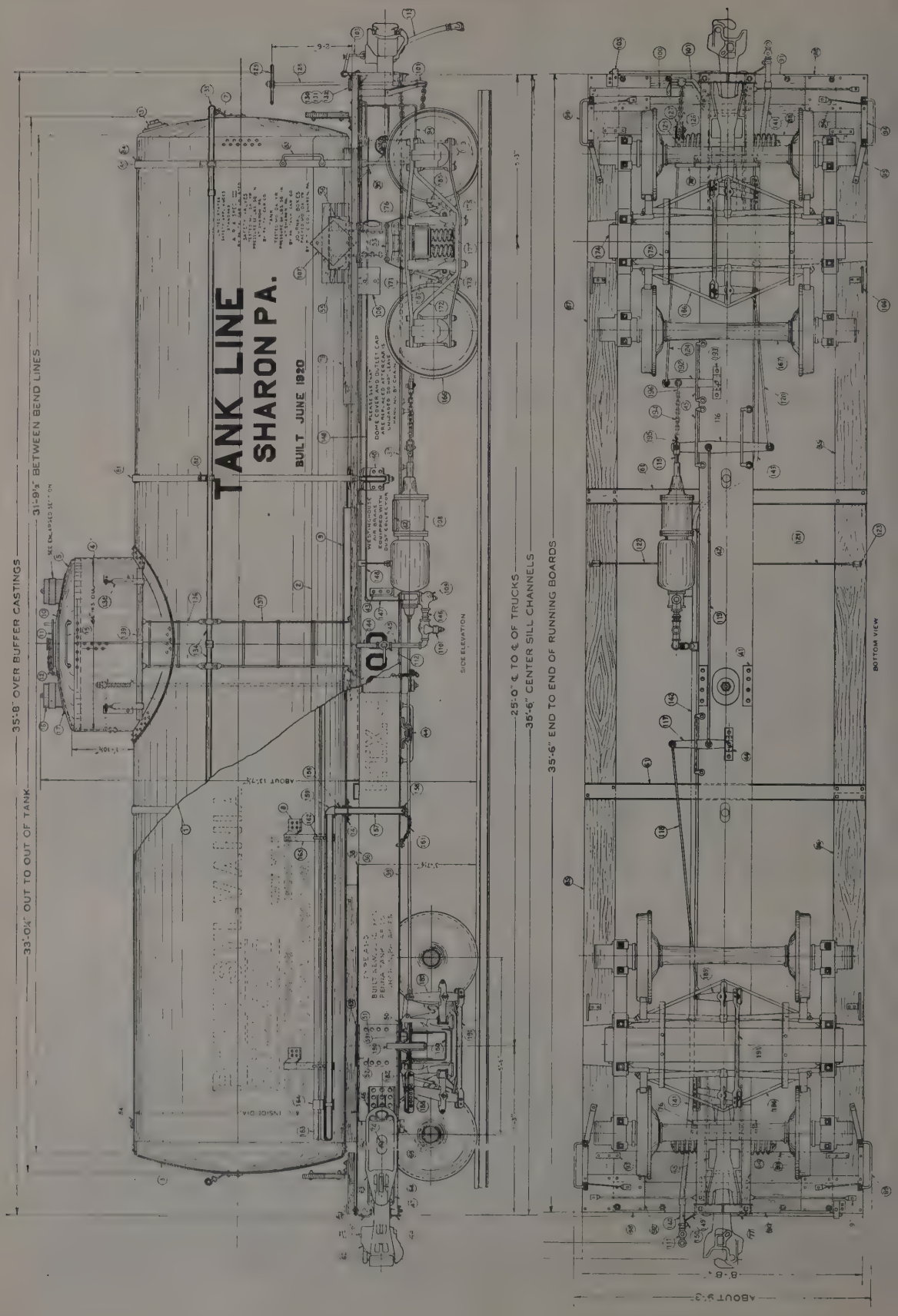
The work of the Committee on Tank Cars will be continued, in an effort to increase the margin of safety in handling explosives and inflammable and volatile products.

Tank cars built in conformity with these specifications, for use on American railways, are fully illustrated and described in pages following.

Fig. 281—Steel Tank Car. Capacity, 10,000 gallons; Weight 44 200 lb. Builder, Chicago Steel Car Company.

Fig. 282—Steel Tank Car. Capacity, 8,000 U. S. Gallons. Builder, Pressed Steel Car Company.

Fig. 283—Steel Tank Car. Capacity, 8,000 lb.; Weight 40,300 lb. Builder, Pennsylvania Tank Car Company.


TANK LINE
SHARON PA.
BUILT JUNE 1920
35'-8" OVER BUFFER CASTINGS
31'-9½" BETWEEN BEND LINES
33'-0¼" OUT TO OUT OF TANK
25'-0" ℄ TO ℄ OF TRUCKS
35'-6" CENTER SILL CHANNELS
35'-6" END TO END OF RUNNING BOARDS
SIDE ELEVATION
BOTTOM VIEW
8'-8"
ABOUT 9'-3"

List of Parts of Tank Car Shown in Figs. 284-285

1 Body Top Sheets
2 Body Bottom Sheet
3 Tank
4 Dome Body Sheet
5 Dome Head
6 Dome Laddler Clips
7 Hand Rail Brackets
8 Coil Support Brackets
9 Center Anchorage
10 Manhole, 15½ in. Dia., Mall. Iron
11 Manhole Cover, Mall. Iron
12 Manhole Cover, Chain and Clip
13 Forged Flange for Tank Head (3 in.)
14 Double Pipe Flange for Bottom Sheet (2 in.)
15 Grab Irons
16 Spring Case
17 Flange
18 Safety Valve
19 Spring
20 Steam
21 Follower
22 Plug
23 Outlet Valve Bracket
24 Lever
25 Spring
26 Rod Collar
27 Rod
28 Rivet, 3 in. Long
29 Outlet Valve
30 Rod Collar Set Screw
31 Rod, Nut (1¼ in. Hex.)
32 Outlet Leg: 4 in. x 22 in.
33 Cap
34 Cap Safety Chain
35 Pipe Plug (2 in.)
36 Center Sill: Channels 15 in. @ 40 lb.
37 Channels 15 in. @ 40 lb.
38 Top Cover Plate ⅜ in. x 20 in.
39 Bottom Cover Plate ⅜ in. x 20 in.
40 Reinforcing Channel 15 in. @ 33 lb.
41 Splice Bars 3½ x ½ in.
42 Cylinder Support
43 Reservoir Support
44 Floating Lever Fulcrum
45 Brake Lever Guides
46 Rear Draft Lugs
47 Front Draft Lugs
48 Tank Band Anchors
49 Top Cover Plate ⅜ in. x 15 in.
50 Bottom Cover Plate ⅜ in. x 20 in.
51 Bolster Web Plates, Pressed Steel
52 Bolster Web Plates, Pressed Steel
53 Bolster End Brace
54 Body Side Bearing, Malleable Iron
55 Tank Support, Malleable Iron
56 Tank Support, Malleable Iron
57 Tank Support Cover Plate
58 Push Pole Pocket, Malleable Iron
59 Body Centre, Plate, Cast Steel
60 Striking Plate, Malleable Iron
61 Intermediate Running Board Support
62 Couplers, A. R. A. Type D, 6 in. x 8 in. Shank, Top Operating
63 Drawbar Yokes, Cast Steel, 18½ in. Pocket
64 Key and Cotter for Coupler and Yoke
65 Cardwell Friction Draft Gear Type G, Class 11-A
76 Rear Carrier Iron and Tank Band Anchor
77 Coupler Carrier Iron
78 Guide for Hand Brake Rod
79 Slabbing, 1 Set A-B-C-D
80 End Tank Bands
81 Intermediate Tank Band
82 Hand Rail Brackets
83 Grab Iron
84 Tank Band Saddle
85, 86, 87, 88 Side Running Boards
89, 90, 91 End Running Boards
92 Running Board Corner Plates
93 Running Board Splice Bars
94 Sill Step
95 Sill Step Side Brace
96 Sill Step End Brace
97 End Running Board Brace
98 End Grab Iron
99 Side Grab Iron
100 End Running Board Brace and Brake Step Support
101 Brake Mast Step, Malleable Iron
102 Uncoupling Rod
103 Uncoupling Rod Hook
104 Uncoupling Rod Bracket
105 Uncoupling Rod Bracket
106 Routing and Defect Card Board and Bracket
107 Inflammable Card Board and Bracket
108 Air Brake Cylinder and Reservoir, Type C—10 in. x 12
109 K-2 Triple Valve
110 Centrifugal Dirt Collector
111 Angle Cock
112 Cut Out Cock
113 A. R. A. Brake Hose
114 Pressure Retaining Valve, Type 15-D
115 Push Rod
116 Cylinder Lever
117 Floating Lever
118, 119, 120 Connecting Rod — Truck Lever, to Floating Lever; Floating Lever to Cylinder Lever; Cylinder Lever to Truck Lever
121 Long Release Rod
122 Short Release Rod
123 Release Rod Bracket
124 Hand Brake: Connecting Rod
125 Connecting Rod Clevis
126 Chain
127 Chain Sheave
128 Mast
129 Wheel
130 Ratchet Pawl
131 Ratchet Plate
132 Ratchet Wheel
133 End Pipe
134 Side Pipe
135 Hand Rail Bracket Loop
136 Dome Ladder Upper Section
137 Dome Ladder, Lower Section
138 Dome Platform Brackets
139 Dome Platform Boards
140, 141, 142, 143, 144, 145 Standard 1¼ in. Pipe
146 Standard 1 in. Pipe
147 Standard ⅜ in. Pipe
148 Standard ½ in. Pipe
149 End Pipe Clamps
150 End Pipe Clamp U Bolts
156 Extra Heavy 2 in. Pipe
157 Standard 2 in. Pipe
158 Standard 2 in. Pipe
161 Safety Chain
162 U Bolts for 2 in. Pipe
166 Wheel 33 in. Dia. Double Plate, Chilled Thread
167 Axles 5½ in. x 10 in. Journals
168 Journal Boxes
169 Journal Bearings
170 Journal Wedges
171 Top Arch Bar
172 Bottom Arch Bar
173 Bottom Tie Bar
174 Spring Planks
175 Brake Beam Safety Angles
176 Column Posts
177 Springs—Std. A. R. A. Class D
178 Column Bolts
179 Journal Box Bolts
180 Pressed Steel Bolsters
181 Truck Center Plate
182 Dead Lever Fulcrums
183 Side Bearing Pocket
184 Side Bearing Block
185 Brake Shoe
186 Brake Beams
187 Brake Beam Hanger
188 Dead Lever Guide
189 Truck Lever
190 Center Pin
191 Truck Lever Connection

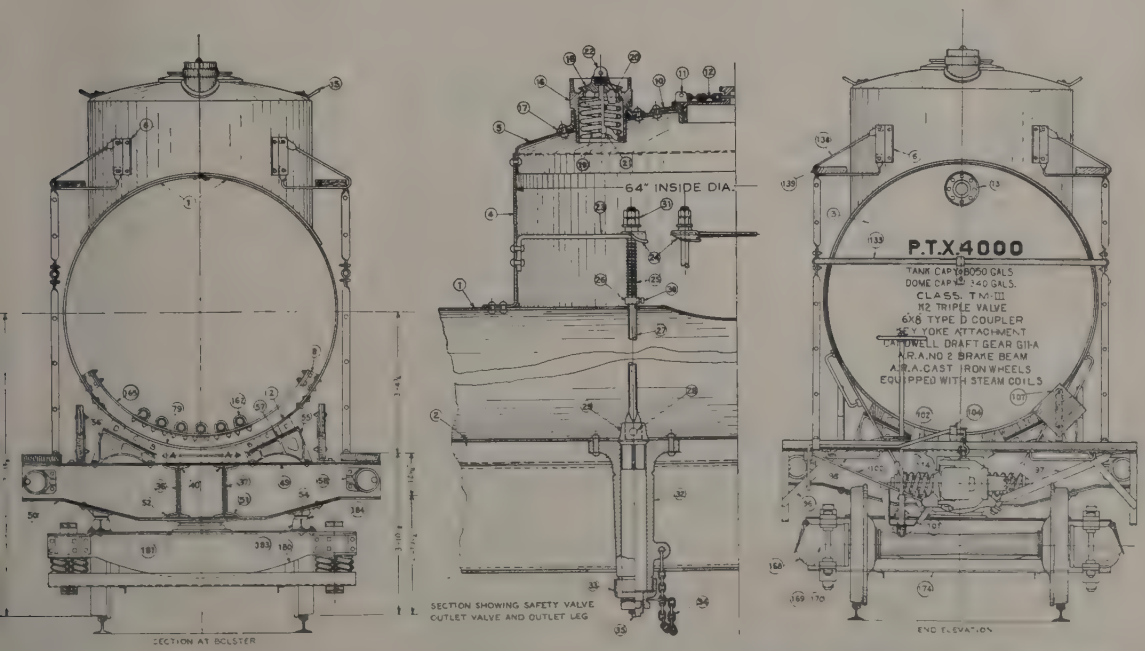


Fig. 285—Section Showing Safety Valve, Outlet Valve and Outlet Leg. Section at Bolster and End Elevation of Steel Frame, Type A-I-D Tank Car Shown in Fig. 284. Builder, The Pennsylvania Tank Car Company.

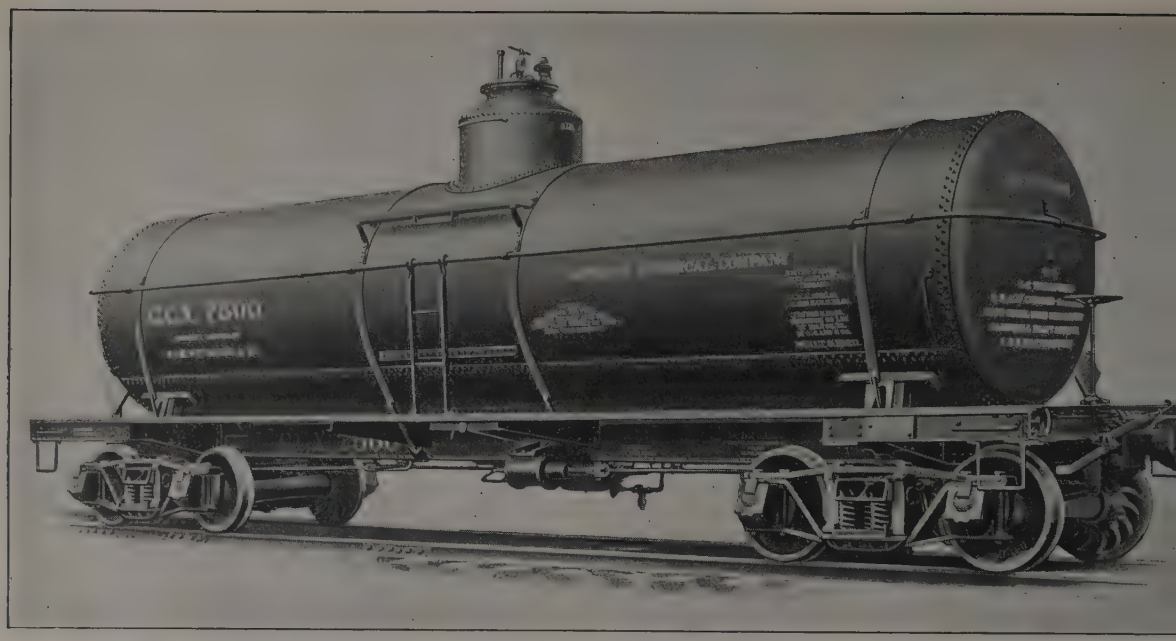


Fig. 286—Steel Frame, 70-Ton Tank Car for Carrying Sulphuric Acid. Tank Capacity, 9,800 Gallons. Built by the American Car & Foundry Company for the General Chemical Company.
(*See also Figs.* 287-288 *and Pages* 266-267)

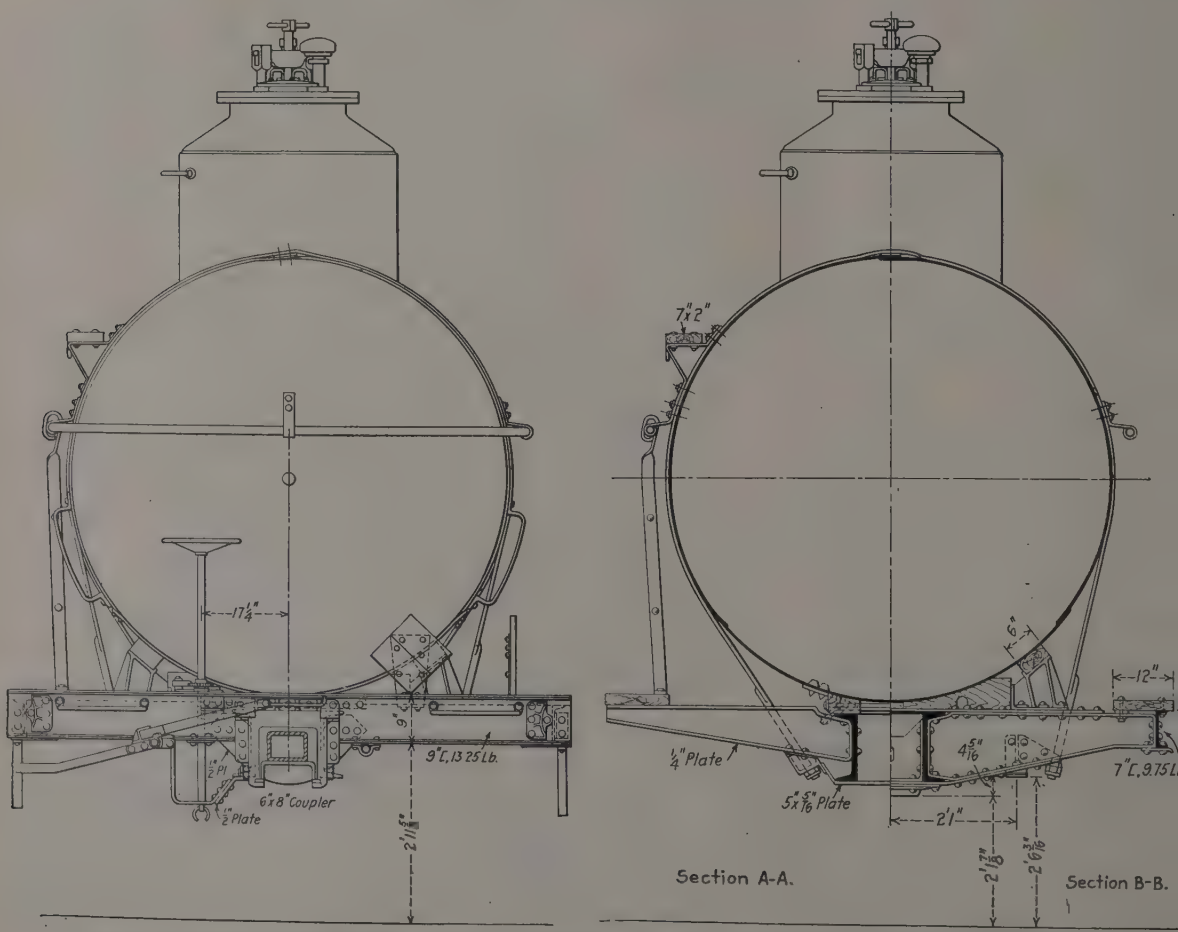


Fig. 287—End and Cross Section of 70-Ton, 9,800-Gallon Capacity Acid Tank Car Shown in Figs. 286 and 288.

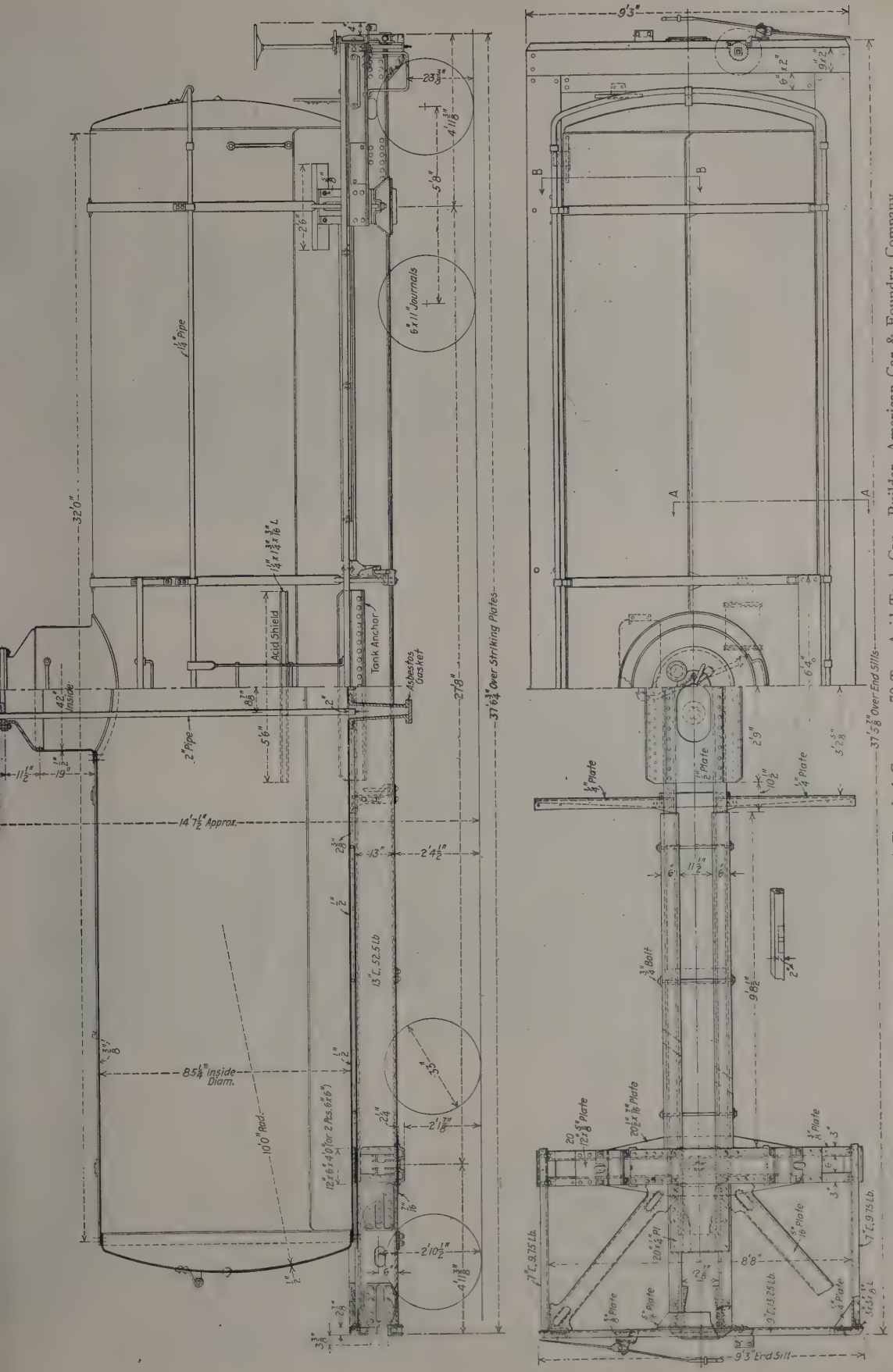


Fig. 288—Plan and Side Elevation of General Chemical Company 70-Ton Acid Tank Car. Builder, American Car & Foundry Company.
(See also Figs. 286-287 and Pages 266-267.)

"Car Foundry" Insulated Tank Cars

Class IV insulated tank cars, made by the American Car and Foundry Company, are used for products which require protection from atmospheric temperatures. Some ladings, including natural—casinghead—gasoline, must be kept cool for safety and to prevent evaporation losses; others such as asphalt, tar, crude naphthaline, and other viscous liquids, must be kept warm, to facilitate unloading or to preserve quality.

Fig. 289—"Car Foundry" Class IV Insulated Tank Car

The inner tank and other details of construction are essentially the same as the standard "Car Foundry" Class III car. The dome has a cover with outside bolts, which can be drawn down tight on an asbestos-metallic gasket placed between the machined surfaces, an arrangement which insures an absolutely tight joint.

The outlet valve is designed especially for this service. It is self-locking and cannot be opened through the bottom outlet. Its action is such that the seat is ground and cleaned automatically, which is a new departure and a distinct advanta

The insulating material is 2 in. thick, and co pletely encloses the inner tank, except where tank and underframe are joined. The insulati is secured to the tank before the latter is mount on the underframe.

The outer shell, or jacket, is made of ⅛ in. st plate sections which are riveted together. T edges of the upper and lower sections are fitt with angles for bolting together. The head s tions are made in complete units and are bolt in place.

The tank can be emptied by gravity throu a bottom outlet, or by internal pressure appli through the dome head, the contents bei forced out through a second pipe leading fr the bottom of the tank to the dome head.

To convert an oil tank of Class III constru tion into the insulated Class IV type requires o a slight change in the dome arrangement and a dition of the insulation and outer steel jack Cars so remodeled comply in all respects with t requirements of the A. R. A. tank car spec cations and of the Bureau of Explosives.

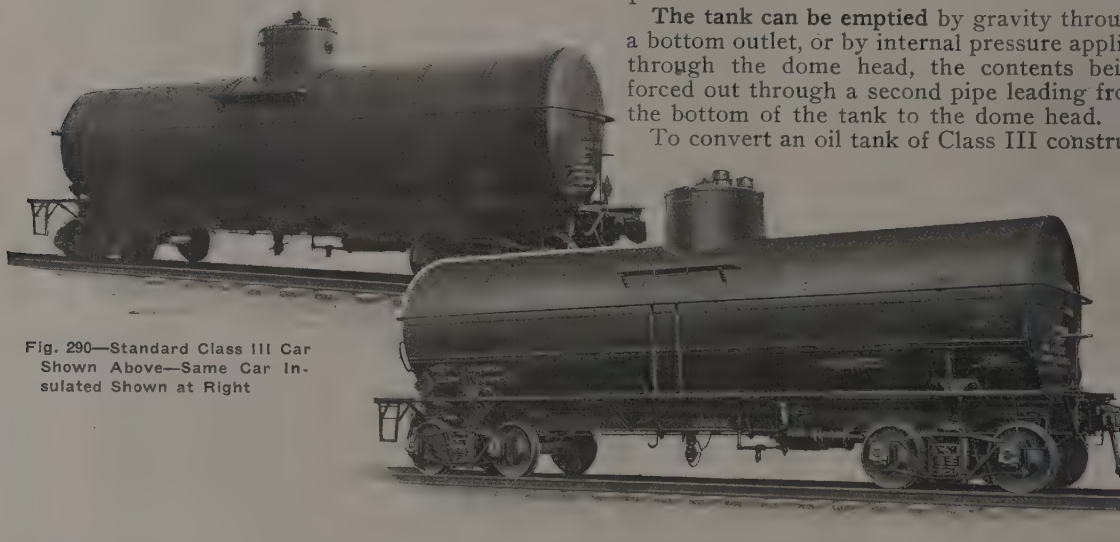


Fig. 290—Standard Class III Car Shown Above—Same Car Insulated Shown at Right

"Car Foundry" insulated and standard tank designs are the results of years of experien Their special features of construction facilita their use in service and insure long life to the c

"Car Foundry" Valve Outlet and Center Anchor

The unloading of tank cars containing heavy liquids and semi-solids such as asphalt, pitch, resin, and heavy oils frequently is difficult because of sluggishness of flow. As these materials are very poor heat conductors, the heating effect from even the most elaborate system of internal coils does not reach the valve and outlet —at least not in sufficient degree to thoroughly liquify the material at these very important points. The outlet valve often cannot be opened quickly or closed tightly, and in addition to this fault at the valve, a residue remains and hardens in the neck of the outlet where it cannot be loosened or removed by heat from ordinary steam coils. The building of fires under the outlet has been resorted to but this practice damages the car.

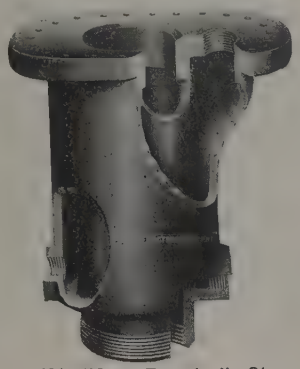


Fig. 291—"Car Foundry" Steam-Jacketed Outlet for Tank Cars

The "Car Foundry" patented steam-jacketed outlet applies the heat directly where most needed, assures quick, thorough drainage with a minimum effort and without abuse to the car. It may be used in connection with any number and length of coils.

Steam enters the jacket near the bottom of the outlet and travels upward, completely surrounding the outlet chamber. As all steam going to the internal coils is compelled to pass through the jacket, the valve and outlet are heated to a higher temperature than any part of the tank.

The device is complete in a single casting of special material, particularly homogeneous and free from blow holes. Every unit is given an adequate pressure test and in every way is acceptable under A. R. A. requirements. The valve seat is at the top and is machined.

This patented outlet already has been applied to several hundred tank cars and by its effectiveness in saving the labor and time required for unloading, invariably has quickly repaid its cost. It can be applied to cars in service as well as to new construction, the installation in the former instance involving no particular difficulty. Cars having this outlet equipment can be unloaded promptly.

For fastening the tanks on the car frame a strongly riveted connection with the underframe at the center of the car is considered by many as superior to any form of riveted or bolted double anchor, in that it leaves the tank free to expand in all directions, whereas, with the latter form, unequal expansion between the tank and the center frame causes intermittent strains and ultimately leakage, and assembling is also made difficult because the rivet holes in tank and anchor do not always register well and require reaming.

The "Car Foundry" center anchor is used as standard on tank cars built by the American Car and Foundry Company, and also in the overhauling of old cars. Its installation eliminates the old head-blocks and double anchors, and completely overcomes the faults of both. The use of this device is particularly desirable on old cars because it is applied at a point where the tank has not been strained previously.

A base plate and two side plates formed from heavy pressed steel comprise this anchor. The base plate is riveted to the upper flanges of the center sill channels and has down-turned edges that fit over them. In addition to its function as part of the anchor, the base plate also acts as a cover plate for the sills, ties them together, and materially increases their strength and stiffness.

The side plates are shaped in their top flanges to conform to and support the tank and are riveted thereto. The bottom edges are similarly riveted to the down-turned portions of the base plate. The side plates are formed with projecting ledges that act as limiting stops to secure the proper distance between tank and underframe and to insure that the rivet holes in the side plates will coincide with the corresponding holes in the base plate in assembling. In operation these ledges carry the weight of the tank and relieve the rivets from shearing strains.

This construction possess decided advantages. Bolts, which often fit imperfectly and become loose, are entirely eliminated as fastenings and even the uncertainties of hand and air-driven riveting are avoided, as all rivets are set in a "bull machine," at the correct temperature and compression for obtaining maximum tightness.

If, in overhauling, removal of the tank is desired, the rivets in the tank do not have to be disturbed as in ordinary constructions. All that is necessary is to cut and remove the conveniently located single rows of rivets at the bottom of each side plate, after which the tank may be lifted bodily from the frame. Upon replacement, the rivet holes will register in their original position and the application of a new set of rivets completes the job.

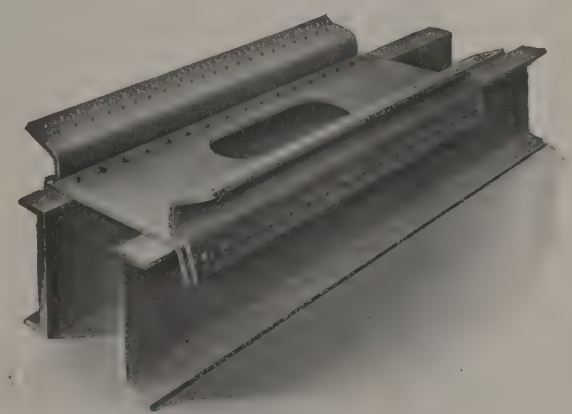


Fig. 292—"Car Foundry" Center Anchor Tank Cars

Fig. 293—All-Steel Tank Car Shown in Figs. 294-295. Capacity, 10,000 U. S. Gallons.

PRINCIPAL DIMENSIONS OF STEEL TANK CAR SHOWN IN FIGS. 293-295.

Length over center sills	36 ft. 10 in.	Height from rail to top of dome body	13 ft. $2^{13}/_{16}$ in.
Length over buffer	37 ft. 1 in.	Length outside of tank	33 ft. $8\frac{1}{4}$ in.
Length from center of bolster bottom cover	26 ft. 10 in.	Length inside of tank	33 ft. $7\frac{1}{4}$ in.
Width over side sills	9 ft. 0 in.	Truck wheel base	5 ft. 6 in.
Height from rail to top of running board	3 ft. 8 in.	Inside diameter of tank	7 ft. 3 in.
		Inside diameter of dome	4 ft. 6 in.

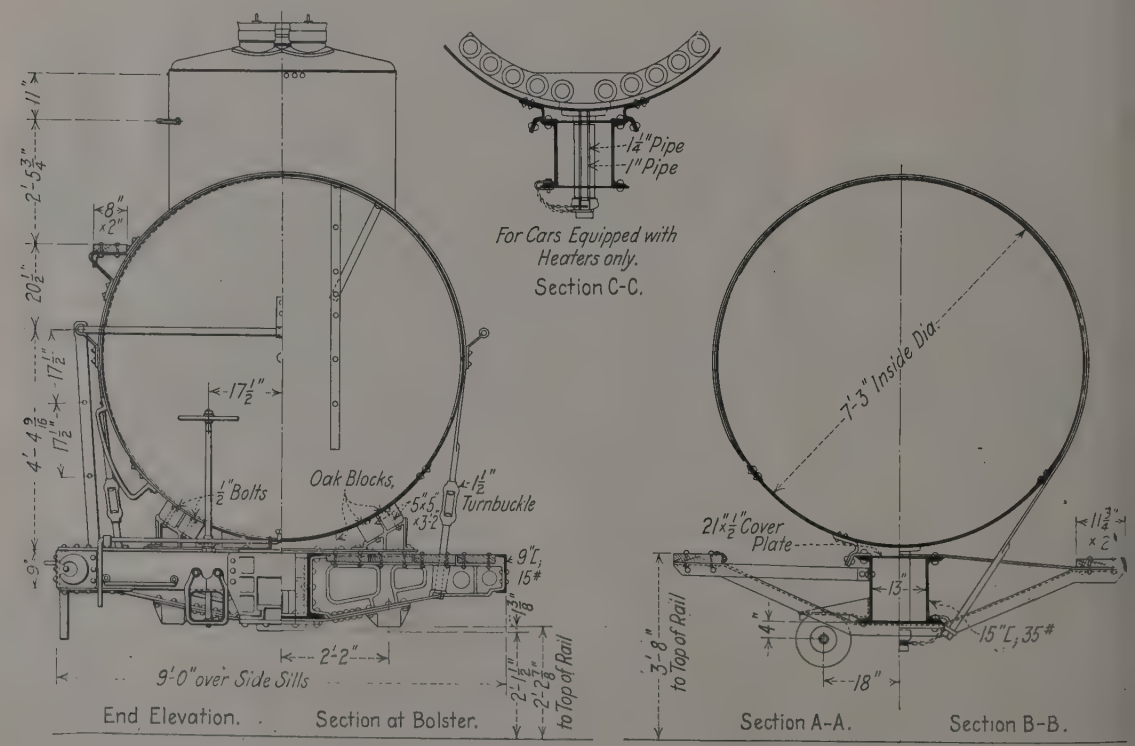


Fig. 294—End Elevation and Section of Bolster of Tank Car Shown in Figs. 293 and 295.

Canadian Car & Foundry Company

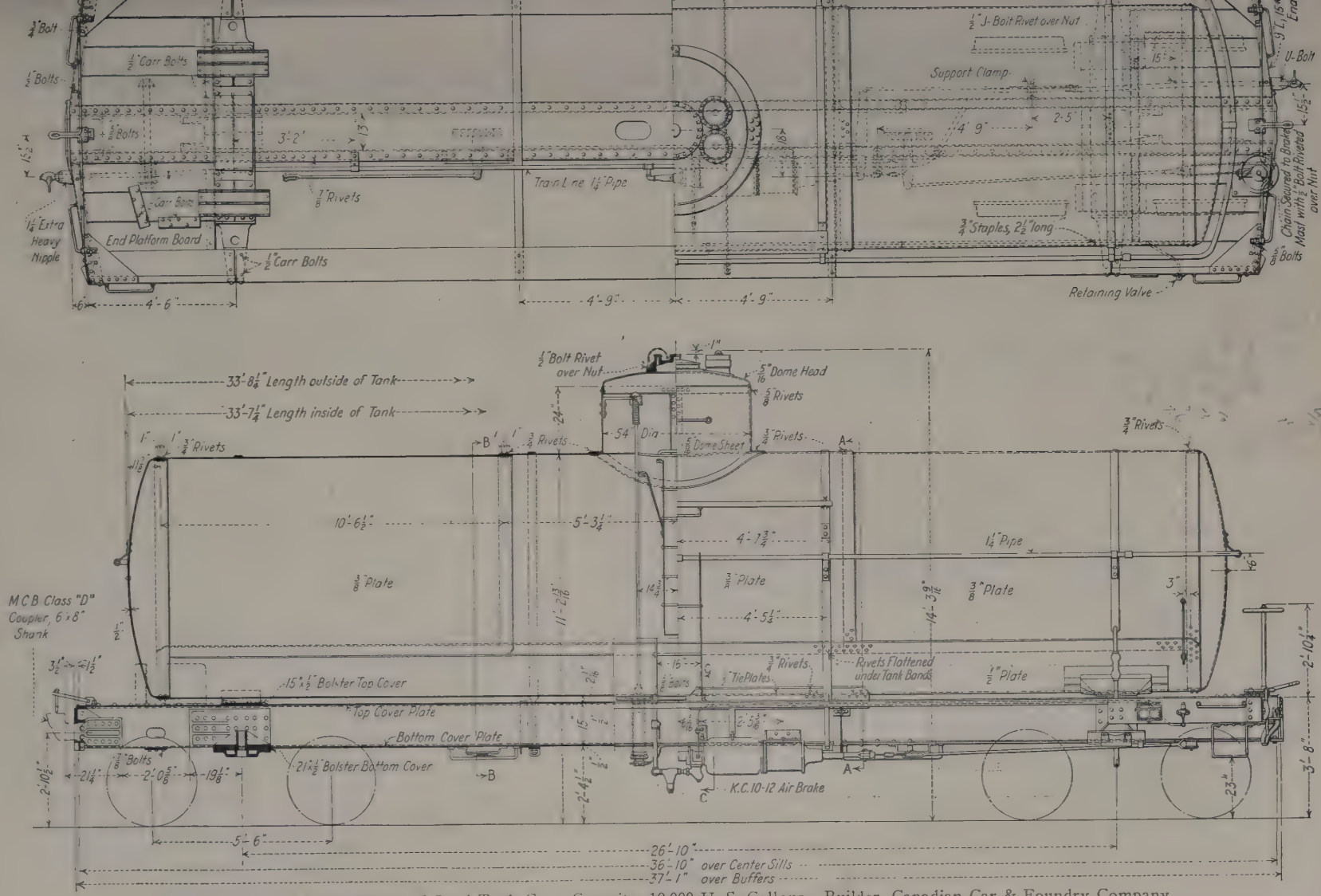


Fig. 295—General Arrangement of Steel Tank Car. Capacity, 10,000 U. S. Gallons. Builder, Canadian Car & Foundry Company.

(*See also Figs.* 293-294.)

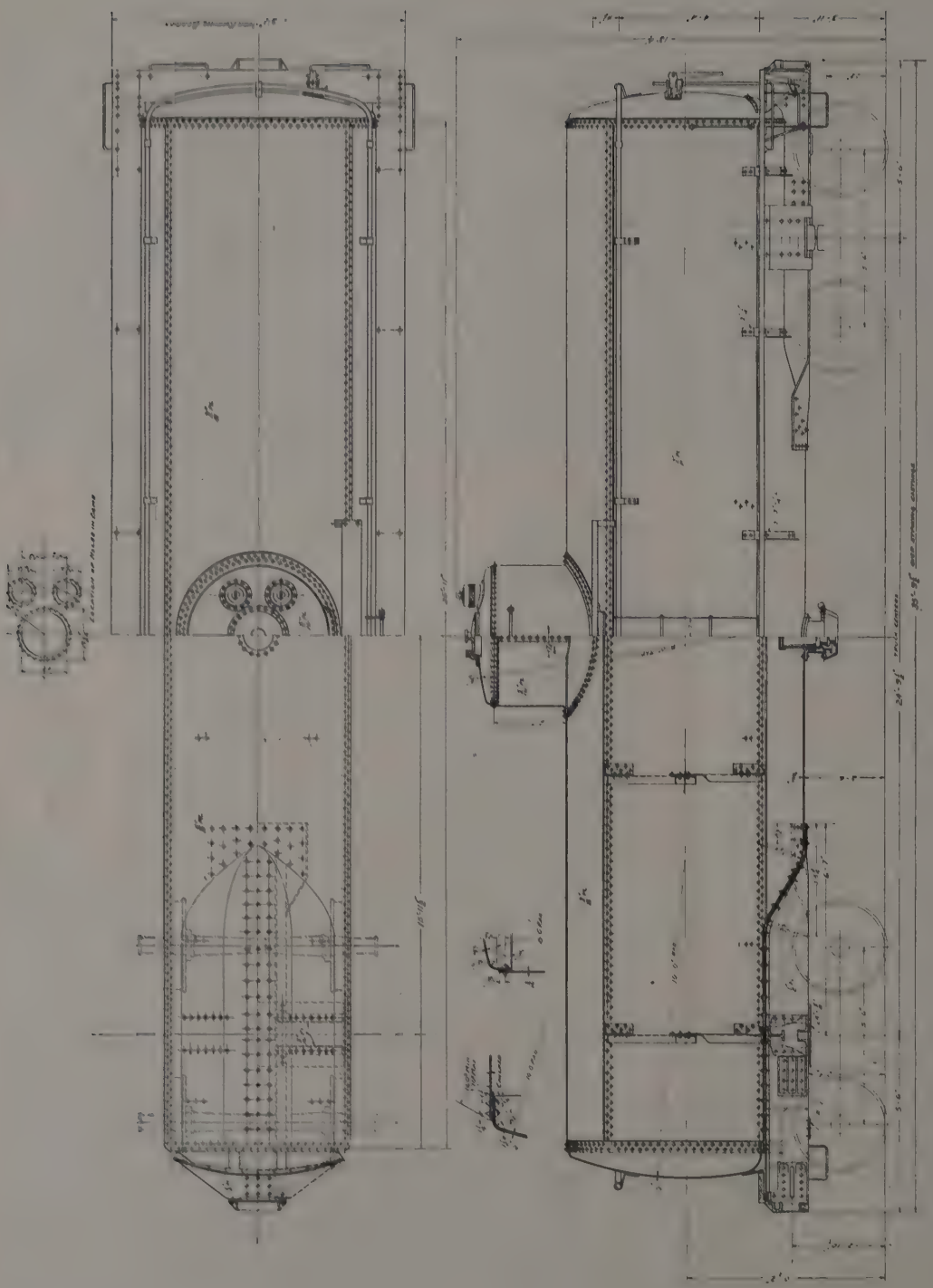


Fig. 296.—Steel Tank Car. Low Gravity Center 10,000-Gallon Capacity. Designer, Enterprise Railway Equipment Company. (*See also Fig. 297.*)

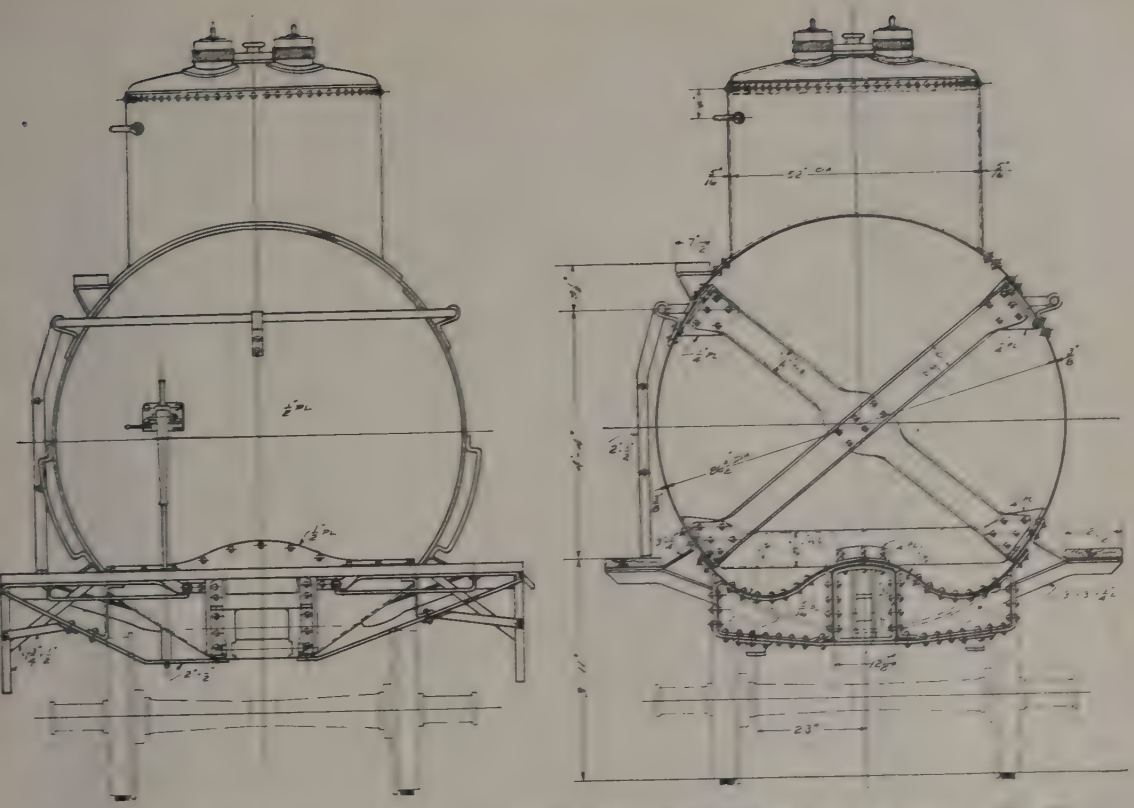


Fig. 297—Elevation and Section of Low Gravity Center 10,000-Gallon Steel Tank Car Shown in Fig. 296.
Designer, Enterprise Railway Equipment Company.

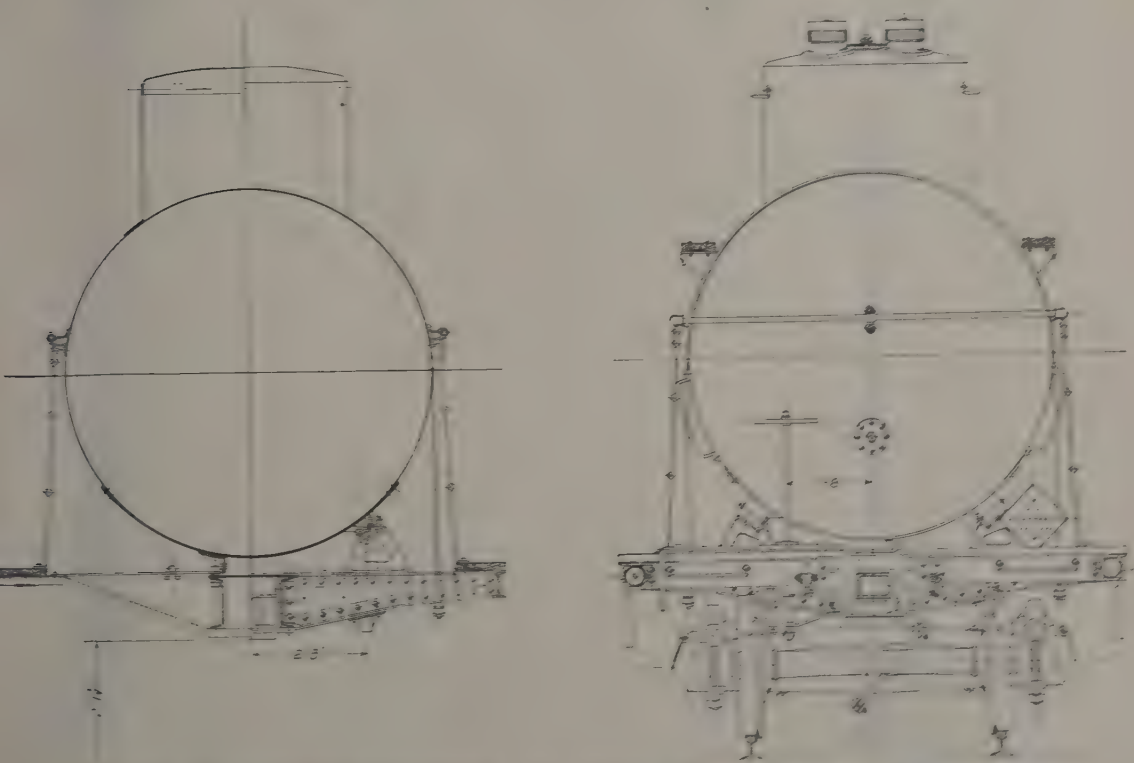
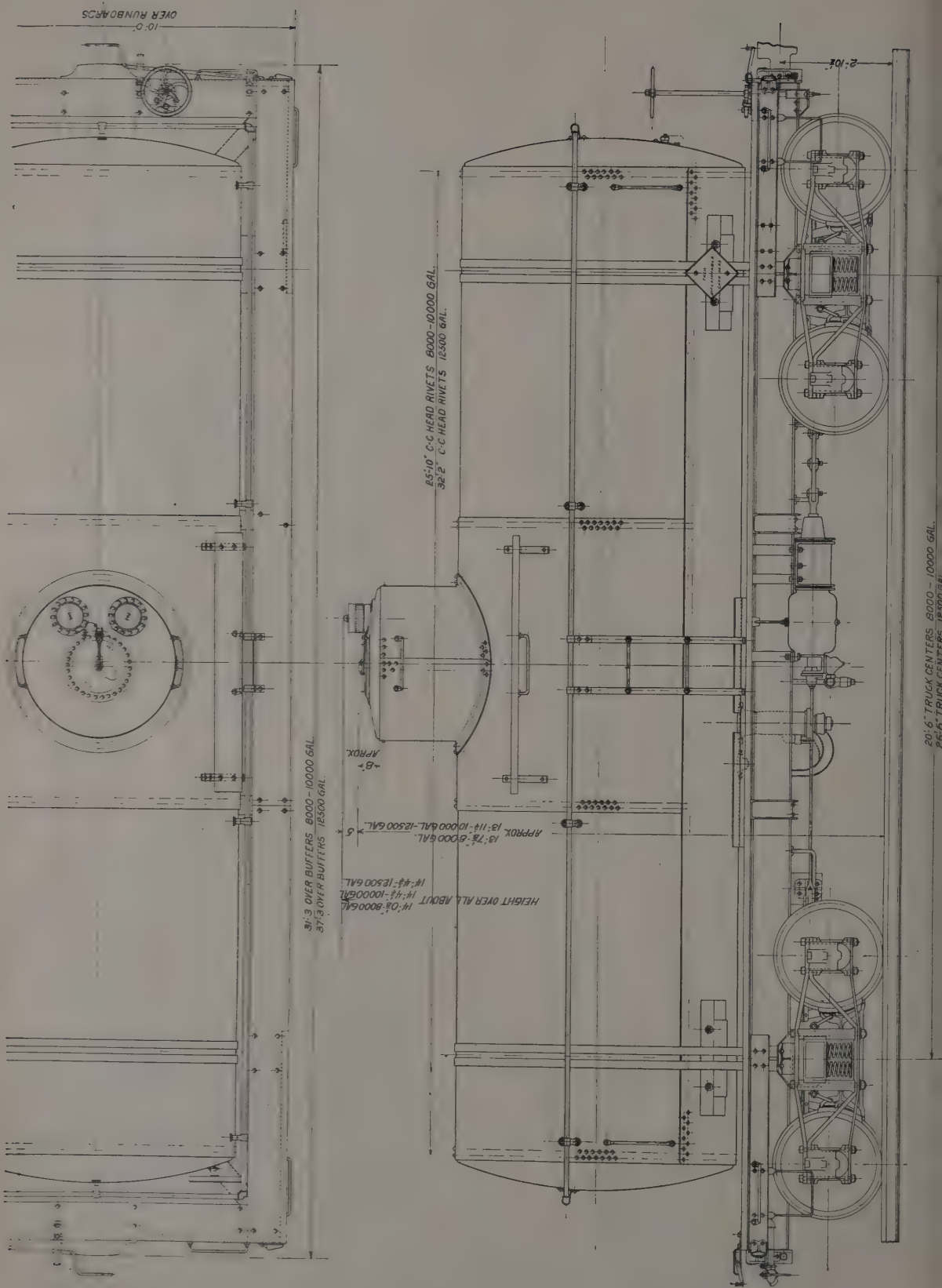


Fig. 298—[illegible] and End Elevation of Steel Tank Car for Transporting Oils, Shown in Fig. 299.
Builder, Chicago Steel Car Company.


OVER RUNBOARDS
10'-0"
2'-10½"
85'-10" C-C HEAD RIVETS 8000-10000 GAL.
36'-2" C-C HEAD RIVETS 12500 GAL.
20'-6" TRUCK CENTERS 8000-10000 GAL.
8'-
APROX.
APPROX. 13'-7½"-8000 GAL.
APPROX. 13'-11½"-10000 GAL.-12500 GAL.
5'
HEIGHT OVER ALL ABOUT 14'-0½"-8000 GAL.
14'-4½"-10000 GAL.
14'-4½"-12500 GAL.
34'-3" OVER BUFFERS 8000-10000 GAL.
37'-3" OVER BUFFERS 12500 GAL.

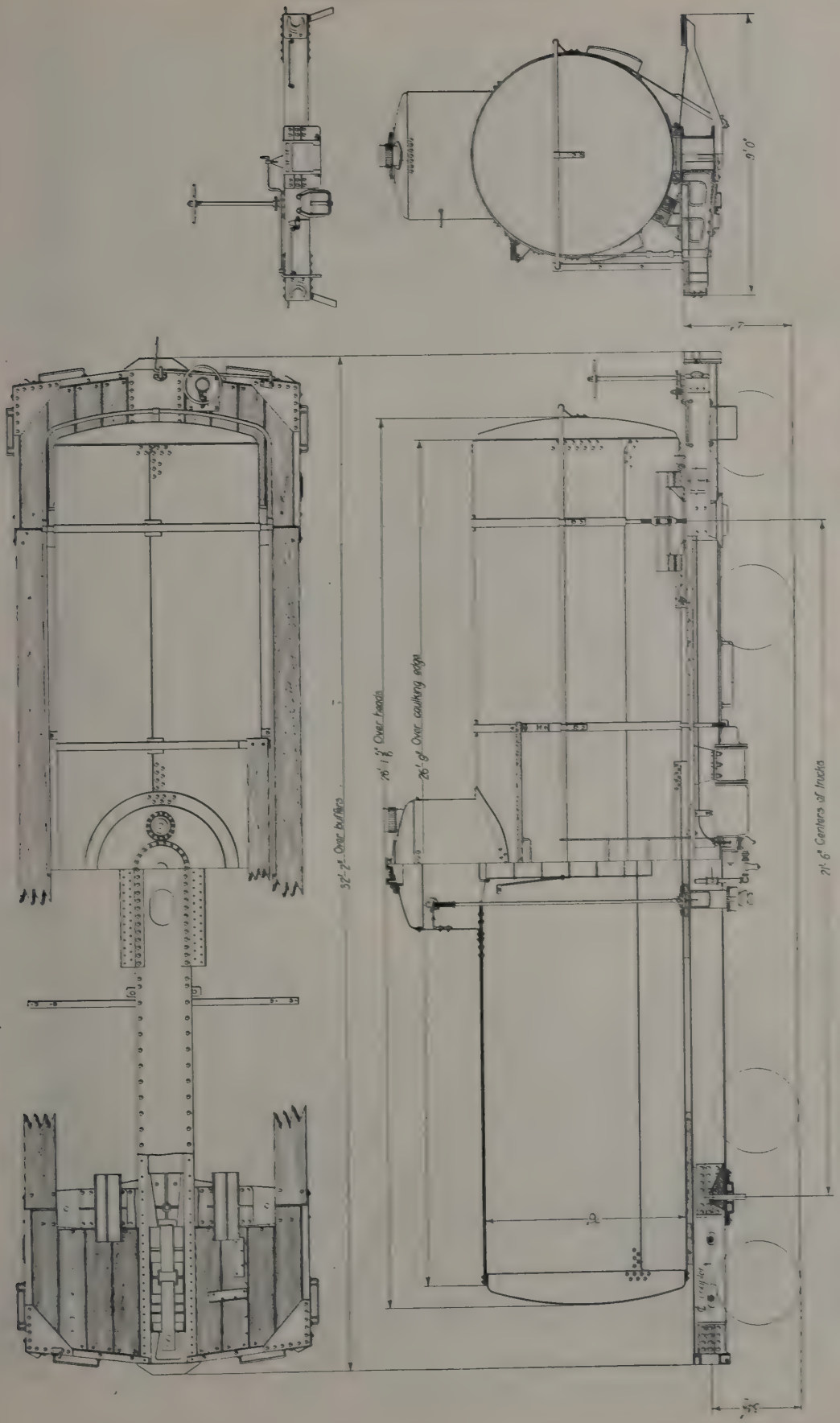


Fig. 300—Steel Frame, Class X-3, Tank Car. Capacity 6,500 U. S. Gallons. Union Tank Line.

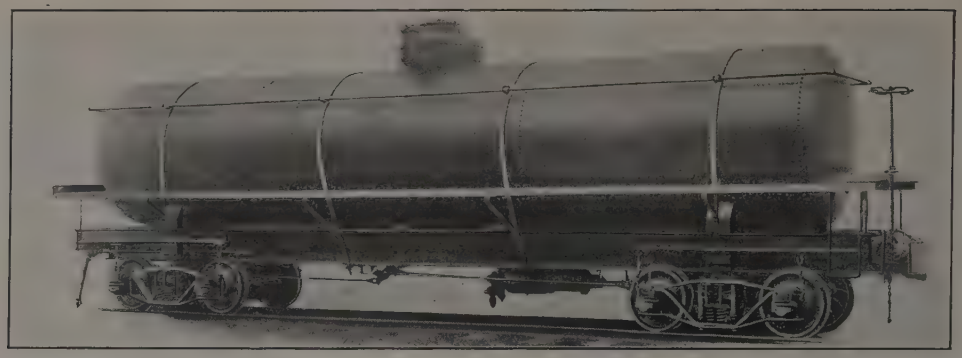


Fig. 301—Steel Tank Car for West India Oil Company, For Transporting Fuel Oil, Molasses, etc. Capacity, 5,000 U. S. Gallons. Builder, The Gregg Company, Ltd.

Fig. 302—Steel Tank Car. Capacity, 10,000 U. S. Gallons, or 100,000 lb.; Weight, 44,600 lb. Builder, Cambria Steel Company.

Fig. 303—Steel Tank Car for Dry Powder, Loaded Through Three Domes, Unloaded Through Six Discharge Hoppers. Builder, General American Tank Car Corporation.

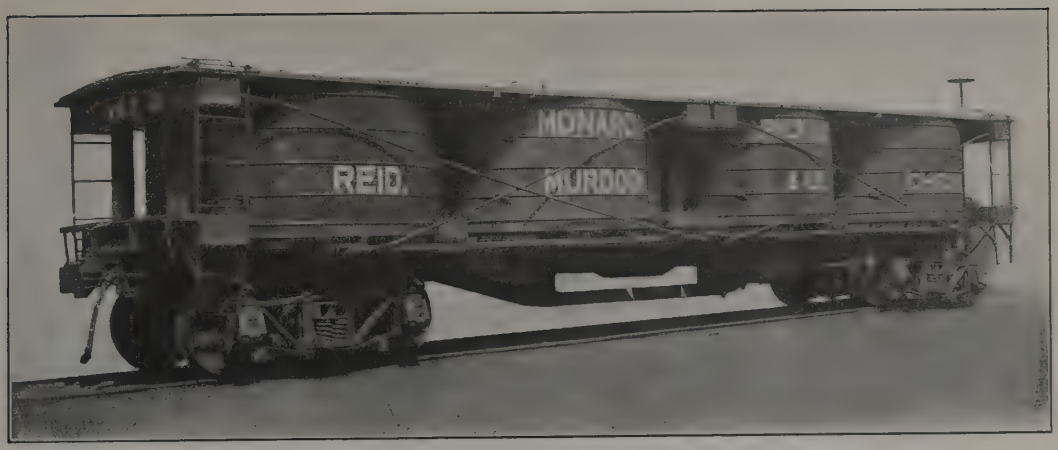


Fig. 304—Steel Underframe Car with Wooden Vats for Carrying Pickles in Brine.
Builder, General American Tank Car Corporation.

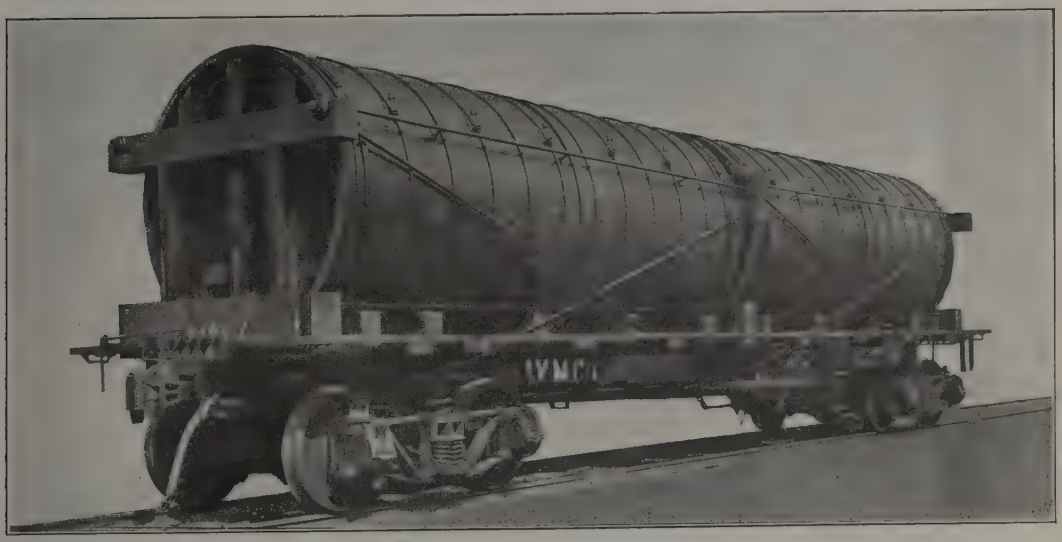


Fig. 305—Steel Underframe Car with Wooden Tank for Vinegar.
Builder, General American Tank Car Corporation.

Fig. 306—Tank Car for Transporting Milk. Equipped for Operation in Passenger Trains. Glass Enameled Tanks, Shown in Phantom. Builder, The Pfaudler Company and Baltimore & Ohio Railroad.

Bettendorf-Built Freight Cars

The production of well built freight cars of thoroughly sound structural design, has been the aim of The Bettendorf Company since the inception of its steel car business. During this period the demands made upon freight carrying facilities, the increased speed with which heavy tonnage trains are moved, and the urgent necessity for a marked reduction in the cost of maintaining railway equipment, have focused the attention of railway executives upon the great value of properly constructed freight cars and the wastefulness of keeping obsolete rolling stock in service.

The Bettendorf Company are prepared to build such cars. An efficient engineering organization and a steel car plant equipped with highly developed car fabricating machinery, provides facilities capable of a large annual output. They not only design and assemble the various parts of a car but many of these parts are the distinctive products of The Bettendorf Company.

It is the policy of The Bettendorf Company to carefully study railroad conditions, observe the failure of old time appliances under the strain of modern conditions and to apply the knowledge so obtained in the design of various freight car essentials. The fundamental idea, incorporated in all Bettendorf construction, is the elimination of detachable parts with a view toward simplicity and reduced maintenance expense. In this connection the possibilities of steel castings and commercial rolled steel shapes have been extensively applied.

Two types of freight car equipment built by The Bettendorf Company are shown in the accompanying illustrations. These cars embody many distinctive features which will be of interest to railroad men, who appreciate the importance of high grade workmanship. Other Bettendorf cars are shown in Figs. 97, 98 and 139.

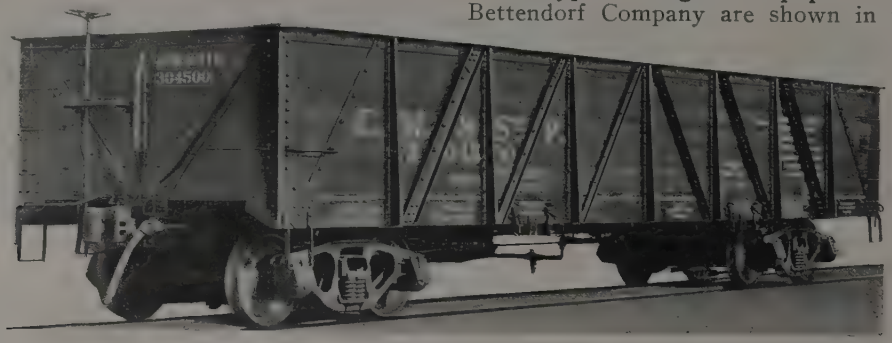


Fig. 307—Composite Drop-Bottom Gondola Car, 5½ x 10 Journals, Weight 40,400 Lb.

The use of Bettendorf steel underframes, single-piece side frame trucks, center sill end castings, etc., in constructing freight cars of any type, will result in a highly efficient product that may be depended upon to adequately meet the demands of modern traffic conditions.

The economical management of transportation systems, is very largely a matter of reducing maintenance expenditure. This can be accomplished by placing in service rolling stock of the type wherein every provision has been made for the practical elimination of minor running repairs, with the assurance of low maintenance cost throughout its entire life.

Fig. 308—Single-Sheathed Box Car, 5 x 9 Journals, Weight 40,900 Lb.

The facilities of The Bettendorf Company enable them to furnish freight car equipment entirely adequate to meet the most exceptional traffic demands.

For other products and branch offices, see classified and alphabetical indexes.

THE BETTENDORF COMPANY, BETTENDORF, IOWA

Ralston Steel Cars

The manufacture of all-steel hopper and drop-bottom gondola cars is an important part of the Ralston Steel Car Company's output. This company has devoted special attention, during the past few years, to the improvement of this class of car construction and have developed an organization of skill and experience in the production of steel hopper, steel gondola and other types of car equipment.

The accompanying illustrations, Figs. 309 and 310 show hopper and drop-bottom gondola cars, built for prominent railroads; these illustrations will give an approximate idea of the general appearance and the various structural details embodied in the Ralston product. Other Ralston cars are shown in Figs. 18-20, and Figs. 178-180.

Accuracy in design and careful workmanship, while highly desirable in any class of rolling stock, are especially important in the building of cars of the hopper variety due to the fact that such cars are equipped with mechanical facilities for the rapid discharge of lading. These facilities usually consist of hand-operated mechanisms, which depend, for their proper functioning, upon careful workmanship in assembling the car structure, so that the various mechanical details will have a true alignment and will retain this condition indefinitely. The revenue value of such cars is frequently impaired by the faulty action and failure of the bottom-dropping or door-operating appliances, which condition is usually the result of improper design or inferior constructional methods.

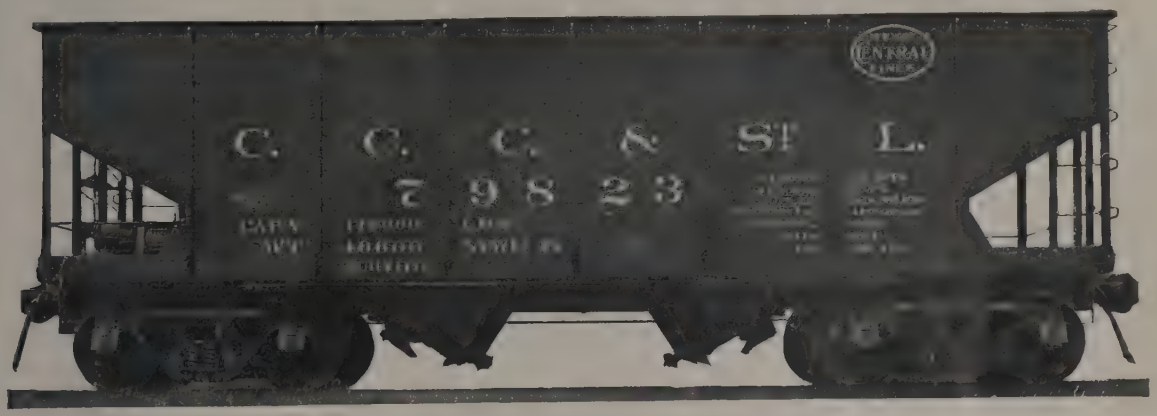


Fig. 309—All Steel Hopper Car Built for C. C. C. & St. L. Railroad

It is the thoroughly established policy of the Ralston Steel Car Company throughout their various lines of manufacture, to deliver a product in strict accordance with the purchaser's specifications, and to produce cars wherein all structural and engineering details have been assembled with the best available workmanship under expert supervision.

Fig. 310—All Steel Drop Bottom Gondola Car Built for the Union Pacific

In addition to the production of high grade steel cars, the Ralston Company is also well prepared to manufacture any type of railroad freight equipment. Their plant has all necessary modern facilities and is in every way thoroughly adapted to the work of either building or repairing freight cars of any description. For information regarding repair work see chapter on "Car Repairs."

For other products and branch offices, see classified and alphabetical indexes.

THE RALSTON STEEL CAR COMPANY, COLUMBUS, OHIO.

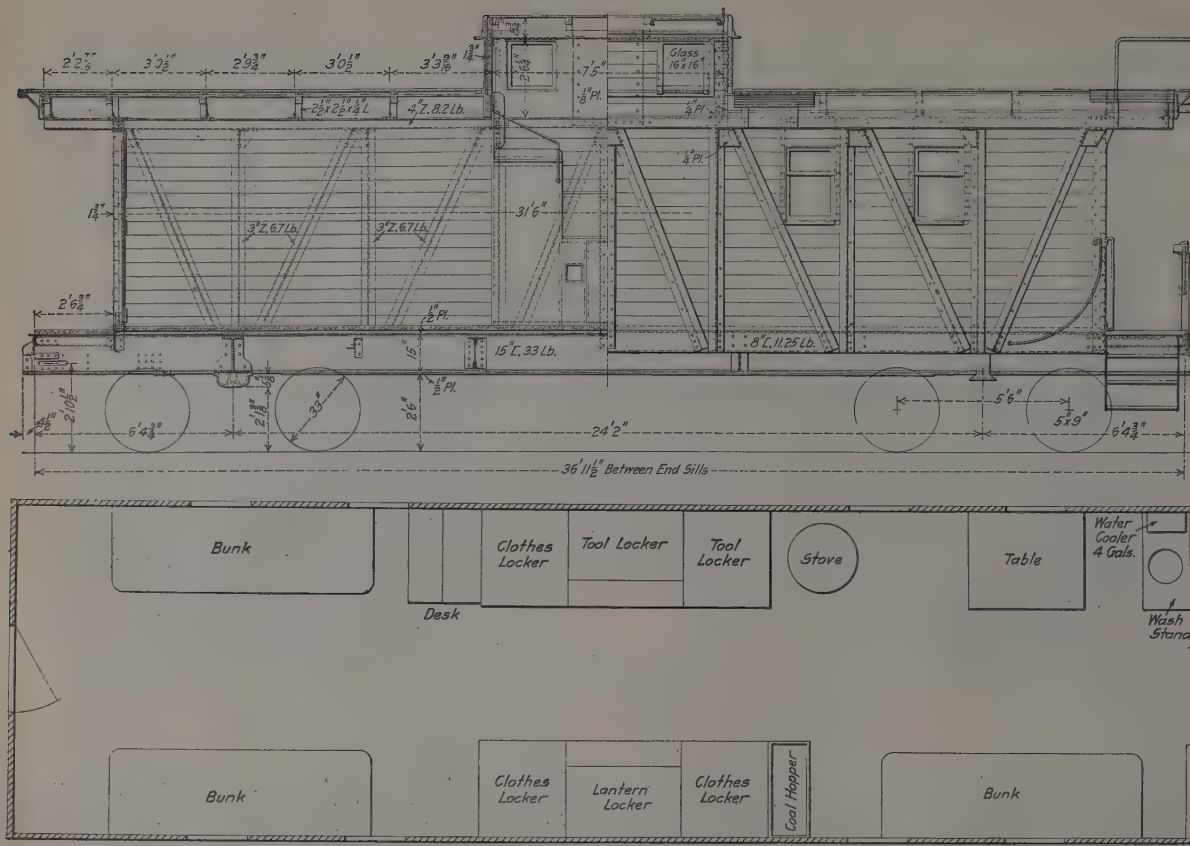


Fig. 311—Side Elevation Section and Floor Plan of Steel Frame Caboose Shown in Figs. 312-316.

Fig. 312—Steel Frame Single Sheathed Caboose. With Specially Constructed Steel Underframe for Use in Heavy Pusher Service. Nashville, Chattanooga & St. Louis Railway.

(*See also Figs.* 311-316.)

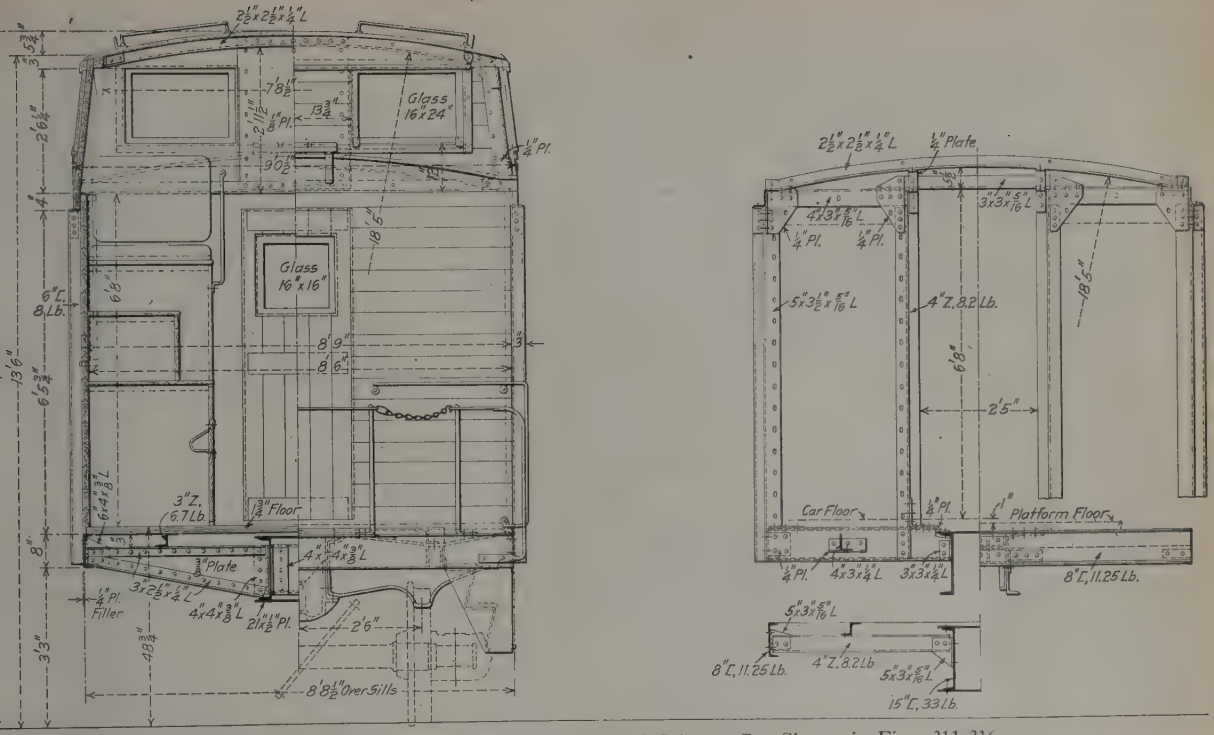


Fig. 313—Cross Section and Half End View of Caboose Car Shown in Figs. 311-316.

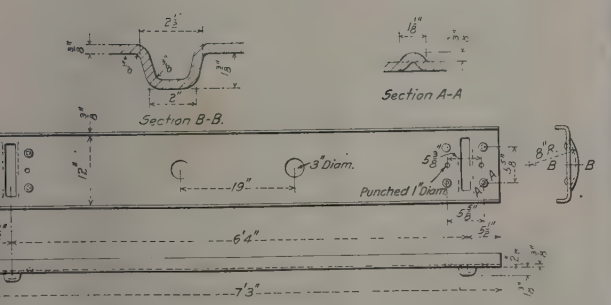


Fig. 314—Sullivan Spring Plank for Trucks of Caboose Car Shown in Figs. 311-316.

Fig. 315—Interior—N. C. & St. L. Caboose Car.

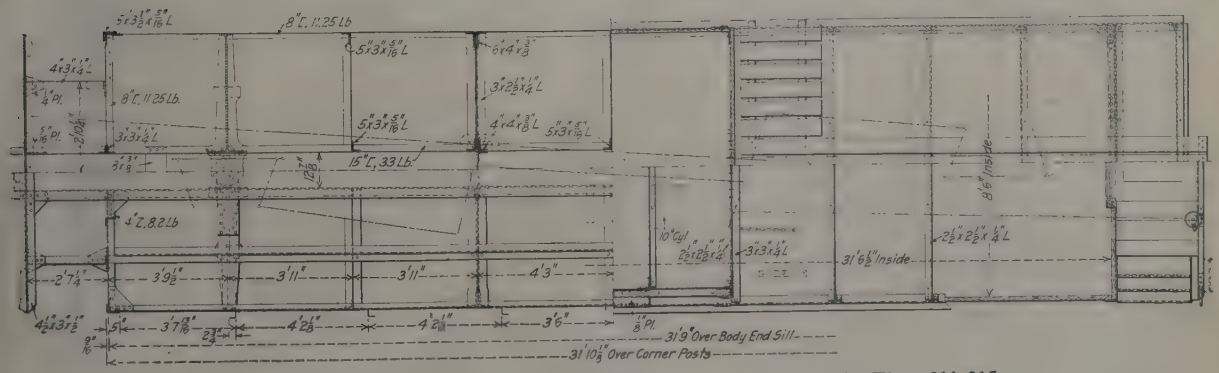


Fig. 316—Plan of Steel Underframe for Caboose Car Shown in Figs. 311-315.

Fig. 317—All-Steel Eight-Wheel Caboose. Weight, 38,000 lb. Builder, Pennsylvania Railroad.

(*See also Figs.* 318-321.)

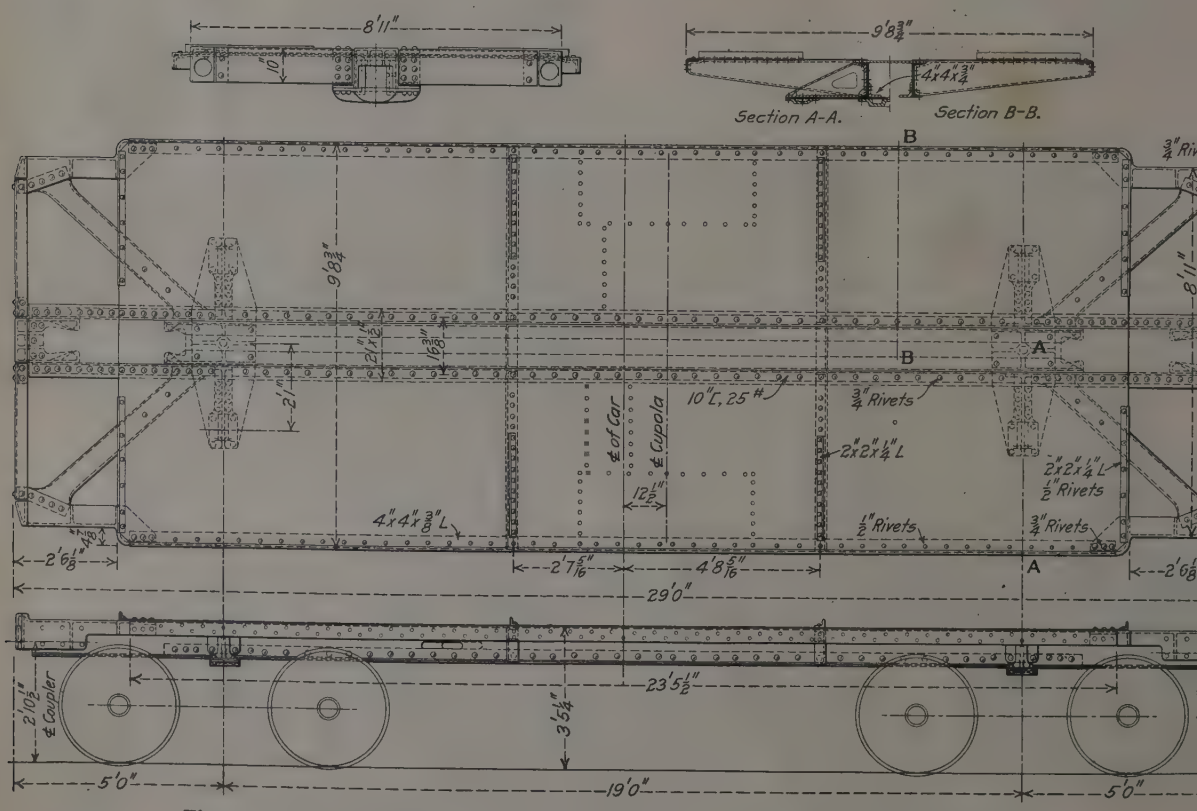


Fig. 318—Arrangement of the Underframe of the Pennsylvania Railroad Steel Caboose.

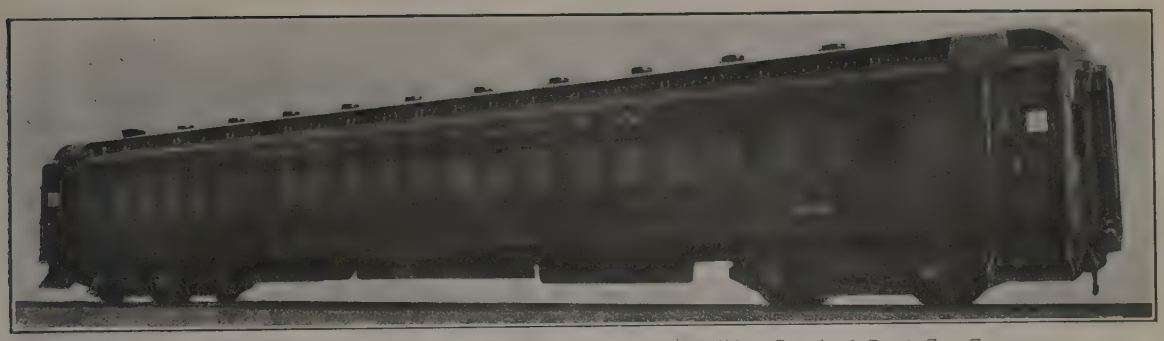


Fig. 327—All-Steel Passenger Coach for the Pennsylvania. Builder, Standard Steel Car Company.

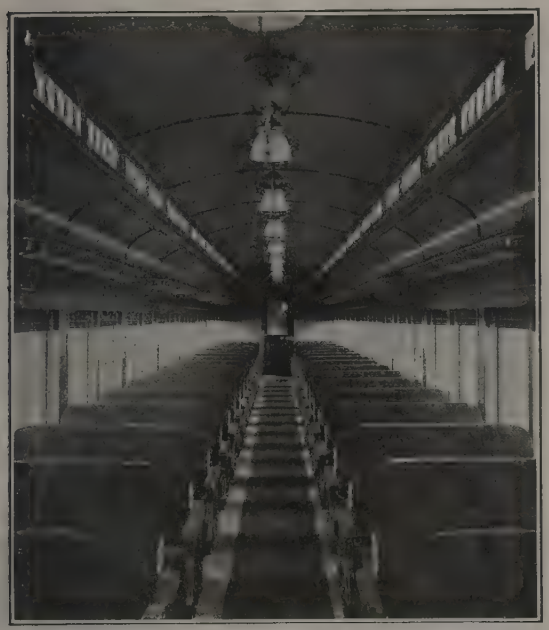


Fig. 328.—Interior of Coach Shown in Fig. 327.

Fig. 329—Interior of Coach Shown in Fig. 330.

Fig. 330—All-Steel Passenger Coach for Pere Marquetté. Builder, Standard Steel Car Company.

Fig. 331—All-Steel Passenger Coach for Philadelphia & Reading. Builder, Bethlehem Shipbuilding Corporation.

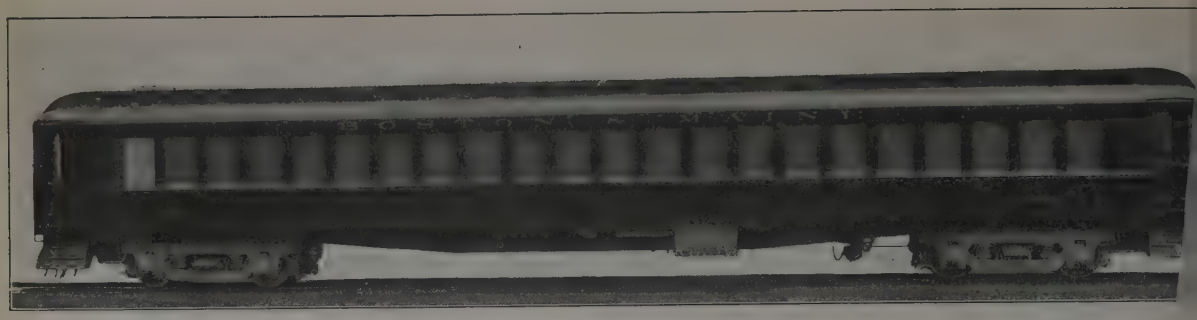


Fig. 332—All-Steel Passenger Coach for Boston & Maine. Weight, 118,500 lb.; Seating Capacity, 88; Length Over End Sills, 70 ft. 3½ in. Builder, The Pullman Company—Pullman Plant.

(See also Figs. 333-336.)

Fig. 333—Interior of Boston & Maine Coach.

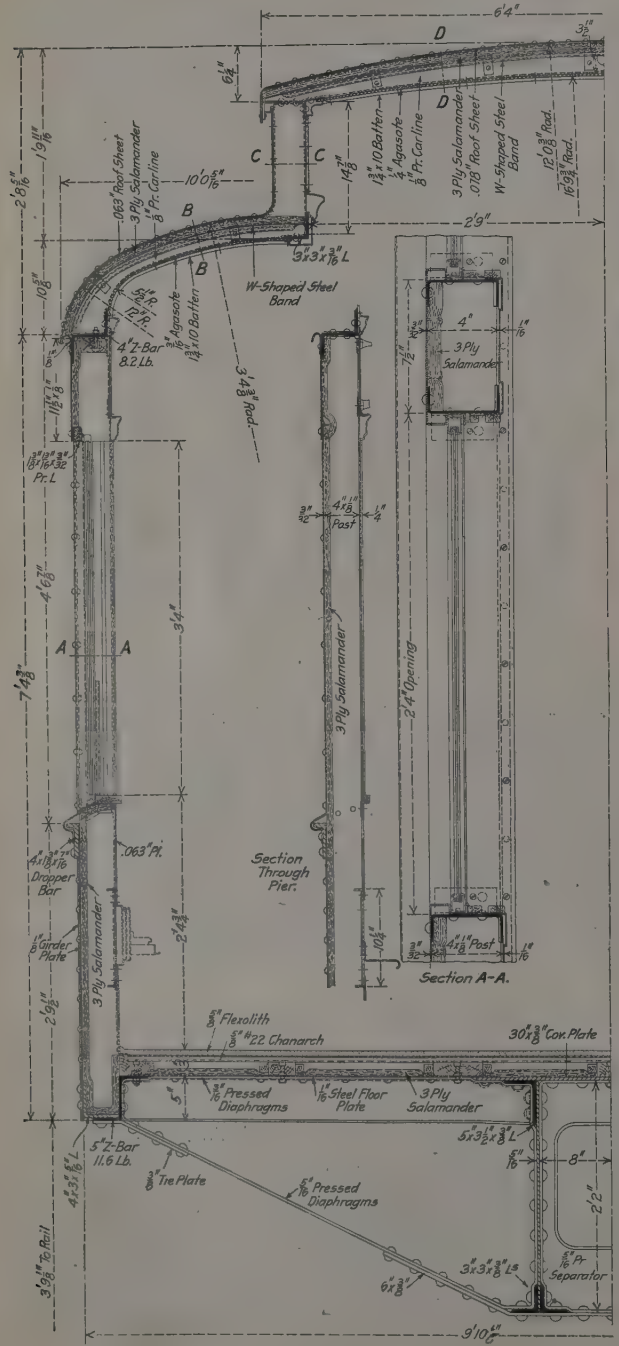


Fig. 334—Cross Sections of Boston & Maine Coach in Figs. 332-339.

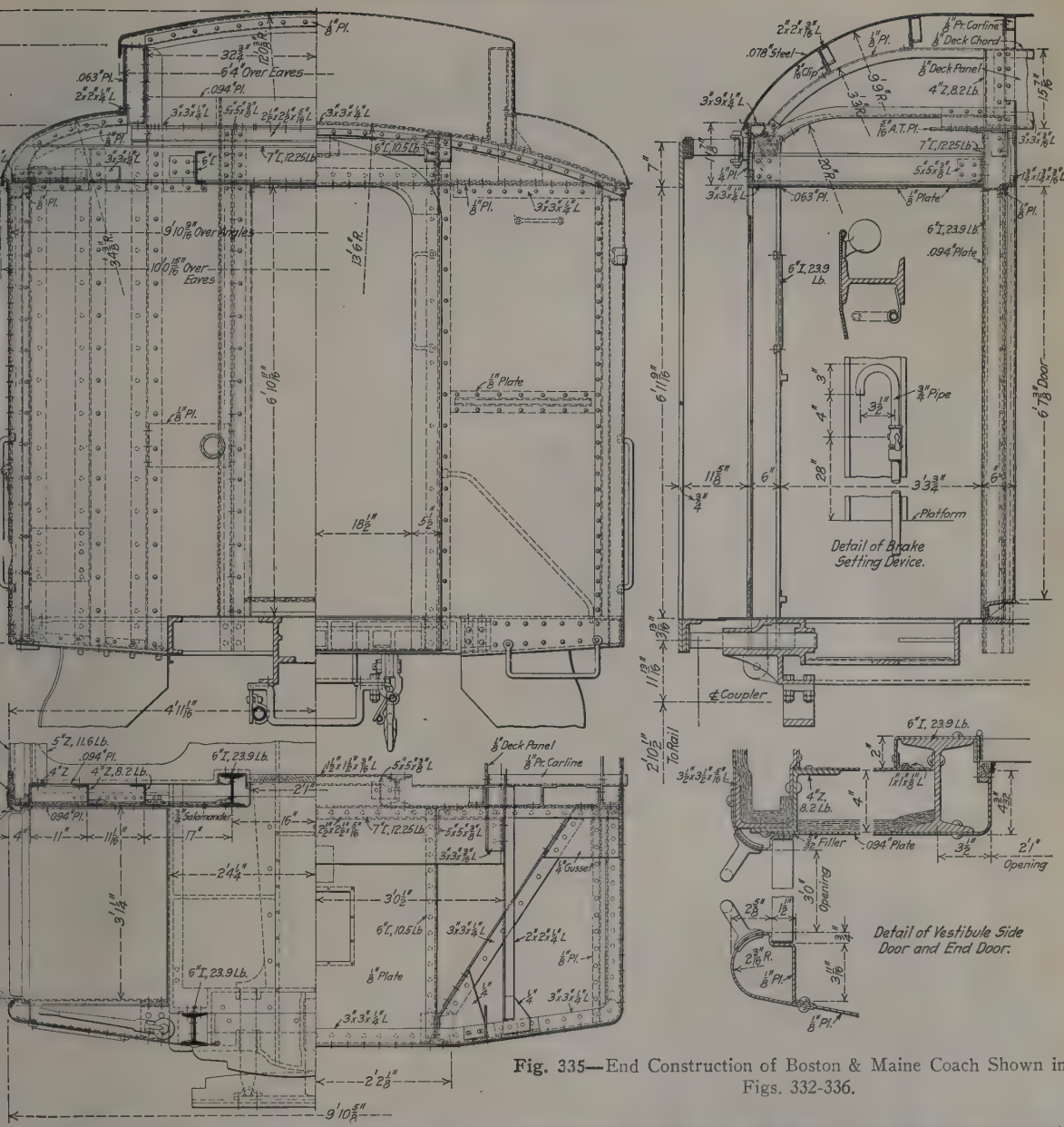


Fig. 335—End Construction of Boston & Maine Coach Shown in Figs. 332-336.

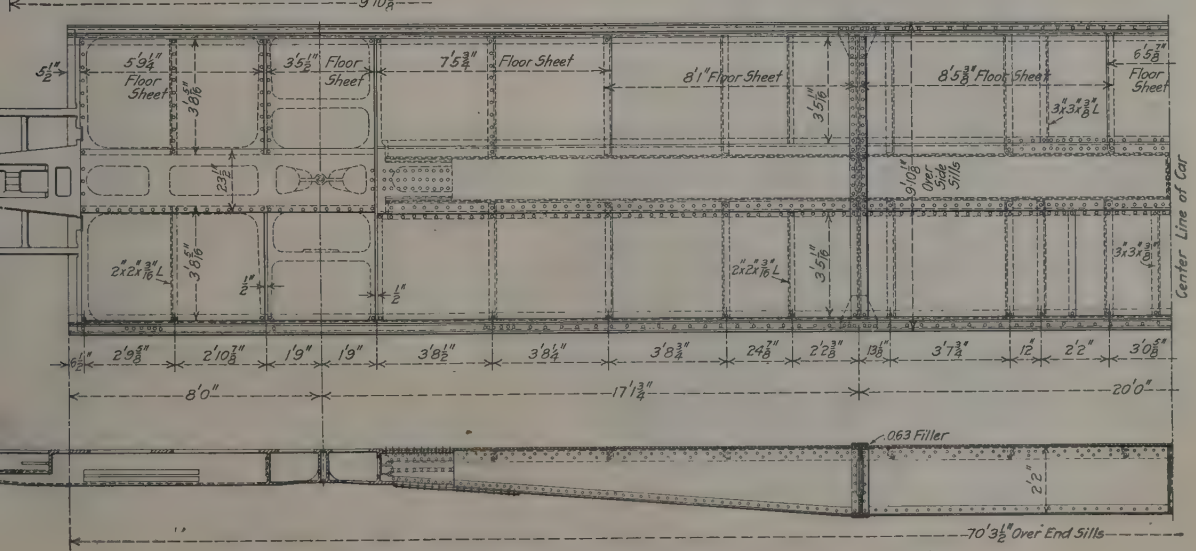


Fig. 336—Steel Underframe for Boston & Maine Coach Shown in Figs. 332-335.

Fig. 337—Steel Suburban Coach, Adapted for Electric Operation. Weight, 92,100 lb. Built for Illinois Central by the Pullman Company—Pullman Plant.
(*See also Figs.* 338-343.)

Fig. 338—Interior Showing Open-End Seats of Suburban Coach Shown in Fig. 337.

Fig. 339—Design of Vestibule Showing Air-Operated Door of Suburban Coach Shown in Fig. 337.

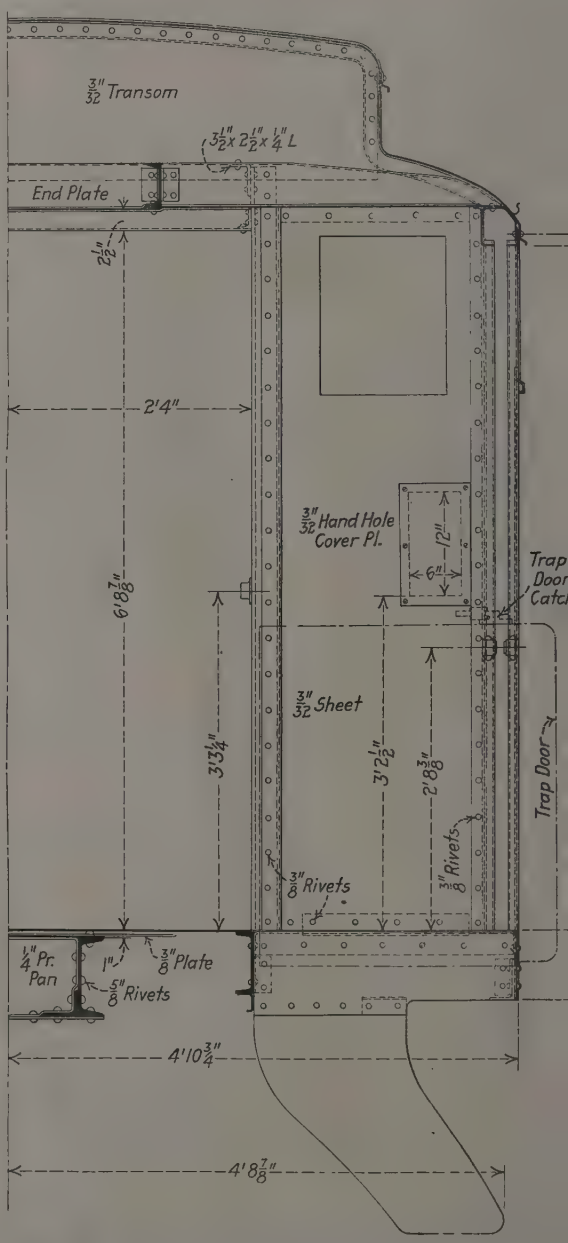


Fig. 340—Details of Vestibule Framing of Suburban Coa Shown in Fig. 337.

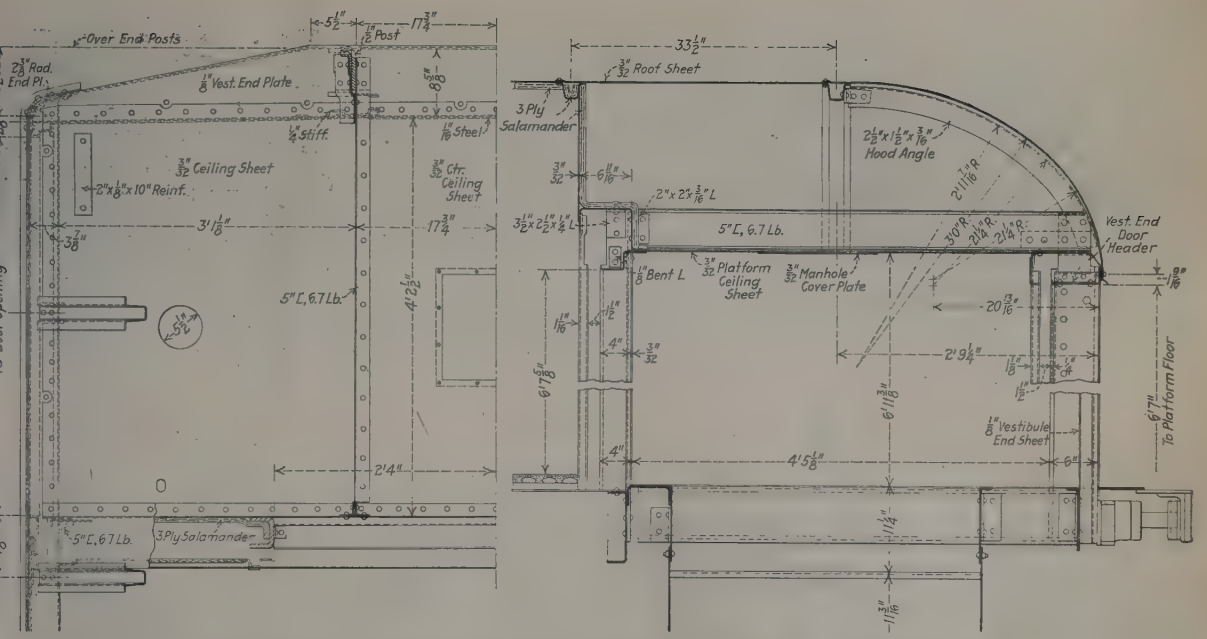


Fig. 341—Section Through Vestibule of Suburban Coach Shown in Figs. 337-343

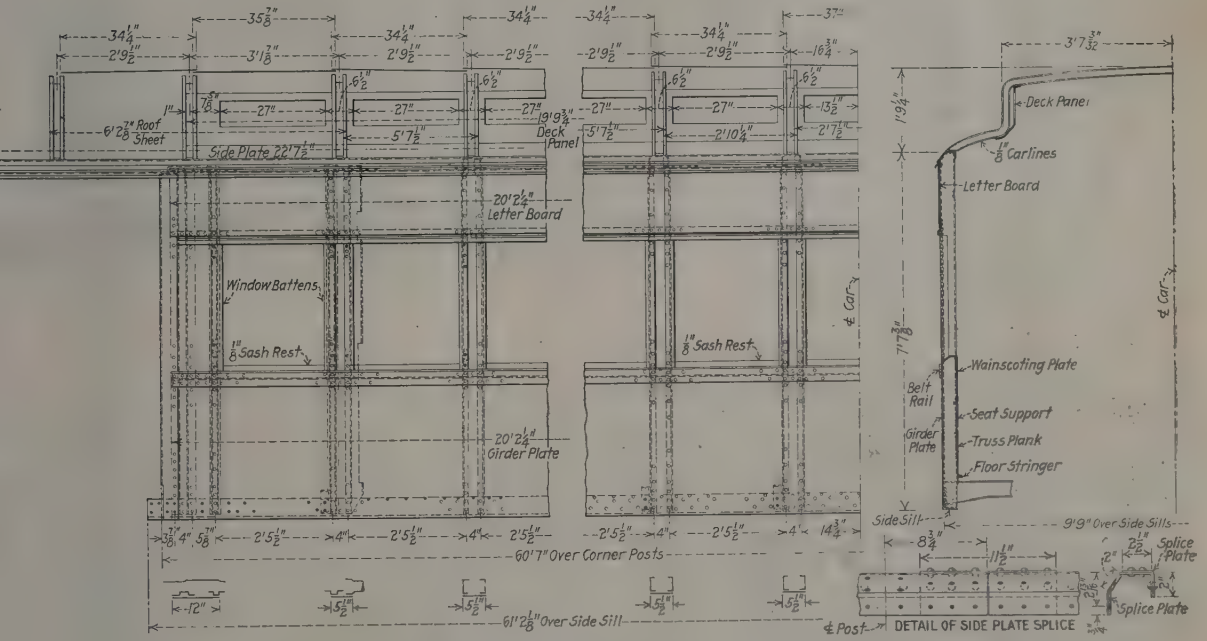


Fig. 342—Side Frame Construction of Suburban Coach Shown in Fig. 337.

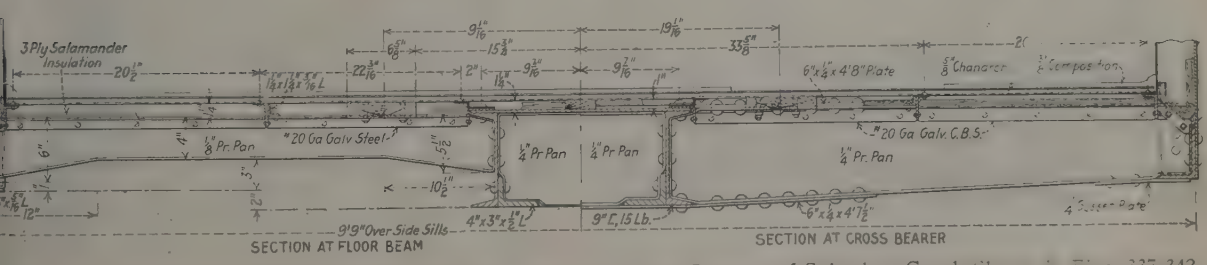


Fig. 343—Transverse Sections of Underframe—at Floor Beam and Cross Bearer—of Suburban Coach Shown in Figs. 337-342.

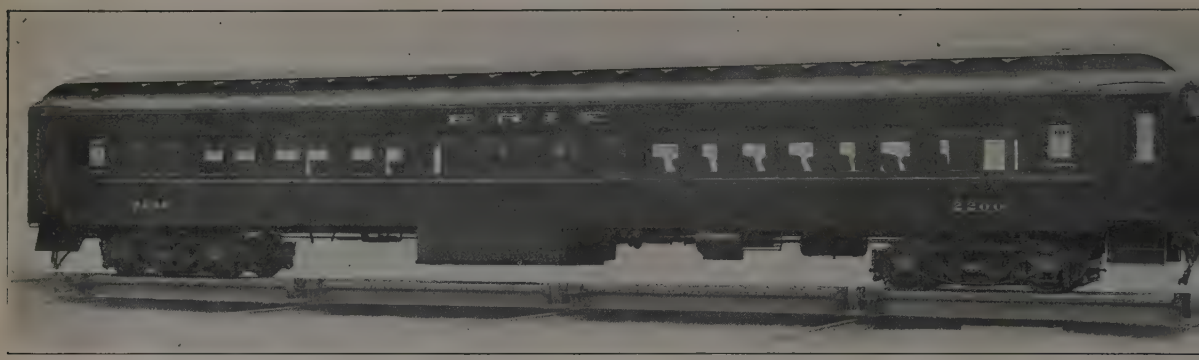


Fig. 344—All-Steel Coach for Through Line Service. Builder, The Pressed Steel Car Company.
(*See also Figs.* 345-348.)

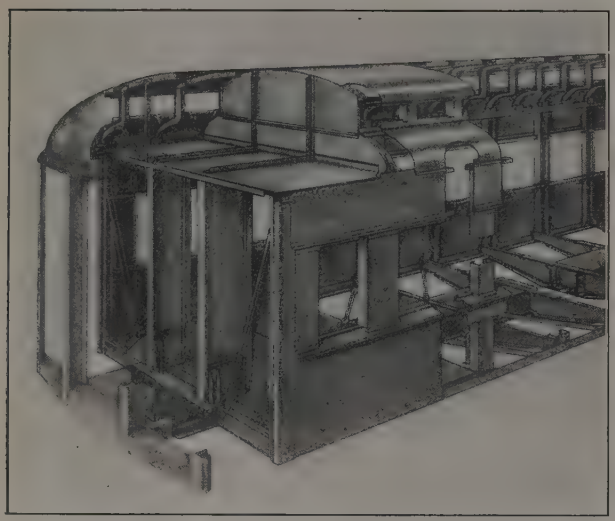


Fig. 345—Anti-Collision Bulkhead for Steel Coach Shown in Figs. 344-348.

Fig. 346—Interior of Erie Coach Shown in Figs. 344-348.

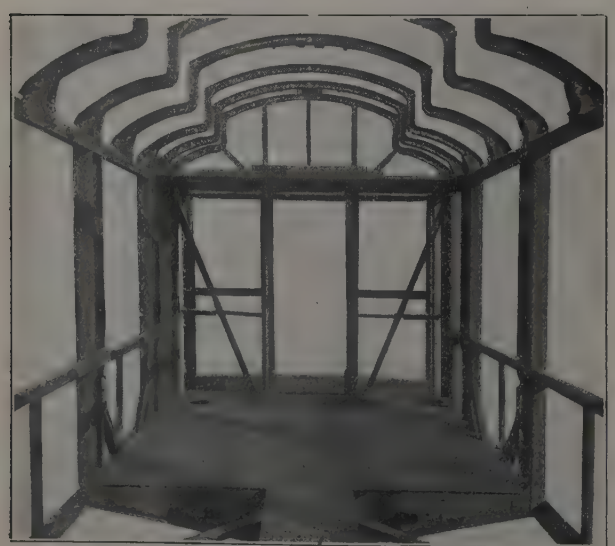


Fig. 347—End Framing of Erie Coach Showing Body Bolster and Underframe Stiffener.

Fig. 348—Framing at End of Erie Coach Shown in Figs. 344-347.

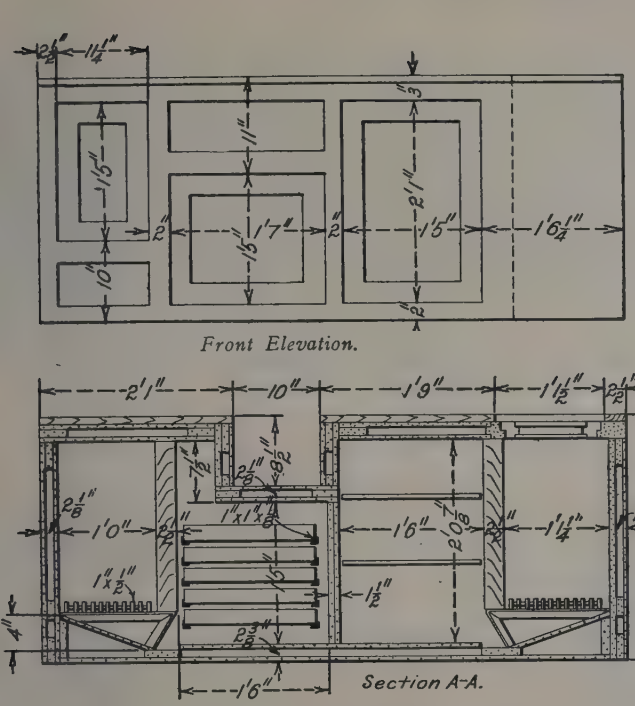


Fig. 376—Buffet Refrigerator. The Bohn Refrigerator Company.

Fig. 377—Gas Broiler No. 1500.

Fig. 378—Gas Broiler and Oven No. 1507.

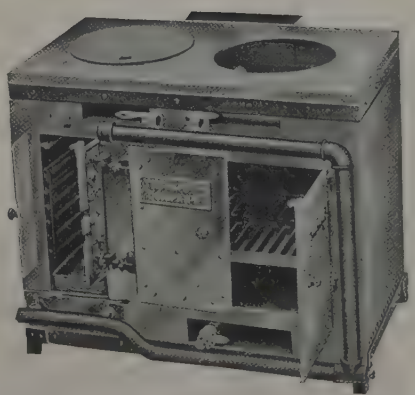


Fig. 379—Gas Broiler and Oven No. 1501a.

The Safety Car Heating & Lighting Company.

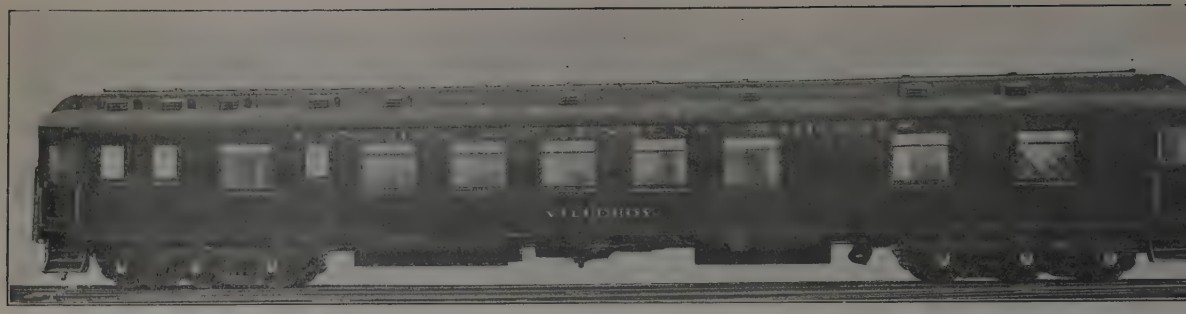


Fig. 380—All-Steel 10-Section Sleeping Car for Canadian Government Railways. Weight, 168,500 lb.; Length Over End Sills, 73 ft. 6 in. Builder, National Steel Car Company.

(*See also Figs.* 381-385.)

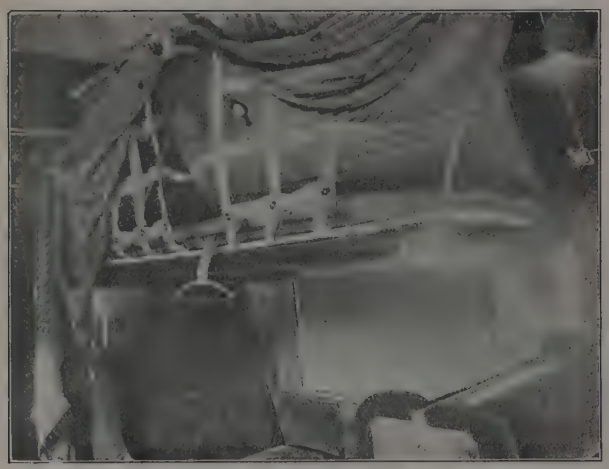


Fig. 381—Upper Berth Safety Straps and Coat Hangers.

Fig. 382—Interior of Canadian Government Railways Sleeping Car.

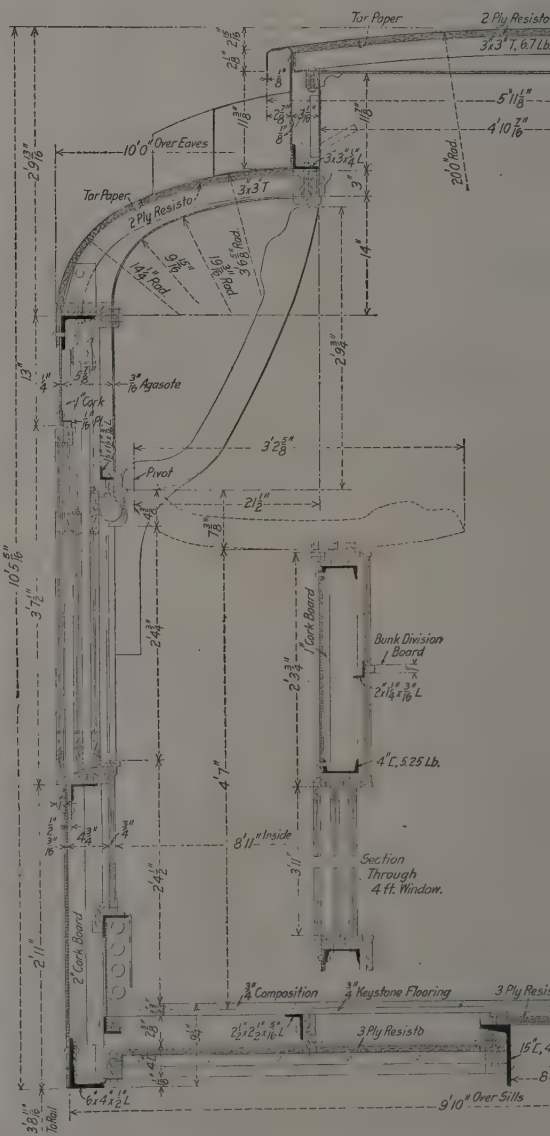


Fig. 383—Cross Section of Car Body and Horizont Section Through the Windows.

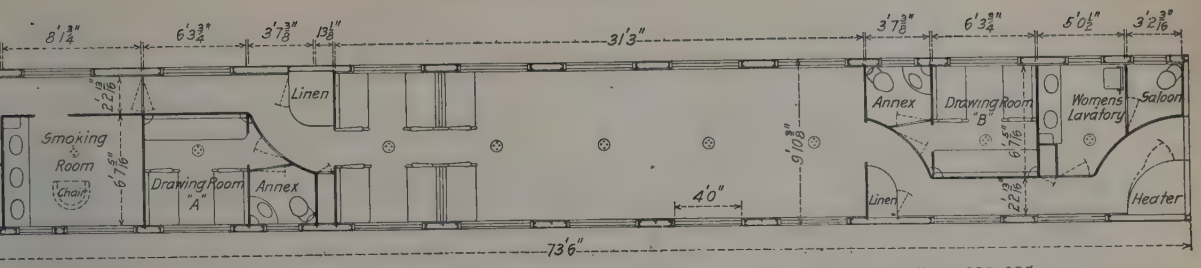


Fig. 384—Floor Plan of Canadian Government Railways Sleeping Car Shown in Figs. 380-385.

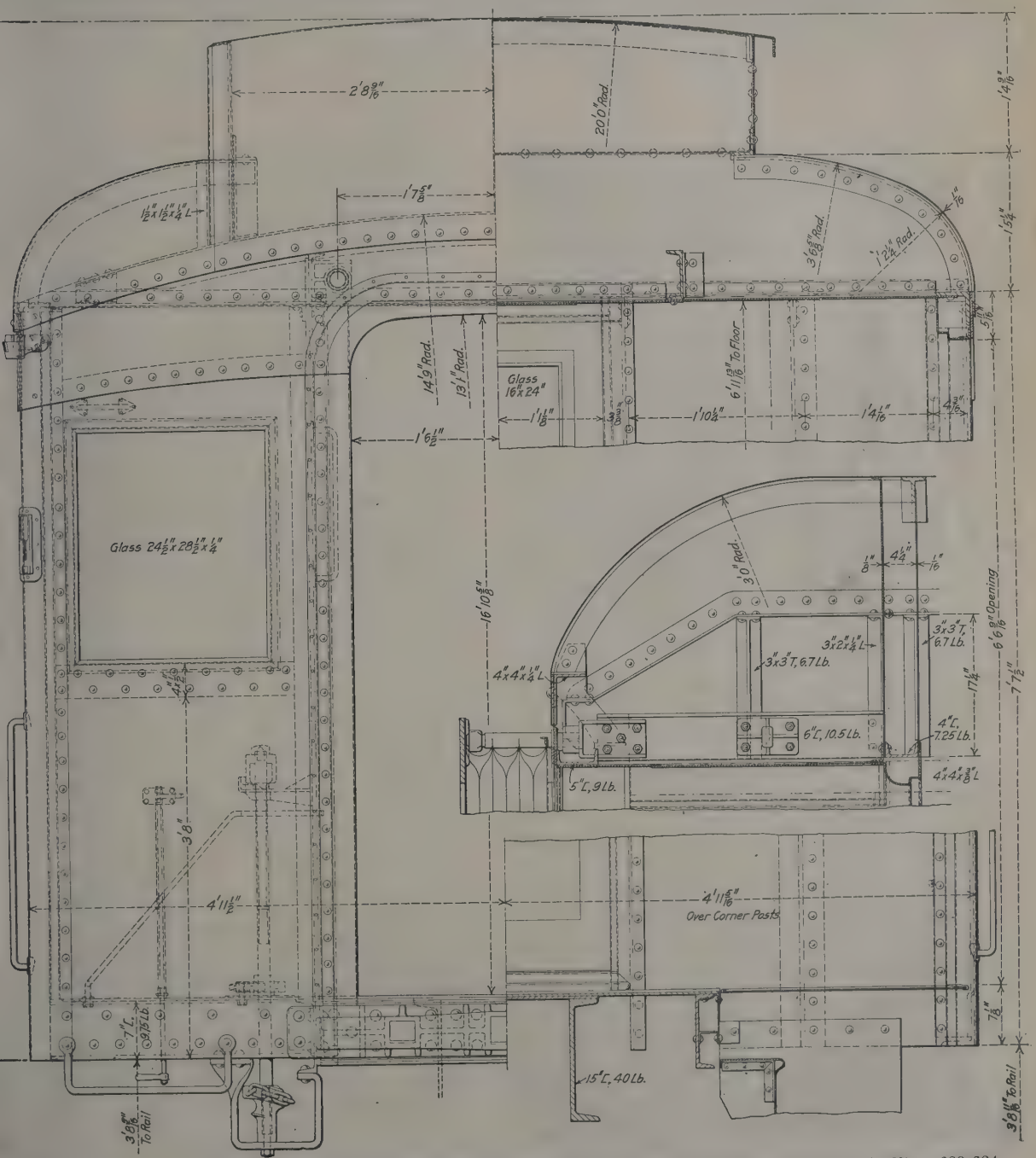


Fig. 385—Vestibule Construction of Canadian Government Railways Ten-Section Steel Sleeper, Shown in Figs. 380-384.

Fig. 386—Pullman Sleeping Car. Builder, The Pullman Company—Pullman Plant.

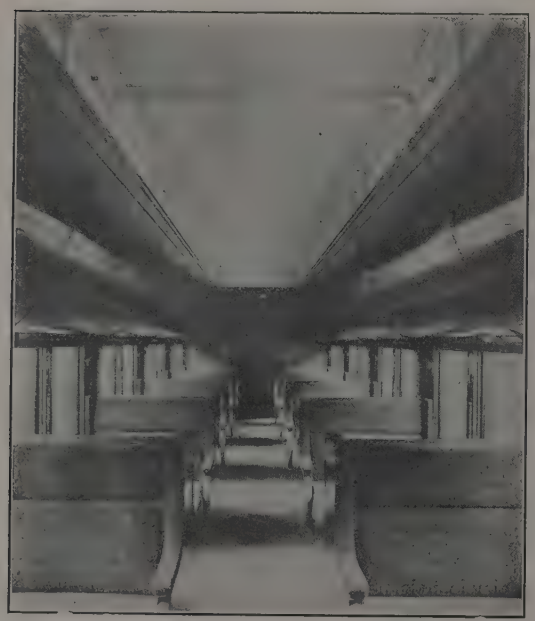


Fig. 387—Interior of Steel Pullman Sleeping Car.

Fig. 388—Interior of Sleeping Car Shown in Fig. 389.

Fig. 389—Steel Sleeping Car Built by the Canadian Pacific Railway. Interior Shown in Fig. 388.

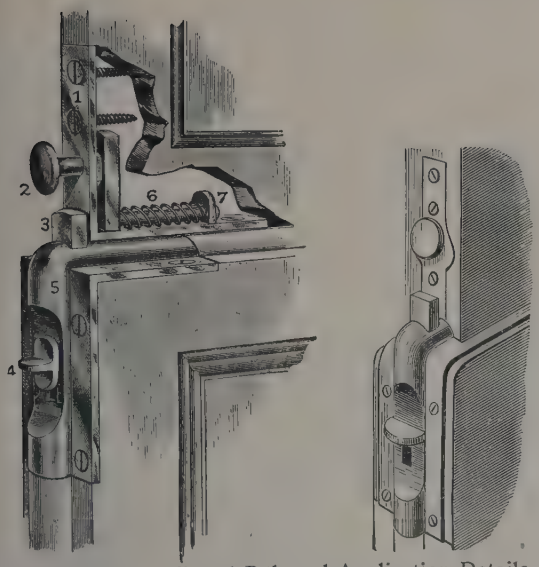


Fig. 390—Head Board Bolt and Application Details. Dayton Manufacturing Company.

Parts of Fig. 390.

1 *Upper Face Plate*
2 *Knob Latch*
3 *Lower or Fixed Bolt*
4 *Slide Latch*
5 *Lower Face Plate*
6 *Bolt Spring*
7 *Upper or Spring Bolt*

Parts of Sleeping Car Sections, Figs. 391-392.

1 *Lower Berth*
2 *Upper Berth*
3 *Lower Berth Arranged as Seat*
4 *Head Board*
5 *Clothes Hammock*
6 *Berth Curtain Rod*
7 *Berth Curtain*
8 *Mirror*
9 *Berth Lamp*
10 *Berth Chain*
11 *Berth Chain Pulley*
12 *Coat Hanger*
13 *Berth Safety Rope*
14 *Upper Berth Ladder*
15 *Upper Berth Safety Straps*
16 *Head Rest, Used at Night as Clothes Rack*
17 *Window Shade*
18 *Electric Bell Push Button*
19 *Portable Table*
20 *Lower Deck Head Lining*

Fig. 391—Pullman Sleeping Car Section with Upper Berth Down.

Fig. 392—Pullman Sleeping Car Section with Curtain Drawn Back Showing Berths Made Up.

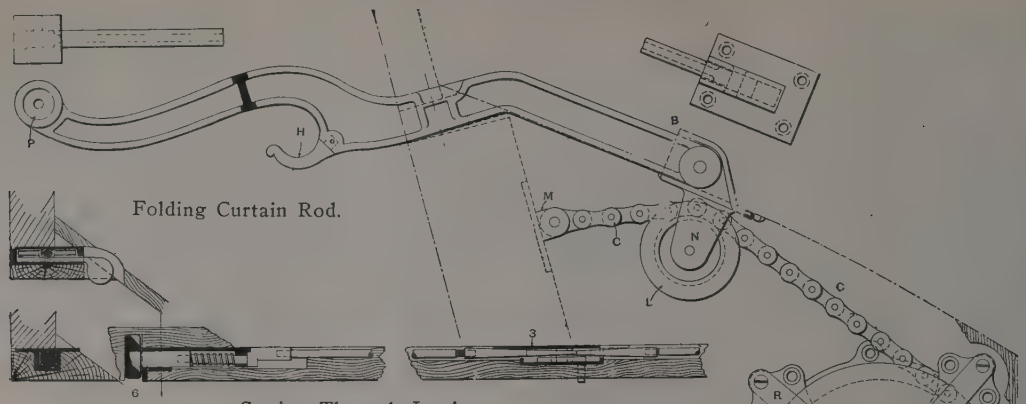


Fig. 393—Upper Berth Details.

Fig. 394—Berth Lock Handle. Adams & Westlake Company.

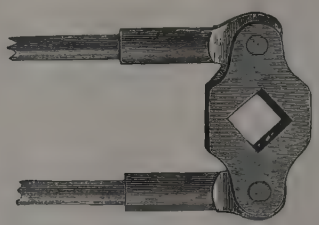
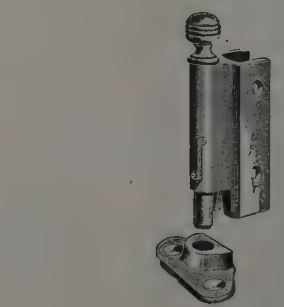
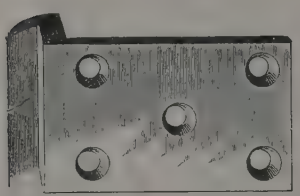


Fig. 395—Berth Lock Rods. Dayton Manufacturing Company.



Berth Spring, Chain and Pulley.



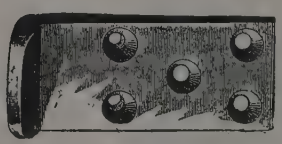


Fig. 396—Table Hooks. Dayton Manufacturing Company.

Fig. 397—Head Board Fastener. Adams & Westlake Company.

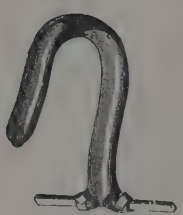


Fig. 398—Berth Curtain Hook. D. M. Co.

Fig. 399—Berth Curtain Hook.

Fig. 400—Berth Safety Rope Hook. A. & W. Co.

Fig. 402—Upper Berth Catch. A. & W. Co.

A. & W. Co.

D. M. Co.

A. & W. Co.

D. M. Co.

Fig. 401—Typical Designs of Berth Hinges.

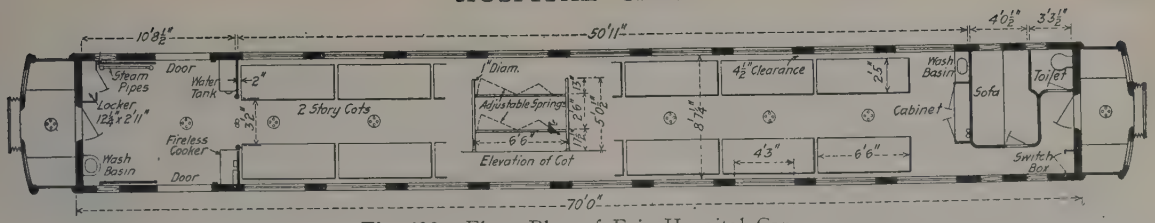


Fig. 403.—Floor Plan of Erie Hospital Car.

Fig. 404—Side Door Patient Car for the U. S. Army Hospital Train. Built by the Pullman Company—Pullman Plant.
(*See also Figs.* 405-407)

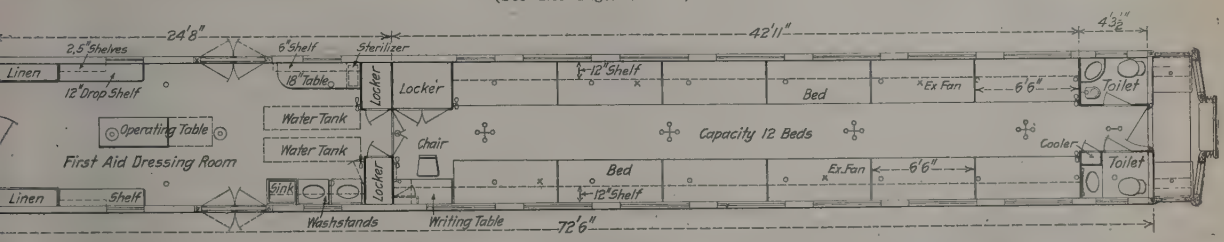


Fig. 405—Floor Plan of First-Aid Car for U. S. Army Shown in Figs. 404, 406, 407.

Fig. 406—Dressing Room of First Aid Car.

Fig. 407—Patient Car Showing Hospital Beds and Upper Berths.

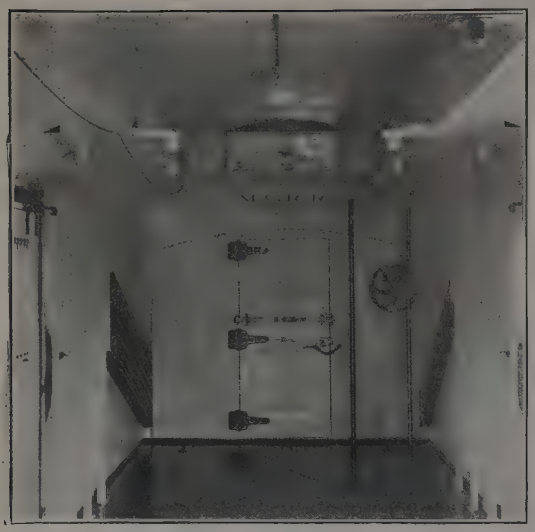


Fig. 408—Interior of New York Central All-Steel Baggage Car at Hand Brake End.

Fig. 409—Interior of New York Central All-Steel Baggage Car at Locker End.

Fig. 410—All-Steel Baggage Car Built by the American Car & Foundry Company for New York Central Lines.

Fig. 411—End View of New York Central All-Steel Baggage Car.

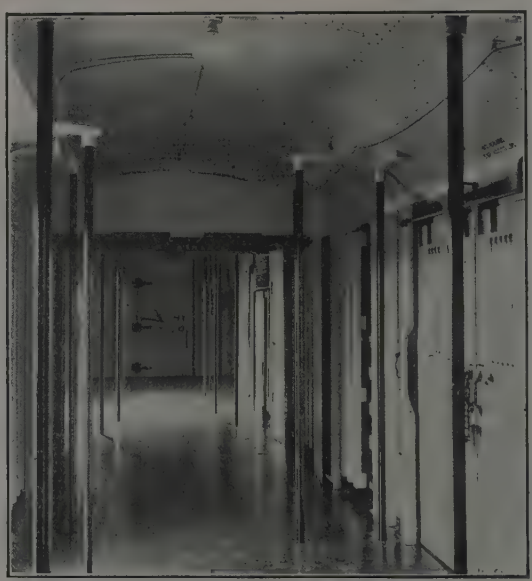


Fig. 412—Interior of New York Central All-Steel Baggage Car.

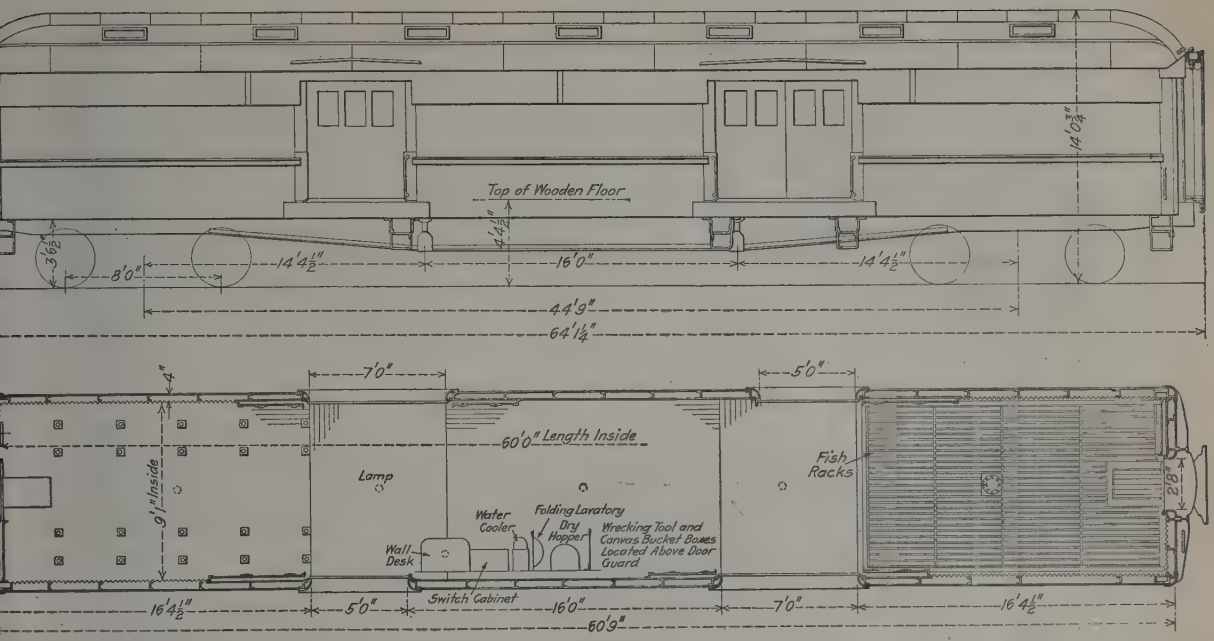


Fig. 413—Floor Plan and Elevation of the U. S. R. A. Standard Baggage Car.

(See also Fig. 414.)

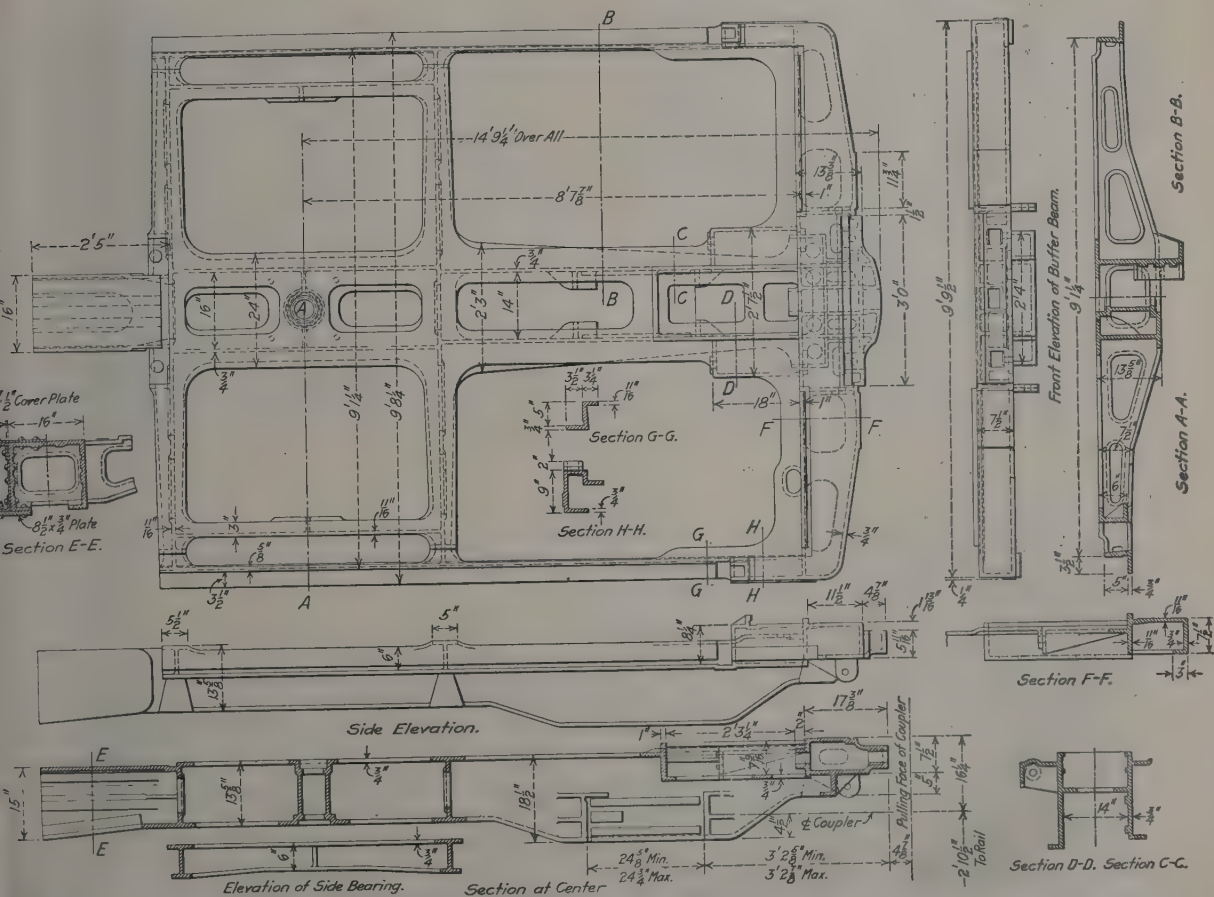


Fig. 414—Unit Cast Steel Double Body Bolster and Underframe End Construction for U. S. R. A. Baggage Cars.

(See also Fig. 413.)

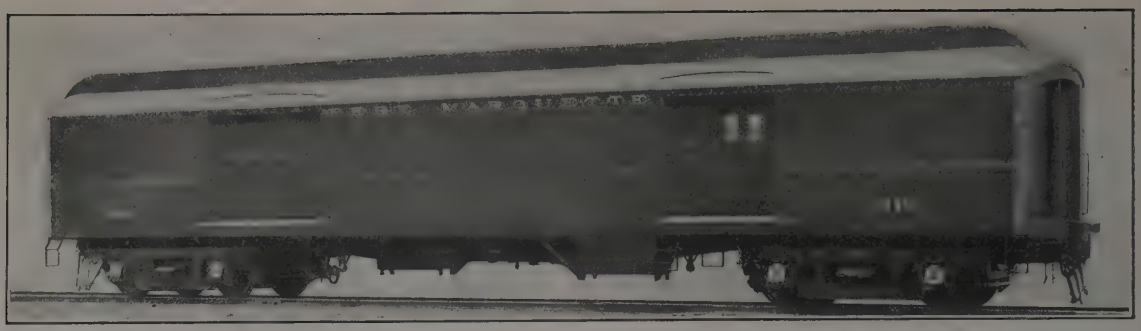


Fig. 415—All-Steel Baggage Car. Length Inside, 60 ft. 7in.; Width Inside, 9 ft. 7 in.. Builder, Standard Steel Car Company.

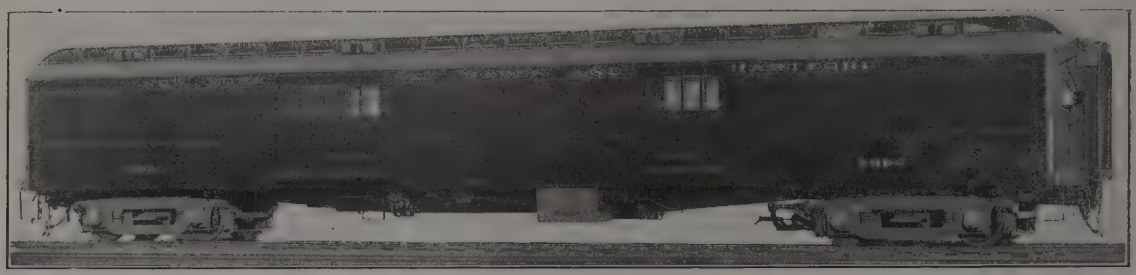


Fig. 416—All-Steel Baggage Car. Length Over End Sills, 73 ft. 3⅝ in. Builder, Osgood Bradley Car Company.

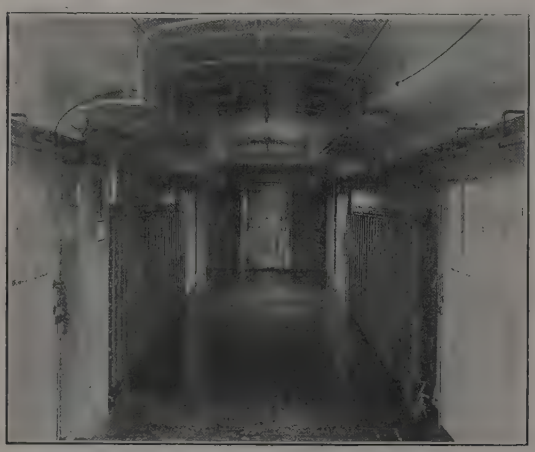


Fig. 417—Interior of Baggage Car. Shown in Fig. 416.

Fig. 418—Interior of Baggage Car. Shown in Fig. 416.

Fig. 419—Steel Underframe Baggage Car. Length Inside, 59 ft. 11⅝ in.; Width Inside, 8 ft. 10⅜ in. Builder, National Steel Car Corporation, Ltd.

Fig. 420—Steel Baggage and Express Car. Weight, 106,000 lb.; Length Over End Sills, 69 ft. Builder, The Pullman Company—Pullman Plant

(See also Fig. 421.)

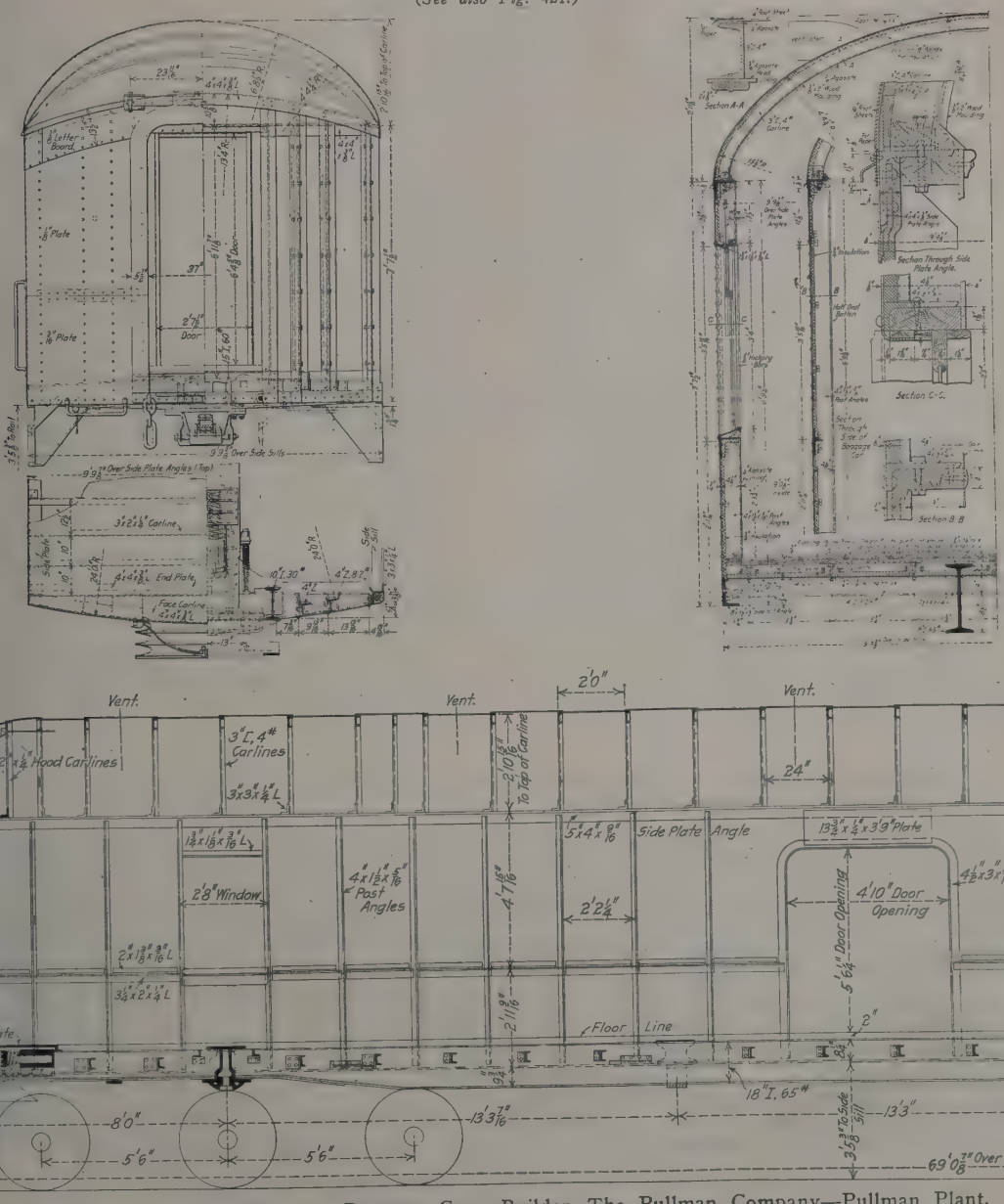


Fig. 421—Union Pacific Steel Baggage Car. Builder, The Pullman Company—Pullman Plant.

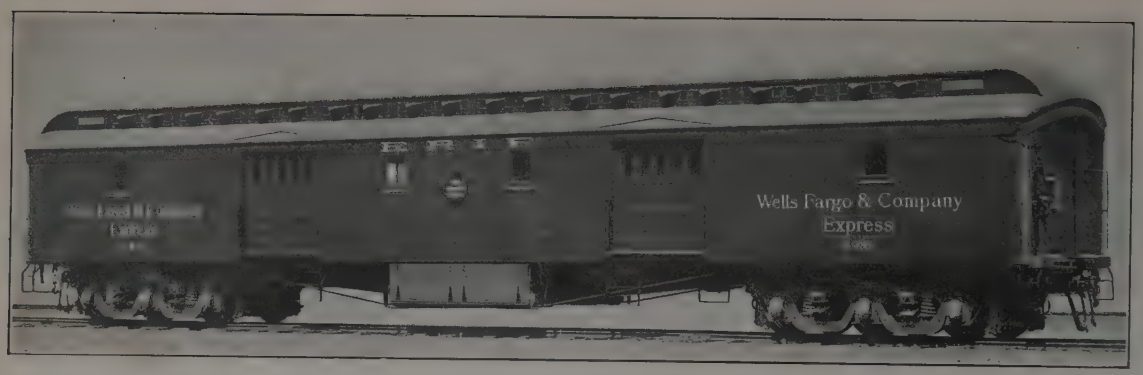


Fig. 422—Steel Underframe Express Car. Length Over End Sills, 70 ft. 9⅝ in. Builder, Osgood-Bradley Car Company.

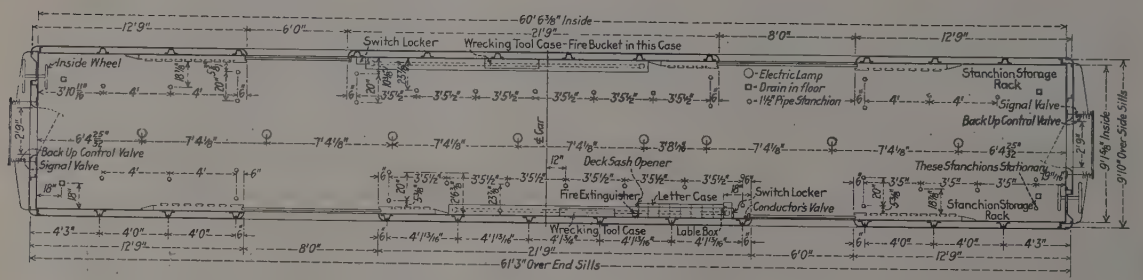


Fig. 423—Floor Plan Steel Express Car. Builder, American Car & Foundry Company.

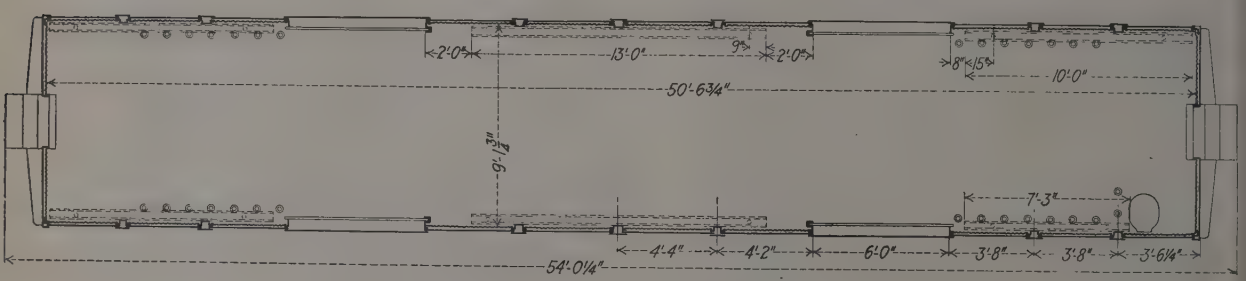


Fig. 424—Floor Plan of Pennsylvania General Utility, Express and Baggage Car Shown in Fig. 425.

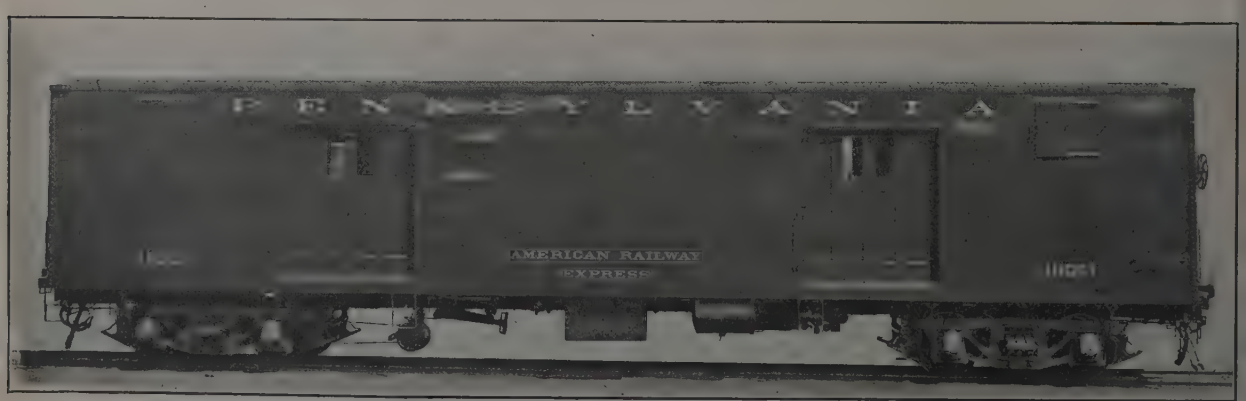


Fig. 425—Pennsylvania 70-Ton Capacity General Utility, Express and Baggage Car.

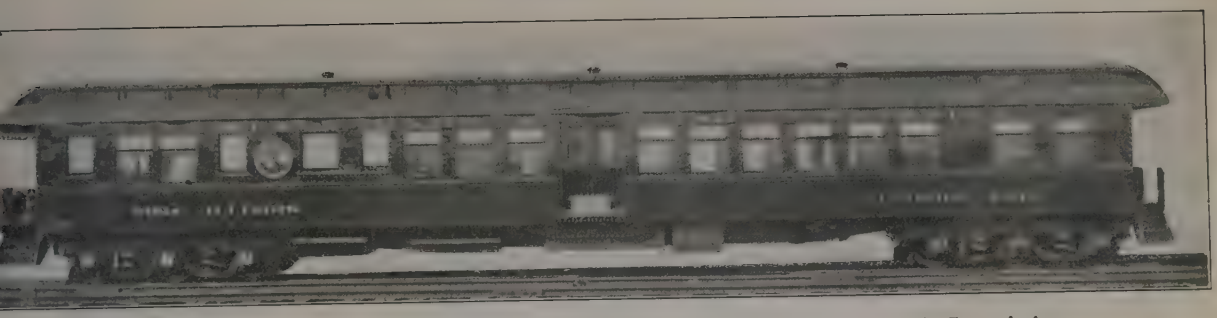


Fig. 426—Express Car Designed for Transportation of Live Fish for Illinois State Fish Commission.

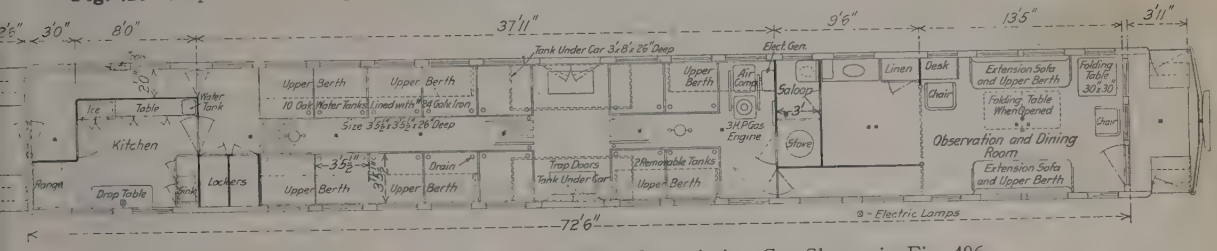


Fig. 427—Floor Plan of Illinois State Fish Commission Car Shown in Fig. 406.

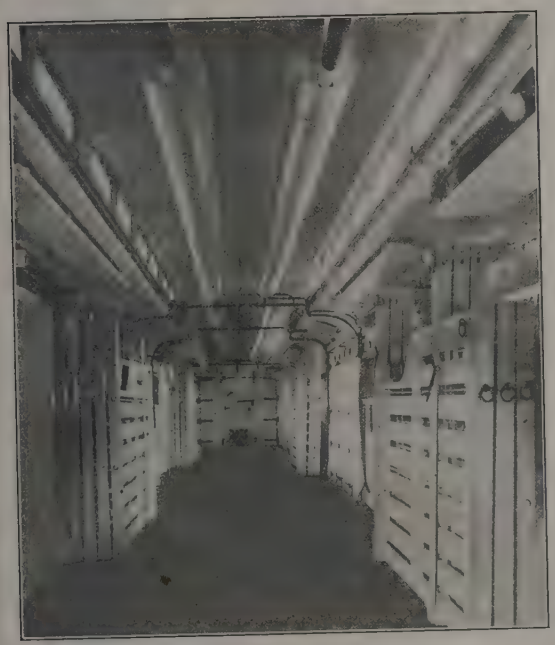


Fig. 428—Interior View of Car Shown in Fig. 430, Showing Stall Partitions Folded.

Fig. 429—Interior of Car Shown in Fig. 430. Partitions as Arranged When Car is Loaded.

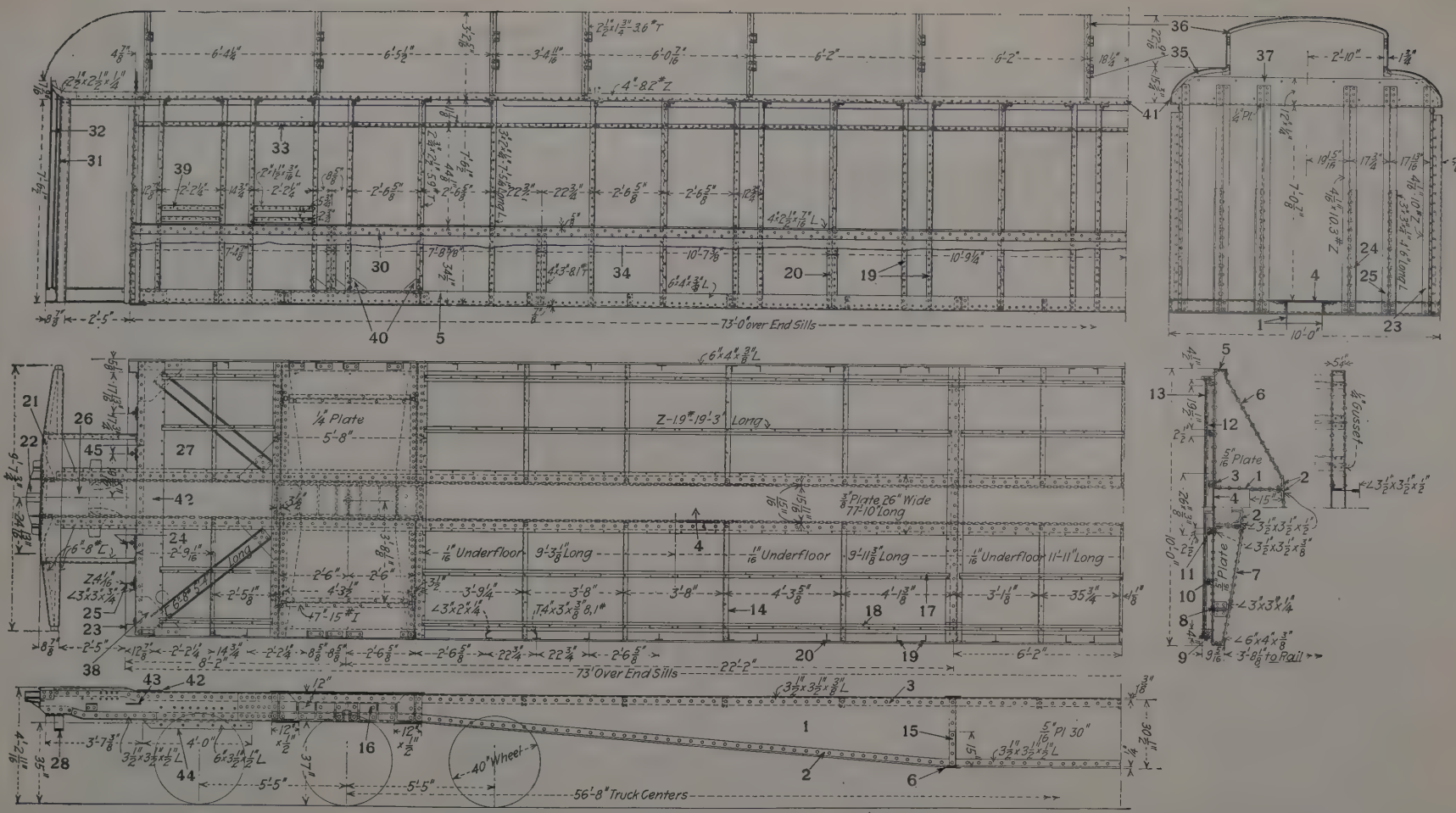
Fig. 430—Steel Express Car for the Transportation of Horses. Weight, 126,000 lb.; Length of Body Outside, 70 ft. Builder, American Car & Foundry Company.

1	*Center Sill Web Plate*	10	*Floor Nailing Strip*	19	*Angle Side Post*	28	*Drawbar Carry Iron*
2	*Center Sill Bottom Angle*	11	*Floor Nailing Strip*	20	*Tee Side Post*	30	*Side Girder Top Member or Belt Rail*
3	*Center Sill Top Angle*	12	*Underfloor Course*	21	*Buffer Beam*	31	*Vestibule Corner Post*
4	*Center Sill Cover Plate*	13	*Top Floor Course*	22	*Buffer Beam Extension*	32	*Vestibule Diaphragm Post*
5	*Side Sill Angle*	14	*Floor Support*	23	*Corner Post*	33	*Window Header Angle*
6	*Crossbearer Bottom Tie Plate*	15	*Crossbearer Center Filler*	24	*End Door Post*	34	*Side Sheathing Plate*
7	*Body Bolster Tie Plate*	16	*Bolster Center Filler*	25	*Intermediate End Post*	35	*Roof or Lower Deck Carline*
8	*Body Side Bearing*	17	*Floor Nailing Strip Stiffener*	26	*Platform Cover Plate*	36	*Roof or Upper Deck Carline*
9	*Floor Nailing Strip*	18	*Floor Nailing Strip Stiffener*	27	*Steel Underfloor Plate*	37	*Metal End Plate*
						38	*Side and End Sill Corner Gusset*
						39	*Window Sill Angle*
						40	*Side Post Gusset*
						41	*"Z" Bar Side Plate*
						42	*End Sill Top Tie Plate*
						43	*End Sill Bottom Tie Plate*
						44	*Draft Lug Angle*
						45	*End Sill Channel*

Fig. 431—Diagram of All-Steel Passenger Train Car, Giving Names and Showing Location of Parts.

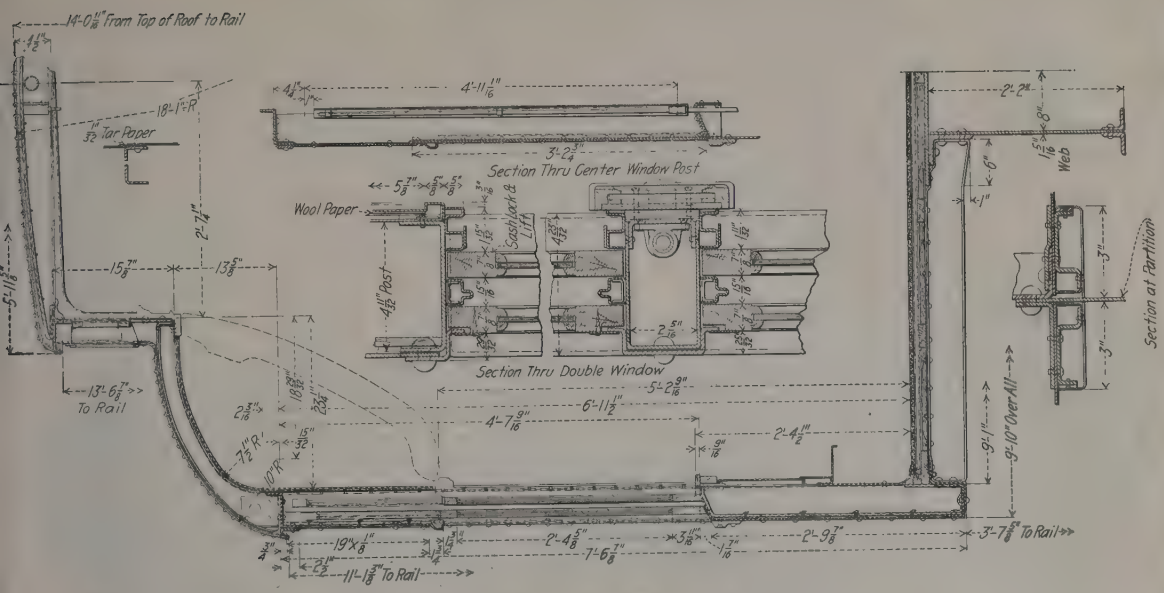


Fig. 433—The Pullman Company Standard Cross Section.

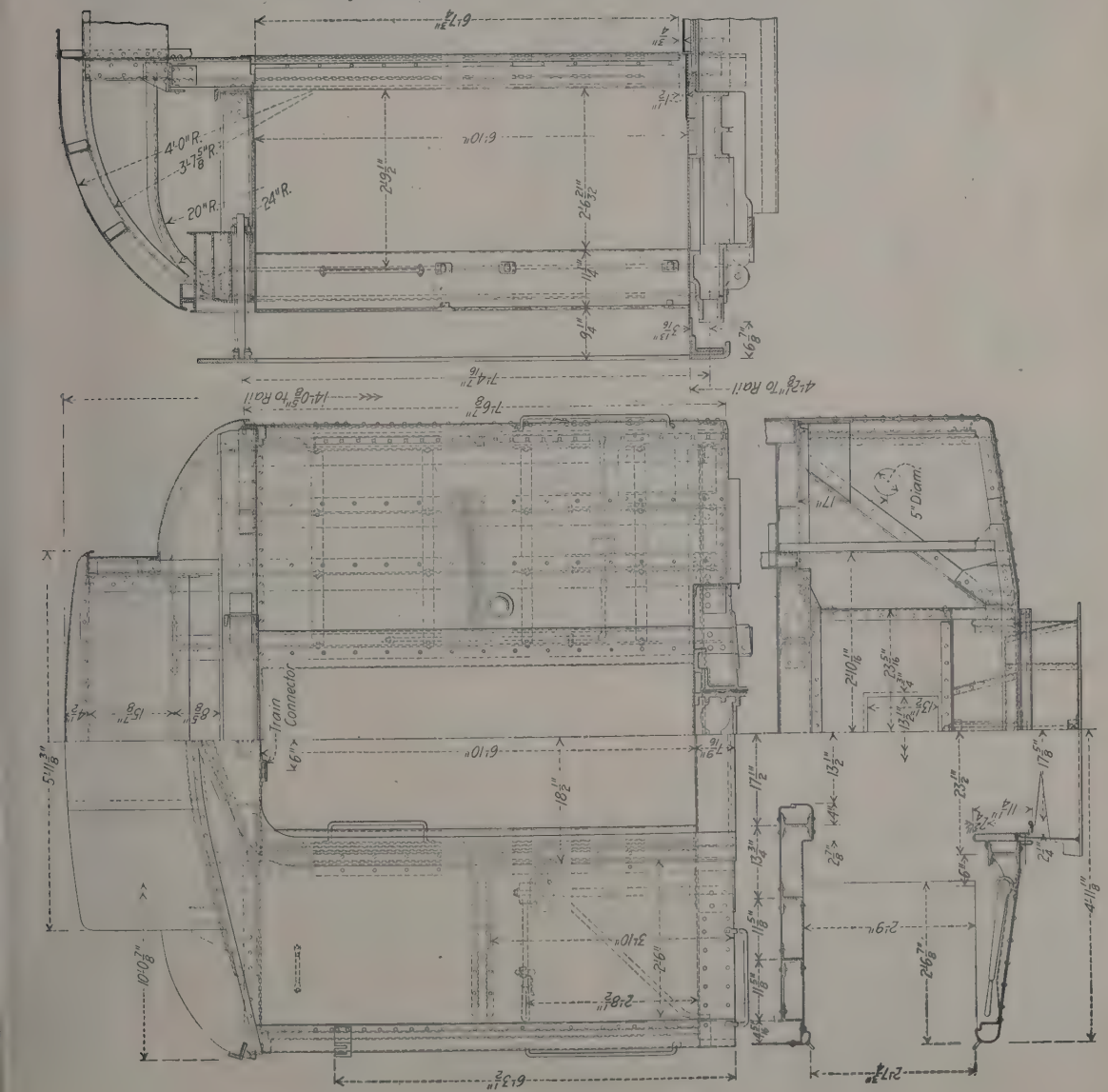


Fig. 432—The Pullman Company Standard Vestibule Construction.

All-Steel Passenger and Baggage Cars

The first cost and maintenance of the cars is an important element in the cost of railway passenger service. Likewise, the quality of the workmanship, convenience, and finish, which characterize the car interiors, is an important factor in attracting patrons. The relationship of the car building company to this branch of railway operation is therefore of unusual significance, and wide experience in dealing with the problem is not merely desirable, but is necessary.

Thorough knowledge of railway car building based on 86 years of continuous operation in the industry, is one of the resources of the Bethlehem Shipbuilding Corporation, Ltd., at the Harlan Plant. As the Harlan & Hollingsworth Corporation, Wilmington, Del., this plant has been engaged since 1836, in the design and construction of railway cars. Here, in 1840, was built what may be called the first types of the modern railway coach.

The Harlan Plant has kept abreast of every advance in the industry; the equipment is modern in every respect and capable of rapid and economical production. Car building tracks are sufficient to accommodate 64 seventy-foot cars at one time, while the machine shop, forge shop, plate shop, carpenter and joinery shops and upholstery shops are fully equipped. Of equal or perhaps greater importance is the experience and knowledge accumulated by the organization at the Harlan plant through many years of building various types of cars. These facts are important because of their bearing upon prompt deliveries and upon keeping down the first cost.

Typical Cars recently built that show the modern trend of the car builders art are illustrated on this page. Among the thousands of other cars turned out at the Harlan Plant, are representative examples of practically all of the types used in passenger, mail, and baggage transportation, for both foreign and domestic service. Included in this equipment are passenger cars, combination passenger and baggage cars, mail cars, express cars, combination mail and baggage cars, dining cars, private cars, special cars—for any purpose specified —café and club cars.

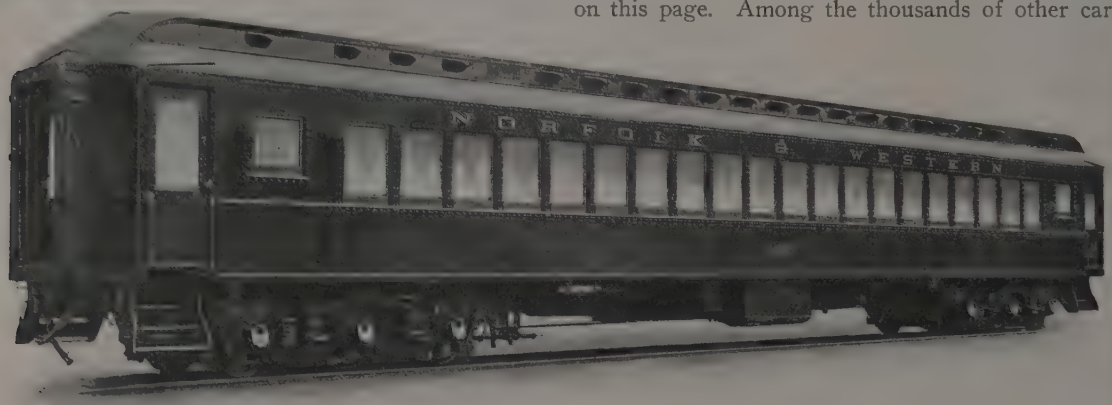


Fig. 434—Steel Passenger Car Built for the Norfolk and Western Railroad

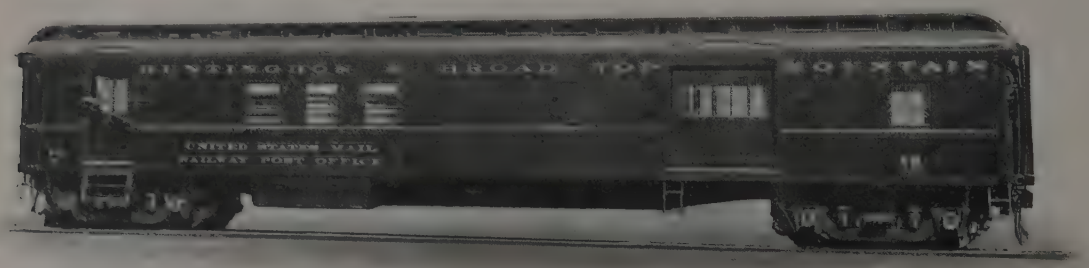


Fig. 435—Steel Combination Mail and Baggage Car Built for the Huntingdon and Broad Top Mountain Railroad and Coal Company

High-grade iron and steel in the building of Bethlehem Cars is assured through the affiliation of the Bethlehem Shipbuilding Corporation, Ltd., with the Bethlehem Steel Company.

Any set of specifications can be fulfilled, and if desired, complete specifications for any equipment can be prepared. The combination of modern equipment and experienced personnel makes possible the production of high grade cars with speed and economy.

For other products and branch offices, see classified and alphabetical indexes.

BETHLEHEM SHIPBUILDING CORPORATION, LTD., BETHLEHEM, PA.

Postal Cars

THE TRANSPORTATION OF MAIL requires the use of specially designed cars equipped for operation in passenger trains. These cars are constructed along the same general lines as baggage cars and other passenger train equipment but are provided with interior fittings especially designed to facilitate the handling of mail. Some cars are provided with facilities—letter cases, pouch racks, etc.—for sorting mail en route; other cars—mail storage—are designed only for the transporting of mail.

In order to standardize this class of equipment, the Post Office Department of the United States Government, in

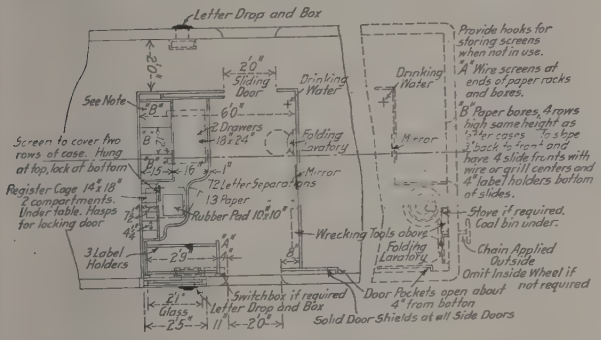

Letter Drop and Box
Provide hooks for storing screens when not in use.
4" Wire screens at ends of paper racks and boxes.
5" Paper boxes, 4 rows high same height as letter cases, to slope back to front and have 4 slide fronts with wire or grill centers and 4" label holders bottom of slides.
Store if required. Coal bin under.
Chain Applied Outside
Omit Inside Wheel if not required
Door Pockets open about 4" from bottom
Solid Door Shields at all Side Doors
Sliding Door
Drinking Water
Folding Lavatory
Mirror
See Note
Screen to cover two rows of case. Hung at top, lock at bottom
Register Cage 14"x18" 2 compartments. Under table. Hasps for locking door
12 Letter Separations
13 Paper
Rubber Pad 10"x10"
Wrecking Tools above
3 Label Holders
Switchbox if required
Glass
Letter Drop and Box

FIG. 436—FLOOR PLAN OF 6 FT. ALLEY COMPARTMENT

1912, after conferences with a committee of mechanical engineers appointed by the railroads, issued specifications and floor plans for postal cars and fixtures for use in United States Mail Service.

In 1915 the specifications and floor plans were adopted as Recommended Practice by the Master Car Builders' Association.

Modifications of these plans, which provided for optional standards, were issued in September 1917; these optional plans were so designed that the mail compartments can be converted from one standard length to another when service conditions make it necessary to increase or decrease the space devoted to handling mail. Further modifications were made under date of February 2, 1920.

In 1922 there were in service on American railroads the following number of cars:

Postal	1,262
Mail Storage	134
Baggage—Mail	1,828
Baggage—Mail—Express	707
Passenger—Mail—Baggage	422

The American Railway Association classification for postal cars; and the specifications with drawings conforming thereto, are as follows:

A. R. A. Classification

Recommended Practice—Adopted 1915

CLASS "M."

"MA"—Postal Car, For use of United States Mail Service, fitted with side doors, with or without mail-bag hook, and having suitable apparatus for the sorting and classifying of mail in transit, with or without end doors or windows.

"MB"—Baggage and Mail. A car having two compartments, one for baggage and one for mail, separated by bulkheads; the mail end fitted with suitable apparatus for sorting and classifying mail, and with or without mail-bag catchers, with or without end doors or windows, and having suitable side doors.

"MP"—Postal Car. Suitable for transporting newspapers or large mail packages for United States Mail Service, having side doors and fitted with stanchions, with or without end doors or windows.

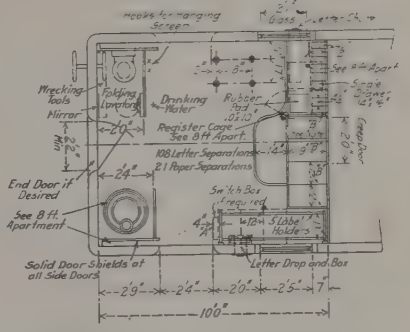


FIG. 437—FLOOR PLAN OF 10 FT. MAIL COMPARTMENT

"MR"—Postal Storage Cars. For United States Mail Service, suitable to carry mail in bulk, without appliances for sorting or classifying, fitted with side doors and stanchions and with or without end doors or windows.

"MS"—Mail and Smoker. A combined car having two separate compartments, separated by bulkheads, one compartment suitable for the transportation, sorting and classifying of mail, the other fitted with seats or chairs to be used by passengers as smoking car.

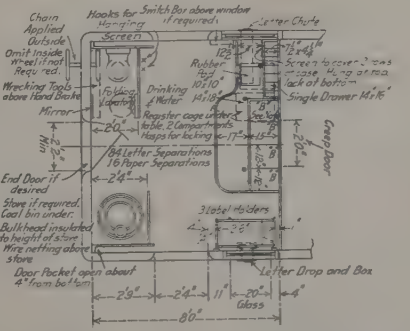
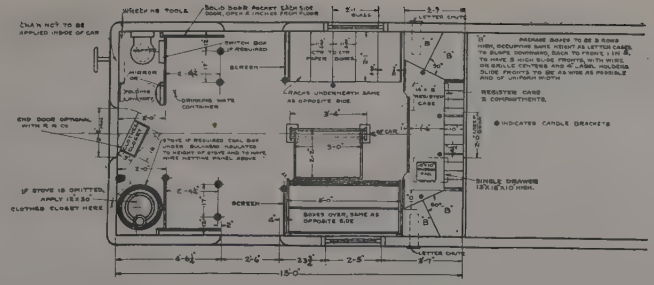


FIG. 438—FLOOR PLAN OF 8 FT. MAIL COMPARTMENT

"MBE"—Combination Baggage, Mail and Express Car. A



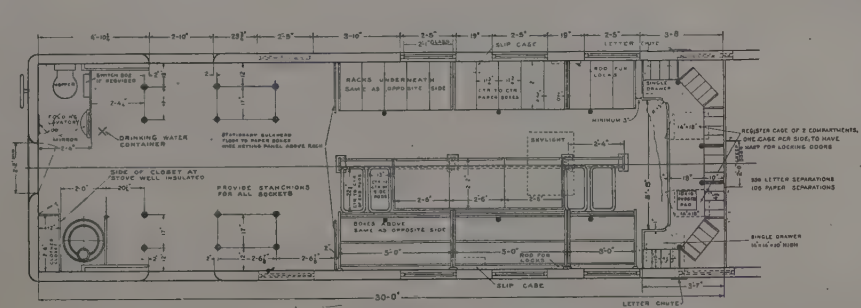
FLOOR PLAN FOR STANDARD 15FT MAIL APARTMENT.

(1) 60 ft. Full Car—Floor plan showing doors and windows arranged for 60 ft. car, or for converting to a 30 ft. or 15 ft. compartment. Windows shown in full lines and three skylights shown by dotted lines for 60 ft. car; windows shown in dotted lines may be installed complete in original construction, or provision made for completion when required. So that part or entire car may be used in other than distributing mail service, extra posts may be provided in side walls of such nature as will permit widening the doors at minimum cost.

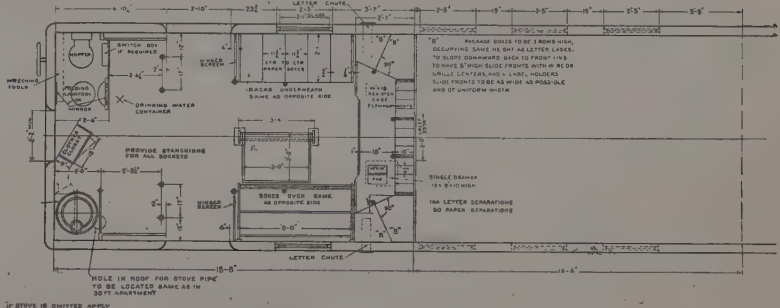
(2) 30 ft. Compartment—Doors and windows located to permit compartment being reduced to 15 ft. without change in this respect. If originally fitted up as a 30 ft. compartment, windows shown in full lines and the skylight in dotted lines are required; windows shown in dotted lines can be installed complete or provision made for completion when change to 15 ft. compartment is made. If contemplated that car may be changed into a 60 ft. car, the additional doors, windows and skylights shown on the 60 ft. plan can be installed complete, or provision made for completion as required.

(3) 15 ft.—15 ft. 8 in. Compartment—Optional, in lieu of the standard plan shown on R.M.S. Sheet F, revised February 2, 1920. Designed to permit compartment being extended to 30 ft. or 60 ft. without change in doors or windows. Involves use of side doors of same width as in 30 ft. and 60 ft. cars, and same space for toilet as in the larger units. The compartment is 8 inches longer than the 15 ft. shown on Sheet F, although there is no increase in the facilities in the compartment and it is rated the same as the 15 ft. compartment.

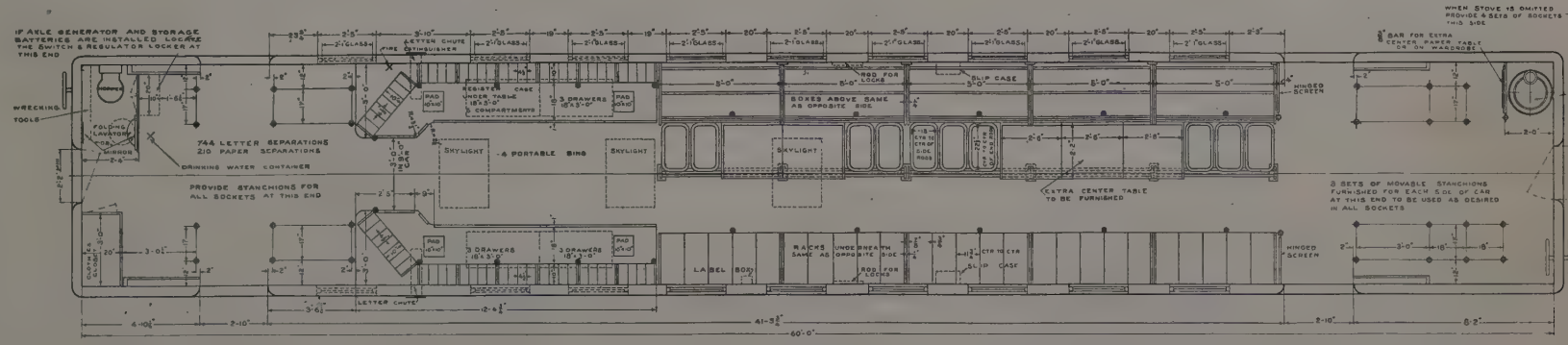
(4) If inside length of car exceeds 60 ft. the excess should be added between side door opening and end of car. If excess is greater than 3 ft. stove should be located at same end of car, on opposite side, and adjacent to the door opening, with a bulkhead of insulated metal plates to height of stove and wire netting panel above; face of bulkhead to be flush with edge of door opening.



FLOOR PLAN FOR STANDARD 30FT MAIL APARTMENT



FLOOR PLAN FOR 15FT. (15FT.–8IN.) MAIL APARTMENT



FLOOR PLAN FOR STANDARD 60FT MAIL CAR

FIG. 439—FLOOR PLANS OF 60 FT., FULL POSTAL CAR AND 30 FT., 15 FT., AND 15 FT. 8 IN. COMPARTMENTS, SHOWING ARRANGEMENT OF DOORS, WINDOWS, ETC., AND LOCATION LETTER CASES, POUCH RACKS, STANCHIONS, ETC.

car having three compartments, each entirely separate from the other for handling its individual class of business.

U. S. Government Postal Car Specifications

1. TYPES.—Postal cars may be built according to any of the following types of construction:

I. Heavy center-sill construction, the center sills acting as the main carrying member.

II. Side-carrying construction, the sides of the car acting as the main carrying members, having their support at the bolsters.

III. Underframe construction in which the load is carried by all the longitudinal members of the lower frame. The superstructure framing shall be of steel.

IV. Combination construction in which the side frames carry a part of the load, transferring same to the center sills at points remote from the center plate for the purpose of utilizing uniform center-sill area.

Steel castings may be used as parts of the underframe in any of the above types.

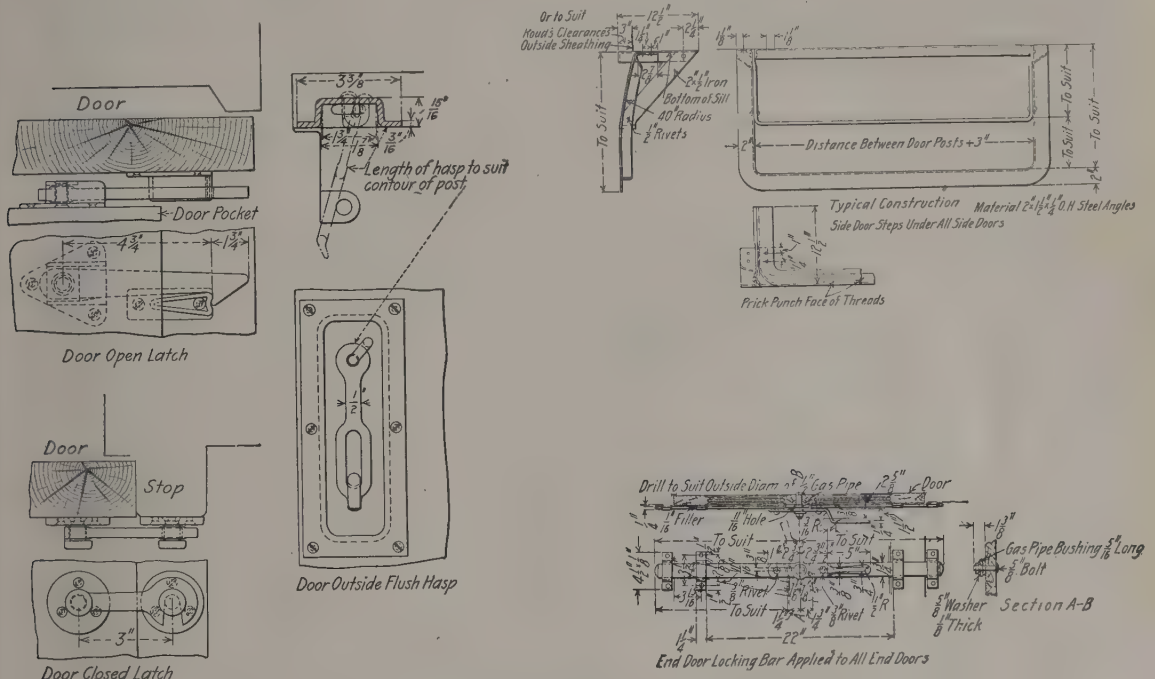


FIG. 440—DOOR HASP AND LATCHES, SIDE DOOR STEP, AND END DOOR LOCKING BAR.

2. MATERIAL.—(*a*) All rolled-steel plates and shapes used in the car framing shall be made by the open-hearth process.

(*b*) The physical and chemical properties of all material used in the car framing shall be in accordance with the latest standard specifications of the American Society for Testing Materials, as follows: The standard specification for structural steel for cars; the standard specification for wrought iron, for iron bars and plates, and the standard specifications for steel castings.

3. WORKMANSHIP.—All workmanship throughout the car shall be first class. The jointing of the car framing shall be made so that the structure as a whole shall be built to dimensions specified, and all joints exposed to the weather shall be made tight against leakage.

4. LIVE LOADS.—(*a*) The car body shall be designed to carry the specified live load in addition to its own dead weight under service conditions. Where no live load is specified by the railroad company, the maximum capacity of car, as determined by journal loads given in Section 36, shall be used as a basis for calculations.

(*b*) For 60-foot distributing cars, 20,000 pounds shall be assumed as the minimum live-load capacity. Where postal cars are used for storage cars or under unusual load conditions, live-load capacity shall be from 40,000 to 50,000 pounds, depending upon the character of the mail to be handled.

5. BUFFING.—The maximum end shock due to buffing shall be assumed as a static load of 400,000 pounds applied horizontally at the resultant line of the forces acting at the center line of the buffing mechanism and at the center line of draft gear, respectively, and shall be assumed to be resisted by all continuous longitudinal underframe members below floor level, provided such members are sufficiently tied together to act in unison. Calculations for resistance to buffing shocks shall be based only on

FIG. 441—OUTSIDE LETTERING. WORDS REQUIRED AS SHOWN. DESIGN TO HARMONIZE WITH OTHER LETTERING ON CAR.

underframe members below floor level. These underframe members may be considered supported against buckling vertically by the superstructure between center plates at cross bearers to the extent that the strength of superstructure, cross bearers, and attachments is available for this purpose.

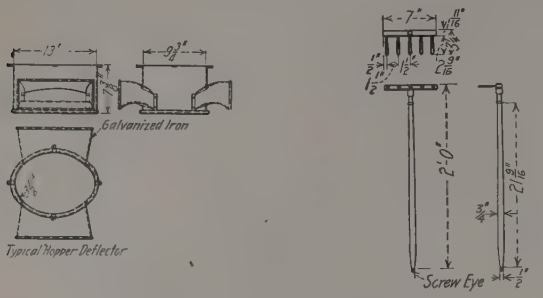


FIG. 442—HOPPER DEFLECTOR; PAPER RAKE.

NOTE 1.—For electric cars operated on lines where electricity is the only motive power and the total weight of trains does not exceed 600,000 pounds, the static load may be assumed to be 200,000 pounds.

NOTE 2.—For self-propelled cars, where the weight of the operating unit, consisting of the power car and one or more trailers, does not exceed 200,000 pounds, the static load may be assumed to be 100,000 pounds.

6. DETAILS.—(*a*) All connections, except those specified for end construction in Section 18, shall be designed by the maximum load to which the member connected shall be subject; and secondary stresses in any members caused by eccentric loads shall be combined with the direct stresses in such members. The maximum fiber stresses in any

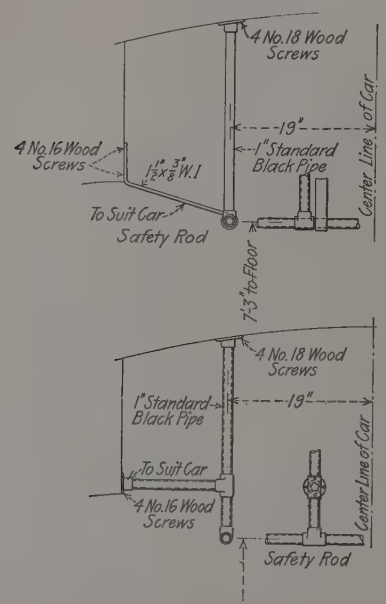


FIG. 443—SAFETY RODS.

member subject to both direct and secondary stresses may be taken at 20 per cent greater than those given in Section 20; but the direct stresses considered alone must not exceed the allowable stresses given in said section.

(*b*) The distance between centers of rivet holes shall be not less than three diameters of the rivet and not more than 24 times the thickness of the thinnest outside member. The minimum distance between the center of the rivet hole and a sheared edge shall be not less than 1½ times the diameter of the rivet.

(*c*) Below the floor line, framing connections of floor beams, posts, etc., may be of rolled steel, pressed plate,

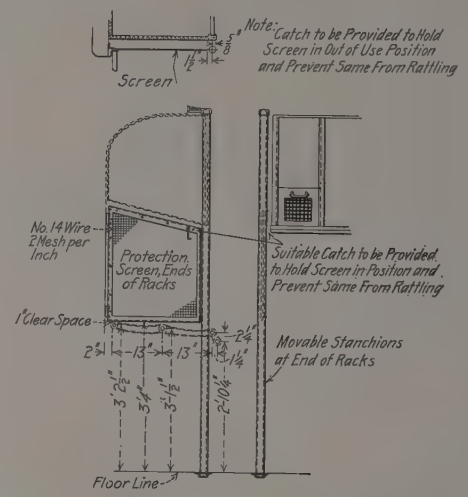

Note: Catch to be Provided to Hold Screen in Out of Use Position and Prevent Same From Rattling
Screen
No.14 Wire 2 Mesh per Inch
Protection Screen, Ends of Racks
Suitable Catch to be Provided to Hold Screen in Position and Prevent Same From Rattling
1" Clear Space
Movable Stanchions at End of Racks
Floor Line

FIG. 444—BAG RACK SCREEN.

or cast steel, and above the floor line such connections may also be of malleable iron. Connections for I beams, channels, or tees may also be made by coping the flanges and bending the web to form a knee, and for angles by coping one leg and bending the other.

(*d*) The use of fillers in the underframe and superstructure shall be avoided wherever possible.

(*e*) All holes for rivets or bolts in the underframe, superstructure, or outside finish shall be drilled or punched

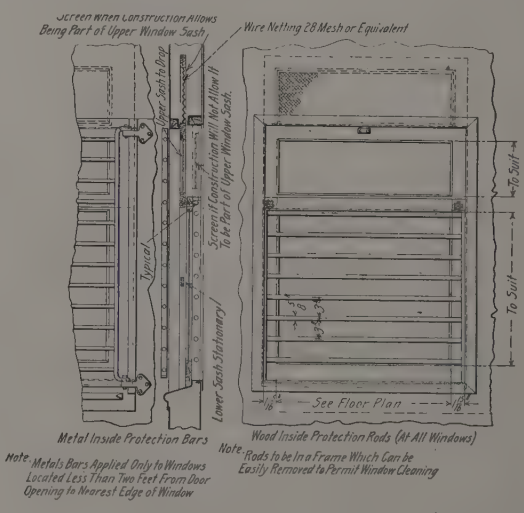

Screen When Construction Allows Being Part of Upper Window Sash
Wire Netting 28 Mesh or Equivalent
Upper Sash to Drop
Typical
Screen if Construction Will Not Allow it To be Part of Upper Window Sash
To Suit
To Suit
See Floor Plan
Lower Sash Stationary
Metal Inside Protection Bars
Wood Inside Protection Rods (At All Windows)
Note: Metals Bars Applied Only to Windows Located Less Than Two Feet From Door Opening to Nearest Edge of Window
Note: Rods to be In a Frame Which Can be Easily Removed to Permit Window Cleaning

FIG. 445—WINDOW PROTECTION RODS.

and reamed to size and fairness. No drifting of holes will be allowed. In deducting rivet or bolt holes to obtain the net area of any section they shall be taken at one-sixteenth inch larger than the diameter of the rivet or

bolt. The effective area of a rivet shall be taken as its area before driving.

(*f*) All rivets, when driven, must completely fill the holes and have full concentric heads or countersunk when required.

7. Center Sills.—The center sills may be built up or composed of rolled or pressed shapes, either with or without cover plates, and cast-steel draft sills or end construction may be used in connection with any of the above types, with suitable riveted connections at splices. Built-up center sills may be either of uniform depth or of the fish-belly shape, and may be composed of rolled shapes, web plates, flange angles, and cover plates. If preferred, the web plates may be flanged and angles omitted. When flange angles are used they shall be connected to the webs with a sufficient number of rivets to transfer the total shear at any point in a distance equal to the depth of the sill at that point. When cover plates are used they must extend at least two rows of rivets at each end beyond their theoretical length.

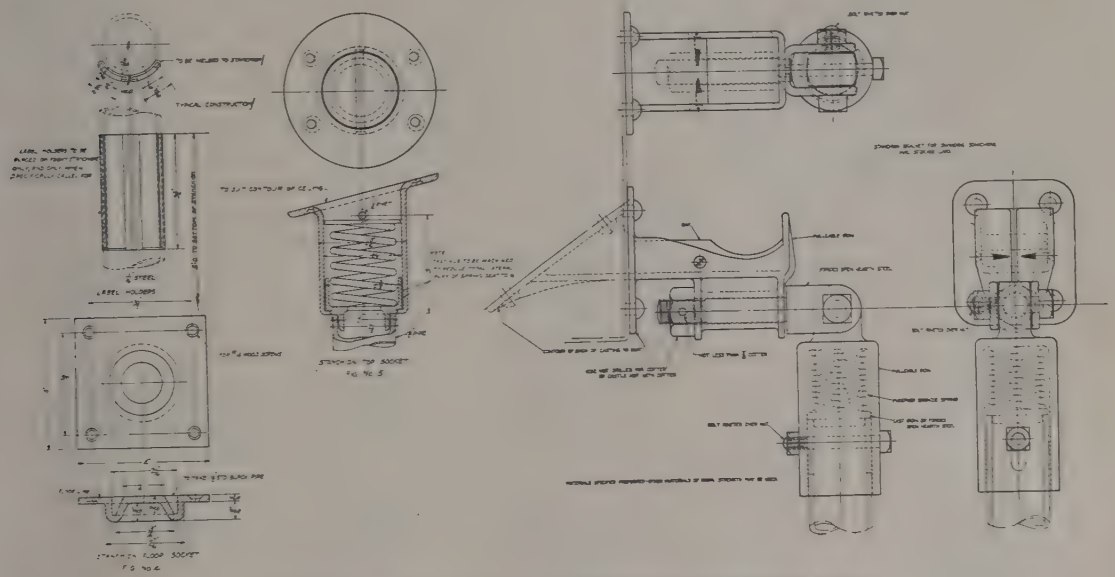


Fig. 446—stanchion sockets—Stationary and swinging types.

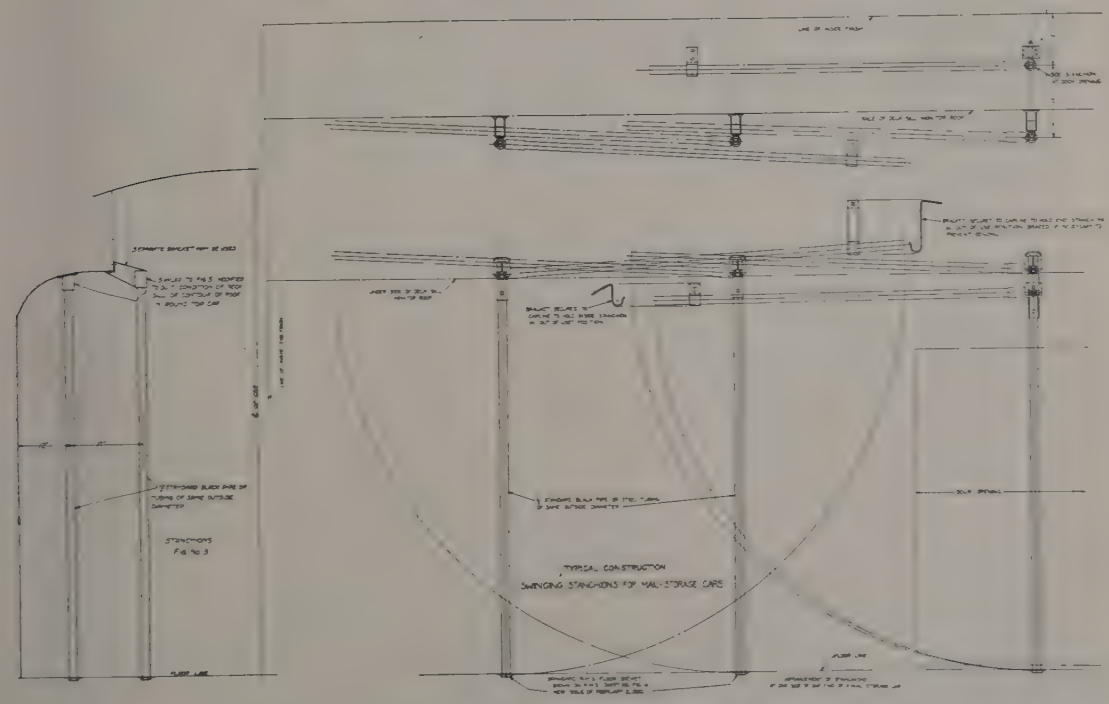


Fig. 447—stanchions—at left, stationary; at right, swinging types.

8. Bolsters and Cross Bearers.—The body bolsters and cross bearers may be of either cast-steel or built-up con-

struction, with ample connections at center and side sills to transmit the calculated vertical shear.

9. Floor Beams.—Transverse floor beams may be of rolled or pressed shapes, with suitable connections at center and side sills.

10. Floor Supports.—Longitudinal floor supports shall be supported at each transverse floor member.

11. End Sills.—The end sills may be either rolled or pressed shapes, built-up construction or cast steel, with ample connections at center and side sills. They must be designed for the maximum vertical loads to which they may be subject and also for the assumed horizontal loads transferred from vertical end members as specified in Section 18.

12. Side Frame—General.—In calculating the stresses in the side frame, its effective depth when designed as a truss or girder may be taken either as the distance between centers of gravity of the side plate and side sill or as the distance between centers of gravity of belt rail and side sill. At the side-door openings the bending moment caused by the vertical shear at door posts shall be considered as being resisted by the section above and below door openings, and the sum of the direct stresses and those due to bending at such sections shall not exceed the stresses specified in Section 20. A sufficient proportion of any reinforcing members added to these sections shall be extended far enough beyond the door posts at each side that their reaction can be taken care of by the side frame without exceeding the limit specified for stresses.

13. Posts.—The sum of the section moduli taken at any horizontal section between floor line and top line of windows, of all posts and braces on each side of car located between end posts, shall be not less than 0.30 multiplied by the distance in feet between the centers of end panels, a panel length being considered as the distance between lines of rivets in adjacent vertical posts.

14. Sheathing.—Outside sheathing plates of steel or iron shall be not less than ⅛ inch in thickness. Additional outer finish may be used.

15. Roof—General.—The roof may be of either the clere-story or turtleback type. In the clere-story type, the deck plates shall be in the form of a continuous plate girder or equivalent construction extending from upper-deck eaves to deck sill, and either built-up of pressed or rolled shapes or pressed in one piece from steel plates. The carlines may be of either rolled or pressed steel shapes extending in one length across car from side plate to side plate or may extend only across upper deck. In the latter case, the lower-deck carlines may be formed by cantilever extensions of the side posts or by independent members of pressed or rolled shapes. In the turtleback type the carlines may be of either pressed or rolled shapes, extending in one length across car between side plate and side plate or may consist of cantilever extensions of the posts.

16. Carlines.—The projected area of the portion of roof in square feet supported by carlines divided by the sum of the section moduli of the carlines must not be more than 100.

17. Roof Sheets.—Roof sheets, if of steel or iron, shall be of a minimum thickness of 0.05 inch and either riveted or welded at their edges.

End Construction

18. Vertical End Members.—(*a*) The sum of the section moduli of all vertical end members at each end shall be not less than 65, and the section moduli of the main members, either forming or adjacent to the door-posts, shall be not less than 75 per cent of this amount. Any excess of section moduli over 65 may be distributed at the discretion of the railroad for whose service the cars are built.

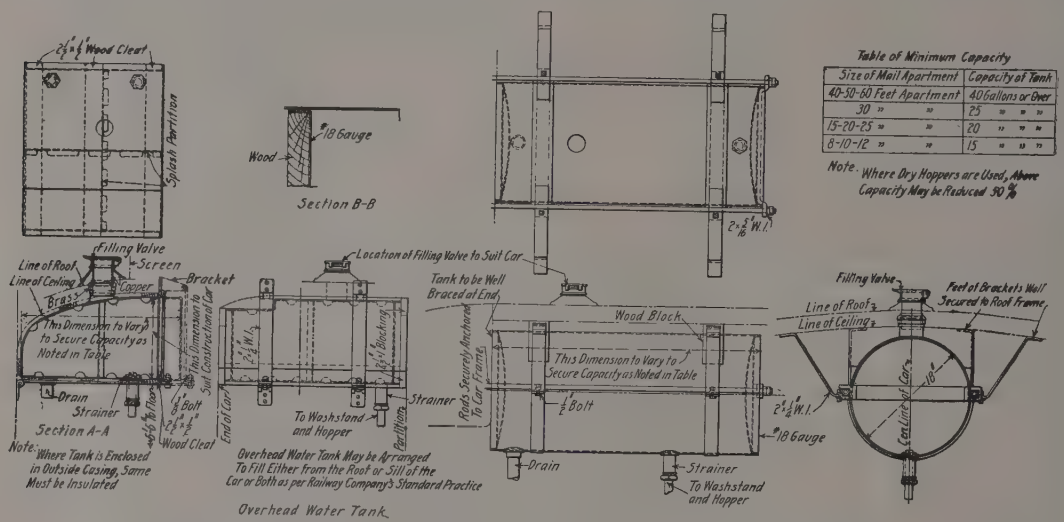


Table of Minimum Capacity
Size of Mail Apartment | Capacity of Tank
40-50-60 Feet Apartment | 40 Gallons or Over
30 " " | 25 " " "
15-20-25 " " | 20 " " "
8-10-12 " " | 15 " " "
Note. Where Dry Hoppers are Used, Above Capacity May be Reduced 50%
Section B-B
Section A-A
Overhead Water Tank
Filling Valve
Screen
Bracket
Drain
Strainer
To Washstand and Hopper
Wood Block
Tank to be Well Braced at End
Location of Filling Valve to Suit Car
Rods Securely Anchored To Car Frame
Feet of Brackets Well Secured to Roof Frame
Line of Roof
Line of Ceiling
Cantilever of Carlines
Where Tank is Enclosed in Outside Casing, Same Must be Insulated
Overhead Water Tank May be Arranged To Fill Either from the Roof or Sill of the Car or Both as per Railway Company's Standard Practice

Fig. 448—typical construction of overhead water tank for postal cars.

(*b*) The horizontal reactions of all vertical end members at top shall be calculated from an assumed external horizontal force, applied 18 inches above floor line, to all vertical members in proportion to their respective section moduli, such force being of sufficient amount to cause bending of all vertical members acting together, and top connections of vertical end members shall be designed for these reactions. The bottom connections of the vertical end members shall be sufficient to develop the full horizontal shearing value of such members.

(*c*) Except where vertical end members shall bear directly against or be attached directly to longitudinal members at either top or bottom, the assumed reactions shall be considered as loads, applied to whatever construction is used at end sill or end plate, and both these last-named members shall have section moduli, respectively, sufficient to prevent their failure horizontally before that of the vertical end members.

Note 1.—For electric cars operated on lines where elec-

tricity is the only motive power and the total weight of trains does not exceed 600,000 pounds, the sum of the section moduli of the vertical end members shall be not less than 40 and the section moduli of the main members, either forming or adjacent to the doorposts, shall be not less than 75 per cent of this amount. This does not apply to cars run in electric trains on railroads using both steam and electric power.

NOTE 2.—For self-propelled cars, where the weight of the operating unit, consisting of the power car and one or more trailers, does not exceed 200,000 pounds, the sum of the section moduli of the vertical side and end framing members in the wedge or parabola and convex-shaped portion shall be not less than 20 each end. All vertical members in the wedge, parabola, or convex portion—in other words, forward or rearward of the rectangular part of the car—may be considered together for the purpose of meeting this requirement. If either end be flat or rectangular in shape the provisions of Note 1, fixing factors of strength, shall apply.

NOTE 3.—In mail cars having vestibules at one of both ends, similar in form to vestibules of passenger cars, the requirements of the preceding paragraph that "the sum of the section moduli of all vertical end members at each end shall not be less than 65" may be considered as applying to the vertical body end members and the main vertical members of the vestibule taken together. The requirement that "the section moduli of the main members, either forming or adjacent to the door posts, shall not be less than 75 per cent of this amount (65)" may be considered as complied with if the sum of the section moduli of the main vertical body end members and the main vestibule vertical members is not less than 75 per cent of 65.

19. END PLATE.—The end plate may be a rolled or pressed section or of built-up construction and shall extend across end of car from side plate to side plate, with ample connections at ends, or shall be of other satisfactory construction to withstand the assumed loads given above.

20. STRESSES.—All parts of the car framing shall be so proportioned that the sum of the maximum unit stresses to which any member is subject shall not exceed the following amounts in pounds per square inch, except as modified in Sections 6 and 18. These stresses, unless otherwise stated below, are for steel having an ultimate tensile strength of from 50,000 to 65,000 pounds per square inch. Where other materials are used, they shall bear the same proportion to the ultimate strength of the material used.

Bolsters of rolled steel.—Stress shall not exceed 12,500 pounds per square inch.

Sills and framing of rolled steel.—Stress shall not exceed 16,000 pounds per square inch.

When cast steel is used, the allowable stresses may be the same as for rolled steel, except tension stresses, which must be at least 20 per cent less than those allowable for rolled steel as specified above.

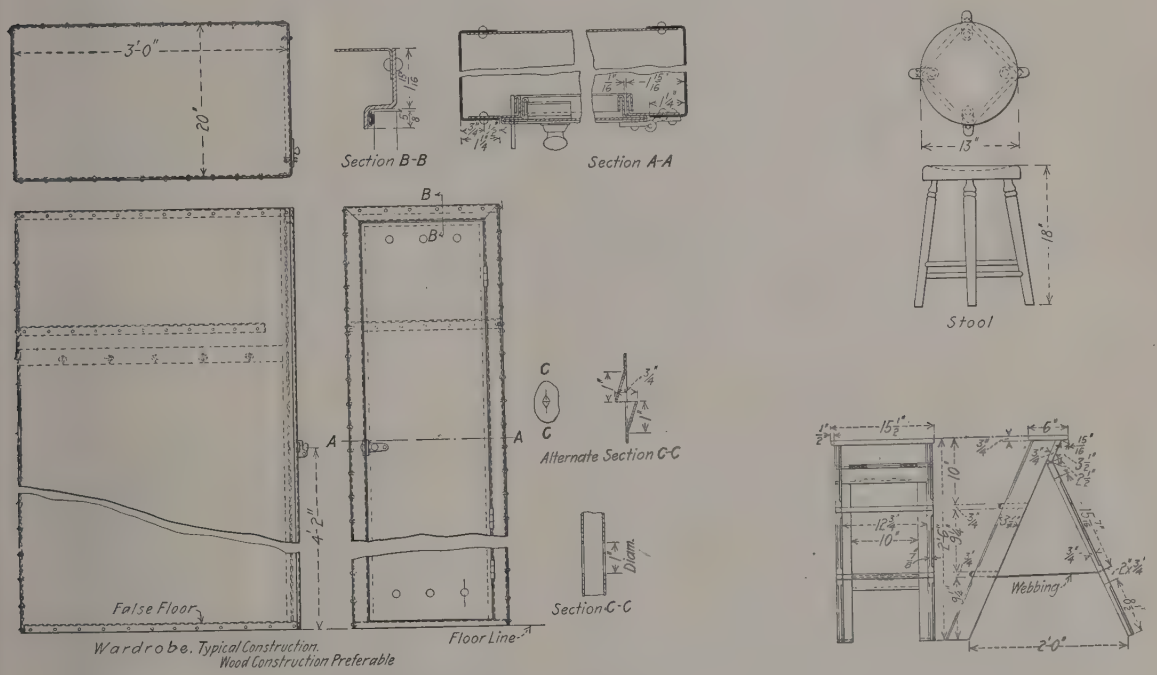


FIG. 449—WARDROBE, STOOL, AND STEP LADDER FOR USE IN POSTAL CARS.

For members in compression the stresses shall be determined by the following formula:

$$\text{Steel } 16{,}000 - 70\frac{L}{R}$$

In the above formula L equals length in inches.
R equals least radius of gyration in inches.

Rivets (rivet steel).

	Pounds Per Square Inch.
Shear, other than buffing	10,000
Bearing, other than buffing	20,000
Shear, buffing	12,000
Bearing, buffing	24,000

21. FLOOR.—(*a*) Subfloor of postal cars to be of iron or steel, flat or corrugated plate, upper or wearing surface to be of matched wooden flooring, maple or rift-sawed yellow pine or fir, laid longitudinally, or composition, preference in order named. If composition is used, the wearing surface between doors and the standing surface in front of letter tables and paper racks shall be of wood, cork or other suitable material. Proper insulation, in-

cluding air space, shall be provided. Floor strips for wood upper course shall be secured by bolts or rivets. Composition flooring may be secured by corrugated, keystone or equivalent style of plate or by wire fastening securely anchored.

(*b*) Where composition floor is used, wearing surface between doors and standing surface in front of letter tables and paper racks, as stated in above paragraph, is defined as follows:

Wearing surface between doors is the full width of the door opening between side doors. Standing surface in front of paper racks shall extend from the center of car to point directly under rod No. 4 on each side. In front of the letter tables, standing surface shall extend at least 2 inches back of a point directly under the front line of table.

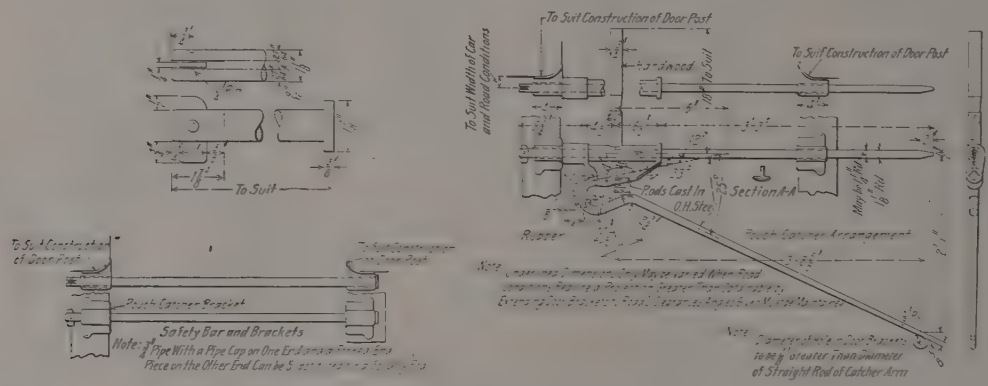


FIG. 450—POUCH CATCHER, SAFETY BAR AND BRACKETS.

Where a single-course main floor is used, the same shall be 1¼ inches thick. In cars for service in extremely cold sections or elsewhere, when desired by owners, two courses of not less than ¾-inch wood flooring, with one course of building paper between, is preferable. Where two courses of main floor are used, the lower course shall be laid either diagonally or transversely and the upper course longitudinally.

22. INTERIOR FINISH.—Inside, side and end linings and head lining of postal cars to be of flat or corrugated steel plate, composition board, or wood, properly secured to the car framing.

23. INSULATION.—(*a*) The car shall be insulated throughout, including floors, sides, ends and roof (except pier panels), with material of such a nature that it can be securely fastened so as to withstand the vibration incident to railway service. The insulating material must be such that it will not support combustion, will not absorb moisture beyond its own weight, and when wet will not become corrosive.

(*b*) Side and end wall and roof insulating material shall be securely fastened. Where the nature of the material permits, it shall be cemented and also mechanically clipped, if necessary, for proper support. Floor insulation shall extend the entire distance between side walls either in one full width or in sections fitted between floor supports and be secured in place.

(*c*) The construction of side and end walls and roof of car shall be such as to avoid or reduce to a minimum continuous metal connection from outside to the inside of the car.

(*d*) To insure maximum of insulating and sound-deadening efficiency, the construction at the junction of side and end walls and floors shall be such as to prevent the circulation of air through the side and end walls or through the floor or into the car.

(*e*) The thermal efficiency of the materials in side and end walls, in roof and in floor must be such that a test duplicate section through walls, roof or floor (duplicate with the exception of framing members, such as posts, braces, carlines or stringers, which are to be omitted) will not transmit, when subjected to the test hereinafter described, more than the following amount of heat per square foot of surface in 24 hours for each degree Fahrenheit difference in temperature between the inside and outside walls of the section. B. t. u.

For side walls, end walls, and roof..... 8
For floor 7

The method of testing shall be as follows:

• drawing Sheet 60, Fig. 451. Where side framing makes this Railway Mail Service Sheet 65, shall be used in all tests. It shall be carefully constructed and of the materials indicated and before used must be standardized for its thermal loss factor. The sections to be tested shall truly represent the materials as used and disposed in the car.

The heat must be supplied by direct electric current of constant voltage, measured by standardized instruments. The difference between inside and outside temperatures must be held as nearly 70 degrees Fahrenheit as possible. Readings of temperature and current shall not be recorded until 48 hours after heat is turned on and test begins, in order to insure thorough heat saturation of calorimeter and test sections. The duration of actual test shall be eight (8) hours, during which time temperature and electric readings shall be made and recorded each hour or more frequently if considered necessary. The average of all readings thus recorded shall be taken as the final result. All differences regarding results which may arise between the Post Office Department and the railroad companies affected shall be referred to the United States Bureau of Standards for decision.

24. DOORS, WINDOWS AND SKYLIGHTS.—(*a*) Postal cars shall be equipped with side doors not less than 6 feet in height from floor, end doors, side windows and skylights as shown on the standard plans of the Railway Mail Service. Storm or double windows shall be provided where required. Doors and windows may be of wood, combination wood and metal, or metal, preference in order named, and when glazed, the glass shall be double strength. Windows shall be made of two sash sections. The upper section shall preferably be divided into approximately two equal portions—the lower half to be fitted with glass and the upper half screened—so suspended that glass or screened section may be used as desired. (See Railway Mail Service

A calorimeter, illustrated and described in Fig. 451 and in impracticable, equivalent screen application will be allowed. Where storm windows are applied, they shall be hinged or made easily removable to allow cleaning. Doors and windows shall have suitable weather stripping. Trimmings and locks shall be the railway company's standard. Hasp and staple for outside of side doors shall be in accordance with Railway Mail Service details, modified to suit shape of doorpost.

25. LIGHTING.—(*a*) Lighting of postal cars primarily to be with electricity or gas, where feasible; mantles to be used on gaslights where practicable; provision shall be made for emergency lighting as hereinafter specified. Fixtures, wiring, battery boxes and their equipment, gas piping, and all other accessories in connection with the lighting system shall be railway company's standard practice. Each electrically lighted car equipped for axle generator

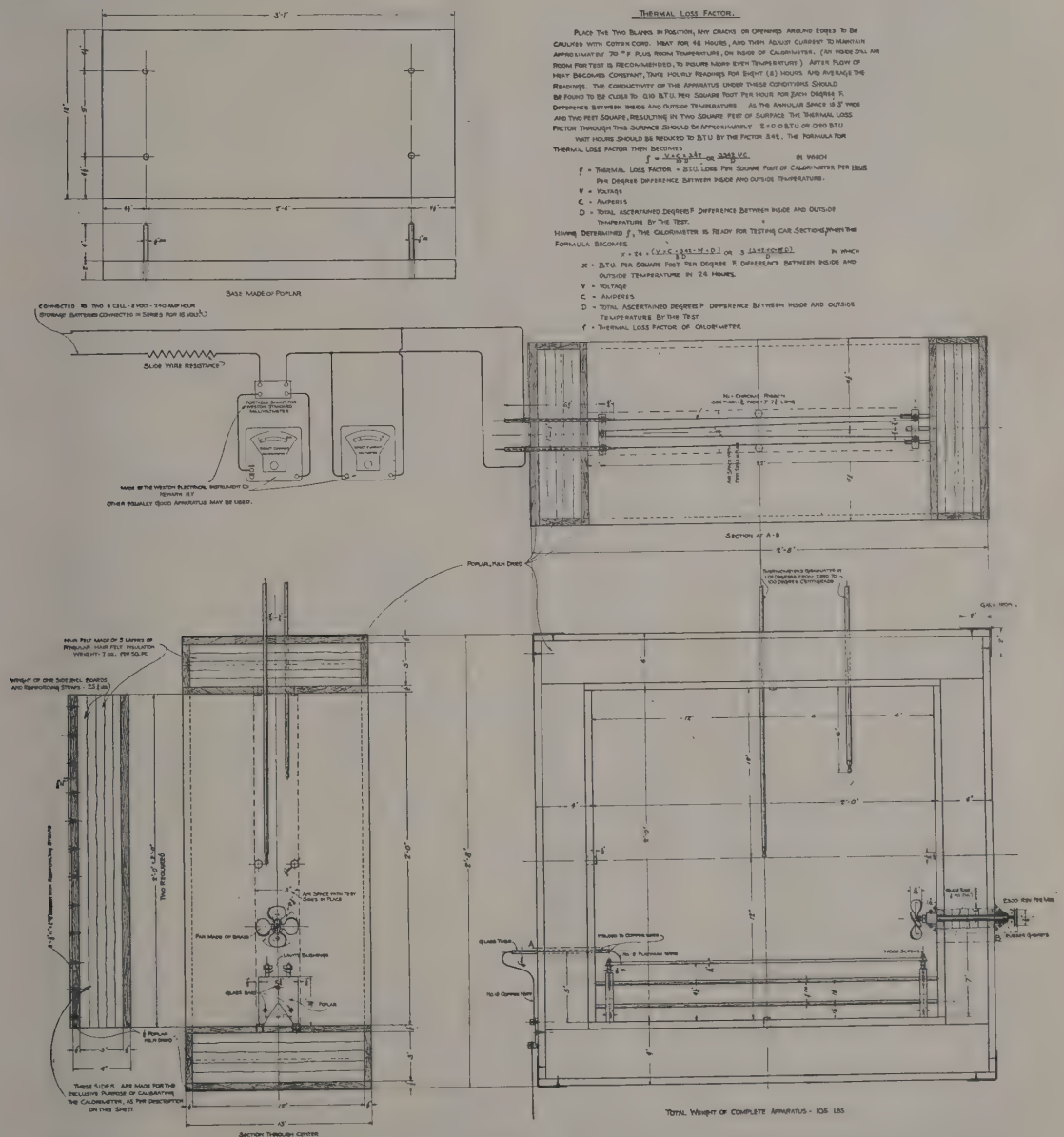


FIG. 451—CALORIMETER FOR TESTING THERMAL EFFICIENCY OF INSULATING AND SOUND DEADENING MATERIALS.

(*b*) Skylights shall have 5 square feet of glass admitting light, glazed with not less than ½-inch rough wire glass or rough plain glass of equal strength; fixtures and suitable shades shall be provided. For curtain shades below skylights, 10-ounce duck or good quality of buff or light yellow holland shall be used; spring roller fixtures shall be provided, or if canvas is used, it may be strung on wires so as to be easily adjusted according to service requirements.

or head-end system of lighting shall be equipped with storage battery of sufficient capacity to furnish for 12 hours the intensity of illumination specified hereinafter. Each car using gas or straight storage electricity as the primary system of lighting shall be equipped with storage capacity sufficient to furnish light for 36 hours at the intensity of the illumination specified hereinafter.

Lights are to be located by the railway companies or car builders to produce results called for under the speci-

fications. The Railway Mail Service will not suggest or recommend location of lights. This applies to new or changed installation where the specifications apply.

(*b*) *Location of light units.*—Body of car. The light units for illuminating the bag-rack and storage portions of the car shall be located on the center line of the car. Direct lighting units in the bag-rack section shall be located at such uniform height that the shadow of the paper boxes is not cast on any bag-rack label, nor higher than approximately 3 inches above the back rod of rack. In no case shall any light unit (except oil lamps the lowest point of which may be 6 feet 9 inches from the floor) be mounted at a height of less than 7 feet measured from the floor to the lowest point of the light unit. Spacing between adjacent units in the bag-rack portion of the car shall not exceed 8 feet 6 inches in case of any direct system of lighting, nor 14 feet in case of any indirect system.

(*c*) *Letter cases.*—Light units for illumination of the letter case shall be mounted at a uniform height from the floor, but not lower than the units in the bag-rack section, and as far from front of the face of the letter case as possible without the body of the distributor throwing any shadow on his work. In standard construction the above distance is 20 inches. Where the car construction does not permit the above distance, a lesser distance, but not less than 16 inches, may be employed. Separation between adjacent letter-case units shall be such as to provide an illumination intensity at all points within the requirements hereinafter specified.

(*d*) If an indirect lighting system be employed, the provisions of the above paragraph will be waived. In such case, the only requirements imposed for location of units at letter cases are those involved in providing for sufficient vertical and horizontal illumination intensities to meet the provisions of these specifications as hereinafter stated, all units in the car burning. For the purpose of these specifications, an indirect system is here defined as any system in which at least 85 per cent of the horizontal illumination on the 46-inch plane of utilization is received, either directly or indirectly, by reflection of the light from the deck of the car.

(*e*) *Special features of light units.*—In the case of incandescent electric or gas lamps, the design of light unit, except letter-case units, shall be such that no portion of the bare lamp filament or the bare mantle is visible to the eye when the unit is observed at an angle of 70 degrees or greater from the nadir. (In general, light units are preferred which emit no light or only a small amount of light between the angles of 50 and 100 degrees from the nadir.) (If Mazda C type lamps are used, they must have frosted or enameled bowls.)

(*f*) The control of the lights in the postal apartment shall be in that apartment and independent of any other lights in the car and the letter-case units shall be controlled independently of any other light units in the postal apartment. Knife and snap switches only shall be placed in mail apartment; all other mechanism to be placed in adjoining apartment.

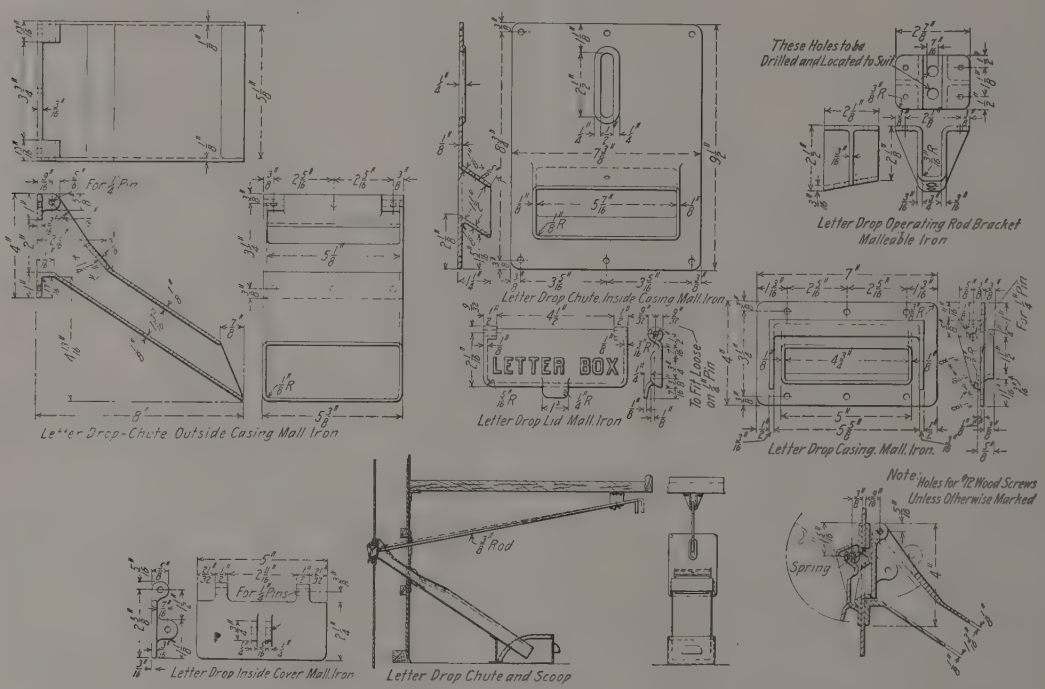

Letter Drop Chute Outside Casing Mall Iron
Letter Drop Chute Inside Casing Mall Iron
LETTER BOX
Letter Drop Lid Mall Iron
To Fit Loose on ⅜ Pin
These Holes to be Drilled and Located to Suit
Letter Drop Operating Rod Bracket Malleable Iron
Letter Drop Casing, Mall Iron.
Note: Holes for #12 Wood Screws Unless Otherwise Marked
Spring
Rod
Letter Drop Inside Cover Mall Iron
Letter Drop Chute and Scoop

FIG. 452—LETTER DROP, AND CHUTE FOR INSTALLATION INSIDE OF POSTAL CARS.

(*g*) *Initial illumination values.*—All horizontal illumination values shall be taken on plane 46 inches above floor line. Vertical illumination values shall be taken on the vertical plane on the face of letter case as specified below. New lighting installations shall be such as to give initial illumination values within the following limits:

Location.	Minimum. F. C.	Maximum. F. C.
Bag-rack portion:		
Center of car, horizontal	4.70	10.00
Mouth of bags, illumination measured 18 inches from side of car, horizontal	2.50	10.00
Letter cases:		
Over table, horizontal	4.70	16.00
Face of case, vertical	2.08	16.00
Storage portion, not behind obstruction, horizontal, measured 30 inches from side or end of car	2.50	10.00

(*h*) Illumination requirements at letter cases as above specified shall be entirely fulfilled by letter-case units, other units in the car not burning, but letter-case units

may be considered as contributing to the specified illumination values for the body of the car. Lights at letter cases should be located high enough so that shadow of reflector is not cast on any of the label holders.

(*i*) If globes or reflectors of opal glass, rough crystal glass, prismatic glass, or aluminumized metal, and those giving similar results (excluding heavy density opal with glazed reflecting surface, mirrored glass, porcelain enamable point in the car. In 30 and 15 foot apartments, locate box over letter case on partition. Candles melting only at relatively high temperatures, 120 degrees or more, shall be used, such as the "Argand-Stearine" or equivalent.

(*m*) *Electric switches.*—In apartment cars locker containing knife and snap switches controlling current and lights should be located on end of paper boxes when same will not project into doorway lower than 5 feet 8 inches

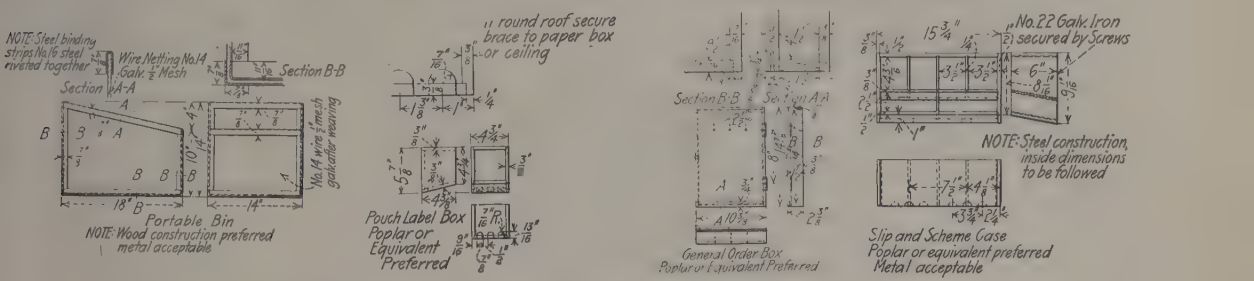

NOTE: Steel binding strips No.16 steel riveted together
Wire Netting No.14 Galv. ½" Mesh
Section A-A
Section B-B
No.14 wire 1-inch galvatite weaving
Portable Bin
NOTE: Wood construction preferred metal acceptable
11 round roof secure brace to paper box or ceiling
Pouch Label Box Poplar or Equivalent Preferred
Section B-B
Section A-A
General Order Box Poplar or Equivalent Preferred
No.22 Galv. Iron secured by Screws
NOTE: Steel construction, inside dimensions to be followed
Slip and Scheme Case Poplar or equivalent preferred Metal acceptable

FIG. 455—PORTABLE BIN, POUCH LABEL BOX, GENERAL ORDER BOX AND SLIP AND SCHEME CASE.

eled metal, and those giving similar results) be employed, the minimum values specified in the above table may be reduced 20 per cent and the maximum values increased 20 per cent.

(*j*) Above illumination values are based on an allowance of 40 per cent for depreciation in service. Less

above floor line. Where this would occur, locker should be located as high as possible on the bulkhead next to hopper, on hopper side.

(*n*) *Service illumination values.*—While the car is in active service the lighting installation shall be maintained at all times to give illumination values not less than the

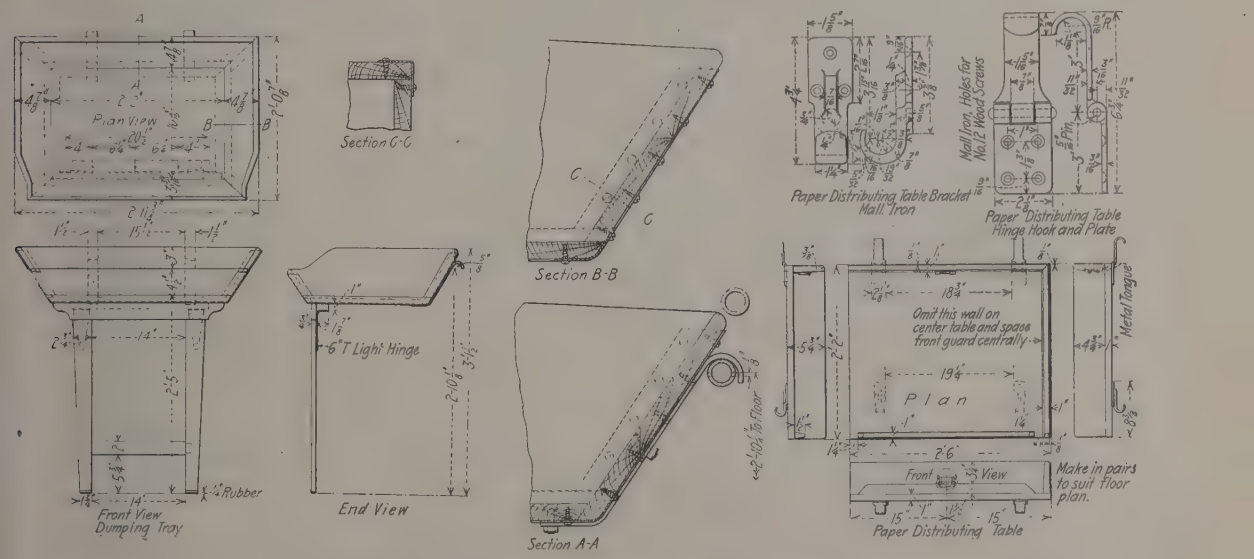


FIG. 456—DUMPING TRAY, AND PAPER DISTRIBUTING TABLE.

efficient maintenance must be compensated for by increased initial installation.

(*k*) If an indirect lighting system be employed, the minimum and maximum values in the above table may be respectively decreased and increased 40 per cent in the bag-rack and storage portions of the car and 25 per cent at the letter-case locations specified in above table.

(*l*) *Emergency lighting.*—An emergency lighting system consisting of candle lamps will be required on all cars lighted primarily by electricity or gas. A more adequate system of emergency lighting as defined hereinafter, may be required. (See floor plans for location of candle lamp holders.) A candle lamp should be furnished for each holder. Boxes to contain candle lamps when not in service should be located at some convenient and accept-

following minimum values:

Location.	Minimum F. C.
Bag-rack portion:	
Center of car, horizontal	2.80
Mouth of bags, illumination measured 18 inches from side of car, horizontal	1.50
Letter cases:	
Over table, horizontal	2.80
Face of case, vertical	1.25
Storage portion, not behind obstructions, horizontal, measured 30 inches from sides or ends of car	1.50

(*o*) Illumination requirements at letter cases as above specified shall be entirely fulfilled by letter-case units, other units in the car not burning; but letter-case units may be considered as contributing to the specified illumination values for the body of the car.

(*p*) If globes or reflectors of opal glass, rough crystal glass, prismatic glass, aluminumized metal, and those giv-

ing similar results (excluding heavy density opal with glazed reflecting surface, mirrored glass, porcelain enameled metal, and those giving similar results) be employed, the minimum values specified in the above table may be reduced 20 per cent.

(*q*) If an indirect lighting system be employed the minimum value in the above table may be decreased 40 per cent in the bag-rack and storage portions of the car, and 25 per cent at the letter-case locations specified in the above table.

(*r*) *Light failure.*—A light failure is defined as the condition where for a period exceeding 30 minutes the primary lighting system fails to give sufficient illumination to permit distribution of mail matter to be continued. It will be considered that whenever the lamp voltage falls below 80 per cent of the normal operating lamp voltage such a condition of light failure has been reached.

(*s*) *Car movement.*—A car movement is defined as the use of a postal car by a crew of postal clerks over the length of their run in one direction. Where a car covers more than the run of one crew, each separate run shall be considered a car movement.

(*t*) *Percentage of failure.*—The percentage of failure of the lighting system is defined as the ratio of the total number of failures to the total number of car movements of each primary system of lighting (gas and electrically lighted cars to be considered separately) on each railway system. The determination of percentage of failure shall be based on the operating performance of each car for the preceding 12 months' period. Only such failures as are promptly reported by the Railway Mail Service to the operating railroad shall be considered in computing the percentage of failure.

(*u*) *Emergency lighting.*—If the percentage of failure of the primary system of electric or gas lighting does not exceed 1 per cent, candle lamps will be accepted as a suitable emergency light.

If the percentage of failure of the primary system of gas or electric lighting exceeds 1 per cent and is not greater than 4 per cent, an emergency system of suitable oil lamps, gas or electric lights, maintained by independent storage capacity, may be required. Such emergency system must provide illumination values not less than 50 per cent of the minimum operating illumination values specified above for the primary system, with the exception of letter cases and center line of car through bag-rack portion, where the illumination shall not be less than 60 per cent.

If the percentage of failure of the primary system of electric or gas lighting exceeds 4 per cent, a new installation or a second complete primary system of lighting will be required on cars so failing.

(*v*) The illumination values herein specified shall be determined by the usual and approved methods. Any differences regarding the same which may arise between

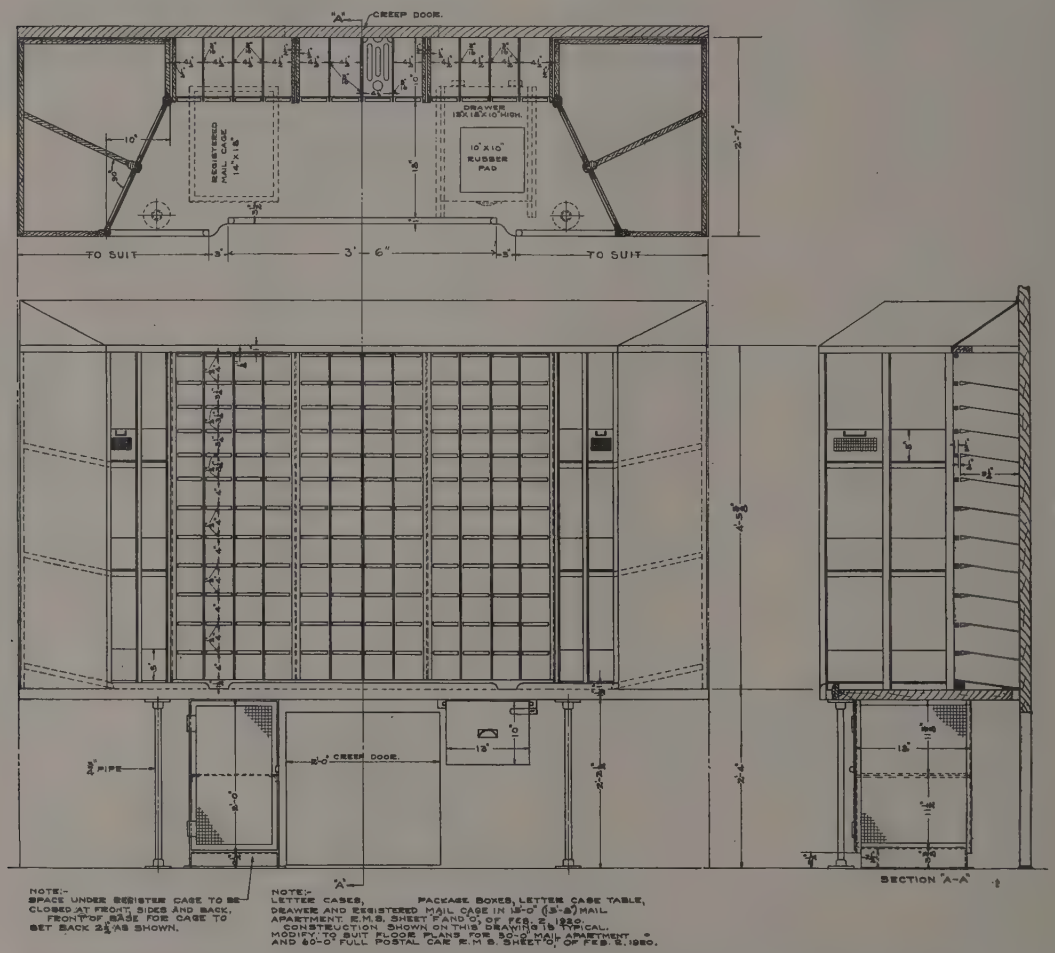

"A" CREEP DOOR.
REGISTERED MAIL CAGE 14"X18"
DRAWER 18"X18"X10" HIGH.
10"X10" RUBBER PAD
10"
TO SUIT
3'-6"
TO SUIT
2'-7"
4'-5"
3/4" PIPE
CREEP DOOR.
18"
SECTION "A-A"
NOTE:- SPACE UNDER REGISTER CASE TO BE CLOSED AT FRONT, SIDES AND BACK. FRONT OF BASE FOR CAGE TO SET BACK 2 1/2" AS SHOWN.
NOTE:- LETTER CASES, PACKAGE BOXES, LETTER CASE TABLE, DRAWER AND REGISTERED MAIL CAGE IN 15'-0" (15'-6") MAIL APARTMENT, E.M.S. SHEET 1 AND 2, OF FEB. 5, 1920. CONSTRUCTION SHOWN ON THIS DRAWING IS TYPICAL. MODIFY TO SUIT FLOOR PLANS FOR 50'-0 MAIL APARTMENT AND 60'-0" FULL POSTAL CAR E.M.S. SHEET 0, OF FEB. 5, 1920.

FIG. 457—LETTER CASE AND TABLE AND ARRANGEMENT OF PACKAGE BOXES, REGISTERED MAIL CAGE, ETC.

the Post Office Department and the railway companies shall be referred to the Bureau of Standards for decision.

Heating

26. HEATING.—(*a*) Requirements of the department embody three main points: First, sufficient heat to keep the postal car or apartment comfortably warm; second, proper distribution of heat, particularly throughout that part of the car occupied by letter cases and bag-racks (care should be taken not to have excess of heat around letter

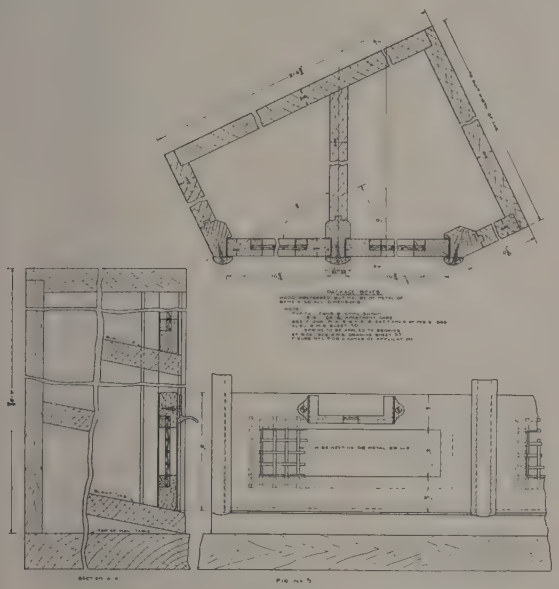


FIG. 458—DETAIL OF PACKAGE BOX.

cases), and third, an arrangement of pipes to avoid interference with distributing facilities.

(*b*) To obtain the results outlined above, the department will require postal cars and apartments to be equipped with sufficient amount of radiation to make the floor of the car comfortable and to obtain a temperature of 65 degrees between the side doors at a point 5 feet above the floor line and to maintain such temperature under the most adverse weather conditions to which the car is subjected when in service. Sufficient radiation should be provided in the end of the car containing hopper and washstand to maintain a temperature of at least 48 degrees in that location.

(*c*) Heating of postal cars primarily to be with steam or hot water. Pipes are to have suitable protection guards of wire or perforated metal. Pipes located behind bagrack sections shall not occupy space exceeding 20 inches in height (22 inches when six 2-inch pipes are used) and 4½ inches from wall of car to outside of guard. All heating-pipe screens, whether of wire netting or perforated metal, should stop 2 or 2½ inches above the floor so as to permit of cleaning. All inlet and trap valves must be accessible when bagracks are hung with sacks or storage stalls are full of mail.

(*d*) Where feed pipes to these wall radiators extend along the face of door pockets, and perforated metal guards are used along the face of pockets, the perforations shall be so located as to permit access to the door track to remove dirt and snow.

(*e*) Where bulkhead radiators are used as part of the heating system, the inside line of same shall be not less than 21 inches from center of car, so that a clear aisle space of 42 inches will be provided where two radiators are installed oppositely. All radiators must be screened. Face of radiator screen shall be on line with side-door opening. Bulkhead radiators should be substantially supported and corresponding stanchions omitted. Leave sufficient clearance to avoid injury to hand when opening door. If necessary, pipe guard on bulkhead radiator should be bent back or cut away.

(*f*) Where wall radiators are installed in storage end of cars, wire netting covering should be reinforced every 18 inches and provision made to hold the screen at least 1 inch are installed oppositely. All radiators must be screeded and it should be substantially constructed.

(*g*) Where service conditions require, an auxiliary coal-burning stove shall be furnished, complete with coal box and firing tools, smokejack properly screened, and protection guards. The stove and coal box to be securely attached to floor. Stoves furnished must be of a safety pattern or design, properly guarded by metal casing so as to prevent overheating of closely surrounding objects and damage which might result therefrom. Protection guards should be built to height of stove and wire netting used above that point to permit free radiation of heat. Guards should extend toward center of car as far as the front line of stove. Front support of guard should be iron pipe.

(*h*) All exposed edges of wire netting or screen shall be bound.

(*i*) The train-pipe steam line to be applied and equipped with end valves, steam hose and couplings, as per A. R. A. requirements and the railway company's standard. All valves must be located so as to be readily accessible.

Ventilation

27. DECK OF CAR.—(*a*) Ventilation of postal cars of clere-story design to be accomplished preferably by means of self-acting ventilators, having intake and exhaust working in conjunction. Four such ventilators per side for 70 and 60 foot cars; two per side in 30-foot mail apartments, and one per side in 15-foot mail apartments, placed to obtain maximum results. Other deck sash to have clear glass and to be placed in fixed position without screens. Trimmings of deck sash to be railway company's standard.

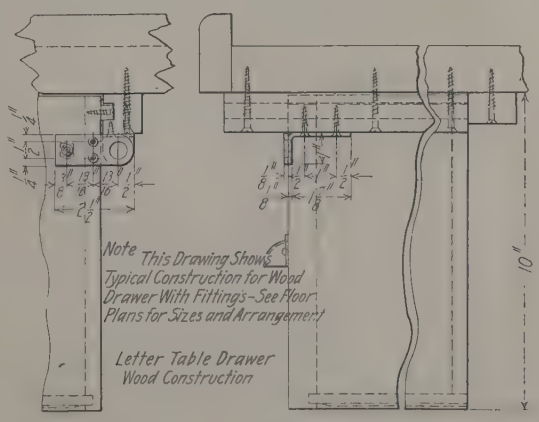

Note This Drawing Shows Typical Construction for Wood Drawer With Fittings—See Floor Plans for Sizes and Arrangement
Letter Table Drawer Wood Construction

FIG. 459—LETTER TABLE DRAWER.

(*b*) Postal cars not having clere-story roofs are to have a sufficient equipment of self-acting ventilators in the roof.

(*c*) Where exhaust ventilators only are used, intake of air should be provided substantially equal to the capacity of the exhaust. If this is accomplished by means of

swinging deck sash, one deck sash should be provided for each exhaust. Such deck sash should be screened. No ventilator or screened sash should be placed in deck immediately or directly opening over letter cases in apartment cars, on either side. An exhaust (or combination) vent should be placed on hopper side of all cars, in opening nearest hopper.

(*d*) As much clear glass surface as possible should be provided in deck of car for the purpose of admitting light, and deck piers should not be wider than necessary.

Car Equipment

28. VESTIBULES.—Postal cars are to be equipped with the railway company's standard short vestibule, preferably with outside buffer springs, and with diaphragms when needed for communicating between cars—steel diaphragms preferred.

(*b*) Brake wheels should be installed inside postal cars and apartments only so far as necessary to comply with Interstate Commerce regulations; one brake wheel in each full mail car is sufficient, located in clear storage end of car. One brake wheel in combination cars, to be located in baggage end, is acceptable where there is a creep or other door connecting the apartments.

(*c*) Suitable cord or attachments shall be furnished for convenient operation of the conductor's valve and train-signal system, which may be hung to safety rod, provided supports are placed at short intervals to prevent cord hanging loosely. Where apartment car has but one signal valve, valve shall not be located in mail apartment.

32. STEPS, HANDHOLDS, SIGNAL BRACKETS.—The details of the steps, handholds and signal brackets to be in accordance with United States safety appliance and A. R. A.

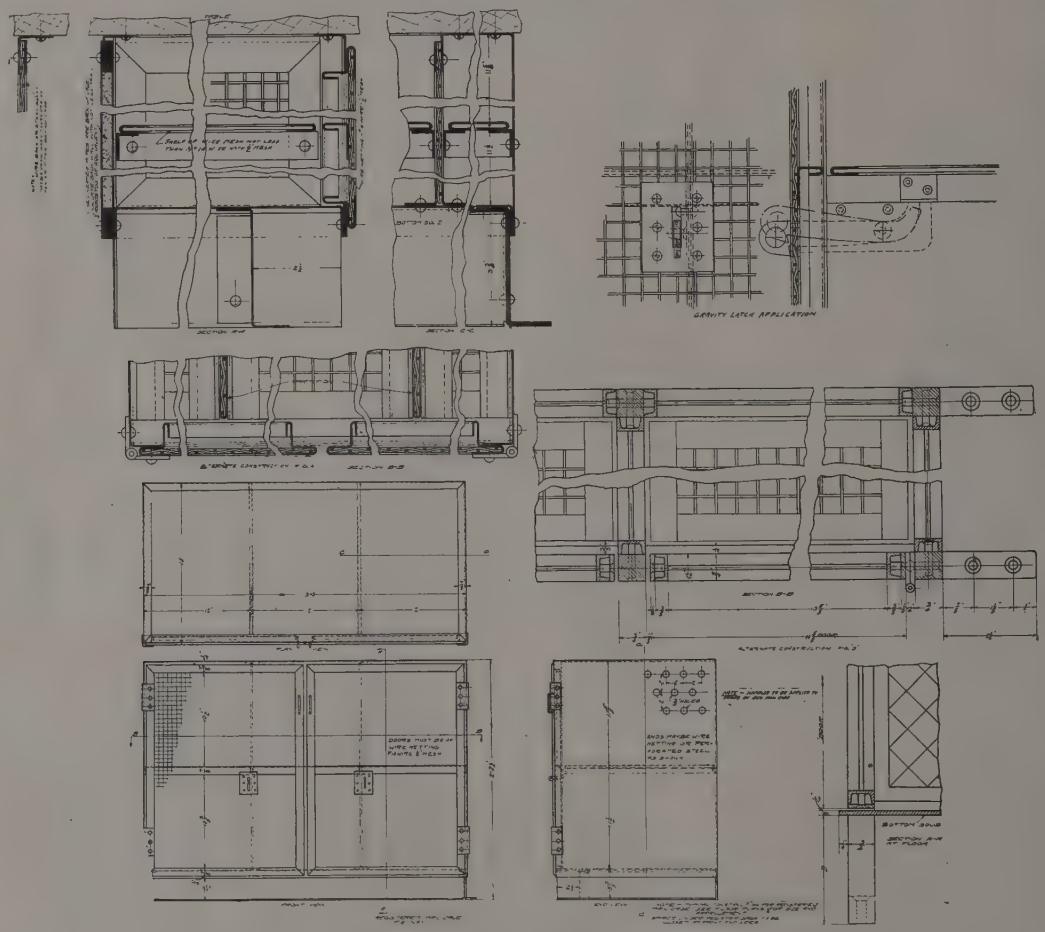


FIG. 460—DETAILS OF CONSTRUCTION OF REGISTERED MAIL CAGE.

29. COUPLERS AND DRAFT GEARS.—The details of the coupler and draft gear to be in accordance with Master Car Builders' and United States safety-appliance requirements and the practice of the railroad.

30. BUFFING MECHANISM.—The details of the buffing mechanism to be in accordance with the practice of the railroad for which the cars are built.

31. BRAKE AND SIGNAL EQUIPMENT.—(*a*) Postal cars shall be equipped with automatic air brakes and signal equipment in accordance with railway company's practice. Hand brakes in accordance with United States safety appliance standards. Brakes shall be applied to all wheels, and, on four-wheel trucks, preferably inside hung or clasp type.

requirements and the practice of the railroad for which the cars are built. Side steps to be full width of door opening, if possible. Handholds to be applied to each side door post.

33. STANCHIONS AND SCREENS.—Stanchions in storage ends and at ends of pouch racks, screen frames, and screens to be located as per standard Railway Mail Service plans.

34. SAFETY RODS AND BARS.—Safety rods to be applied in an equivalent manner to that called for in Railway Mail Service interior specifications. Each side door not equipped with catcher arm should be provided with safety bar.

35. INTERIOR EQUIPMENT.—The following equipment shall be furnished. Railway Mail Service drawings should

be followed where these details are shown; otherwise details to be as per railway company's standard.

Bag Racks	Mirror
Broom	Paper-boxes
Catcher arms	Paper rakes
Chair or stout stool	Portable bins
Cinder guards	Register cages
Disinfectants	Sack and pouch racks
Distributing tables	Shelf and letter drop
Deck-sash opener	Slip case
Dustbrush	Scheme case
Dumping tray	Stepladder
Fire buckets	Torch for lighting gas
Fire extinguishers	Toilet-paper holder
Folding washbasin	Wardrobe
Hopper	Water cooler
Letter cases	Water tank
Letter-drop, Chute and Scoop	Wrecking tools
Lock rods	Wire screens for letter case

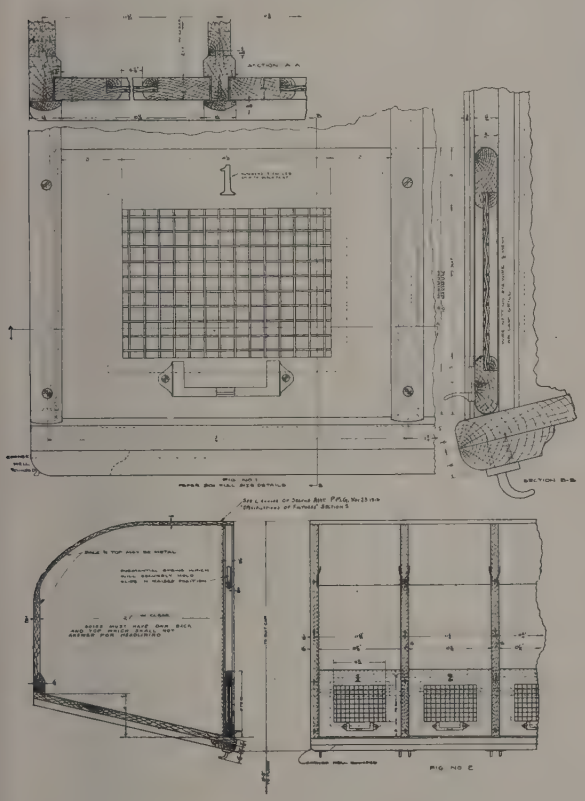


FIG. 461—DETAILS OF PAPER BOXES.

36. TRUCKS.—(*a*) Trucks may have either built-up metal or cast-steel frames, and may be either four-wheel or six-wheel type.

(*b*) Wheels shall be either all steel or steel tired. All other truck details, including body and truck center plates and side bearings, shall be in accordance with Master Car Builders' requirements and the practice of the railway for whose service the cars are built.

37. PAINTING.—The painting of car body and trucks shall be in accordance with railway company's specifications for steel cars. Light-color enamel paint shall be used for interior finish above side plate; below that line the car shall be painted a medium shade of darker color, preferably light buff or light brown, with dull finish. The lettering and numbering of postal cars shall conform to Railway Mail Service requirements and the railway company's standards. The inside length and width, the car number, and title of the company owning shall be painted at a convenient place inside the car. End doors and end door posts must not be sanded.

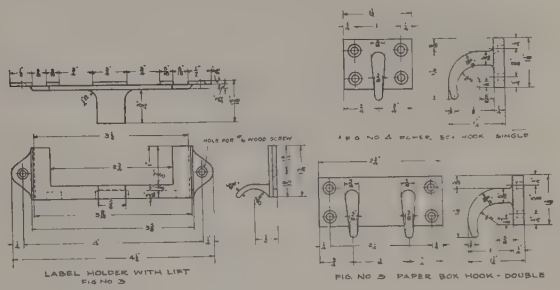


FIG. 462—LABEL HOLDER AND HOOKS FOR PAPER BOXES.

LETTERING.—Lettering on outside of mail cars shall be substantially as shown on Railway Mail Service drawing sheet 64, dated February 2, 1920. On 60-foot full R. P. O. cars lettering should preferably be central with respect to side-door opening. On 30-foot apartments, lettering should

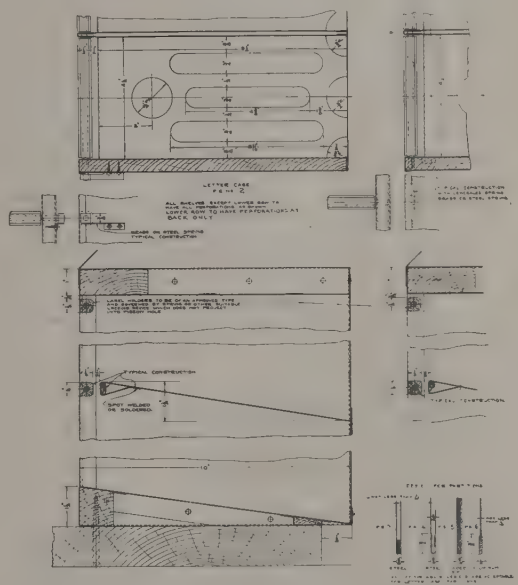


FIG. 463—DETAIL OF LETTER CASE CONSTRUCTION.

be confined to the side wall of the apartment. On 15-foot apartments the lettering shall be abbreviated and in three lines, thus:

U. S. MAIL
RAILWAY
POST OFFICE

and lettering should be confined to side wall of the apartment, if possible.

Specifications for Fixtures

1. FIXTURES.—(*a*) Fixtures for mail cars (letter cases, tables, racks, and boxes for papers) shall be made up in standard sections as indicated on RMS sheets F and O, dated February 2, 1920, and shall be secured to the car body by attachments of such design as will permit of ready removal of these fixtures without defacement of car body,

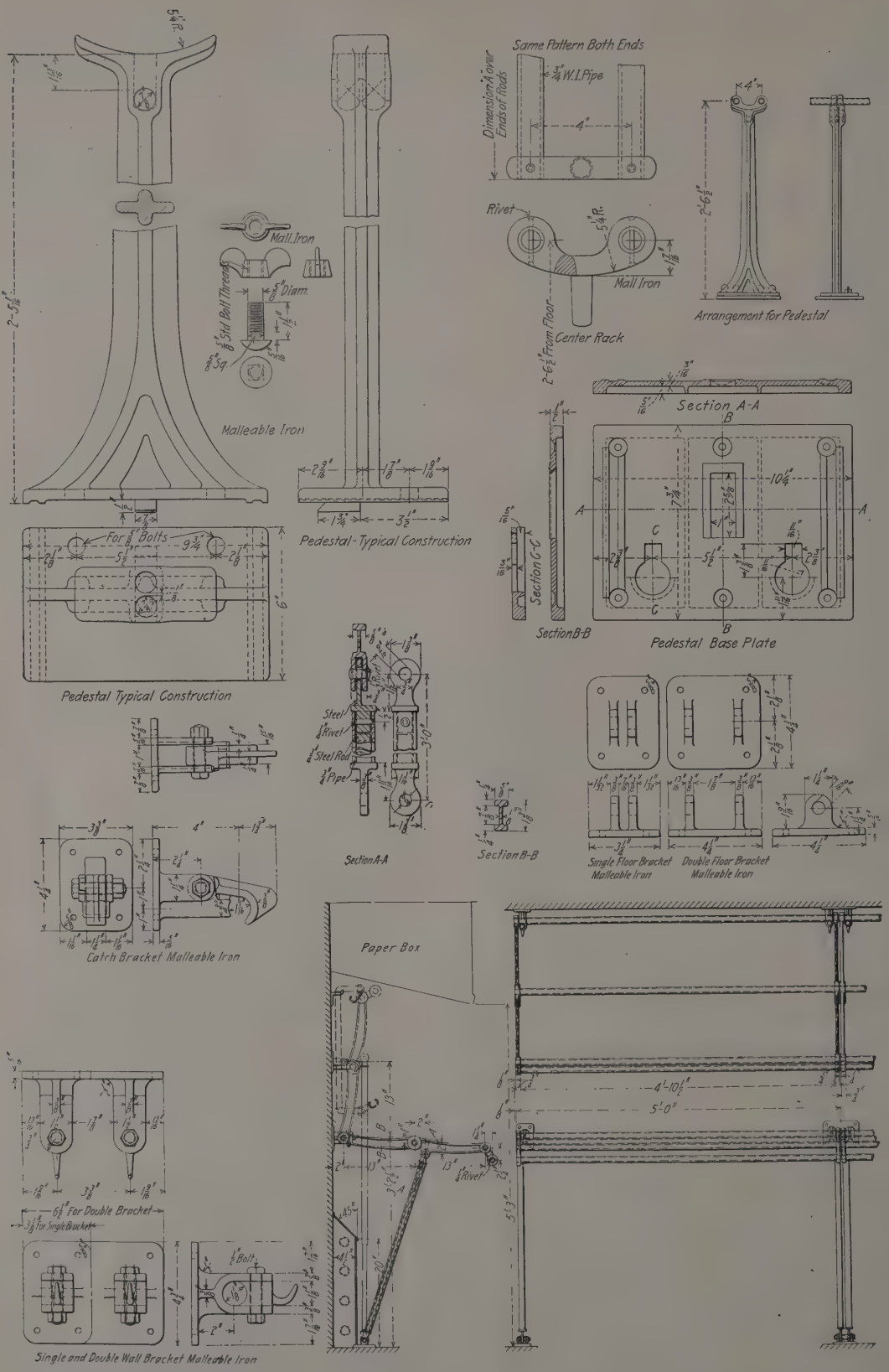


Fig. 464—Center Rack Pedestal, Mail Bag Rack and Hook. U. S. Government Specifications for Postal Cars.

and will permit substitution of sections of letter case and table for sections of racks and boxes, or vice versa. Attachments for securing letter cases and tables to be used as far as practicable for securing racks and boxes for papers, same design of attachments to be used in all cars of any one railroad system.

(*b*) Fittings applied to car body to receive attachments used in securing letter cases, racks, and boxes should be so designed that they will not project into car enough to interfere with carriage and safe handling of baggage, express, or storage mail should the distributing facilities be removed and car used in other service than the distribution of mail.

2. Distributing Tables Under Letter Cases.—(*a*) Contour and location are shown on Railway Mail Service floor plans for mail cars.

(*b*) Tables shall be of cherry, birch, or maple, preference in order named, and when finished shall be 1½ inches thick. Top of table shall be 28 inches from floor. Wooden drawers with hasp for locking shall be installed as indicated on Railway Mail Service floor plans.

(*c*) 10 inch by 10 inch canceling pads of high-grade elastic rubber, ½ inch thick, shall be installed in letter tables at points indicated on Railway Mail Service floor plans, top surface of pads to be flush with top of tables.

(*d*) For details, see Railway Mail Service drawings.

3. Letter Cases.—(*a*) Location of letter cases, with number and size of boxes to be provided, is shown on Railway Mail Service floor plans.

(*b*) Cases shall be constructed of aluminum or other metal, or wood when over-all-dimensions permit. Vertical partitions shall be not less than 1/32 inch thick (if of aluminum, not less than 1/16 inch), devoid of shoulders, and present a rounded front not more than 3/16 nor less than 3/32 inch thick.

Where the partitions are wood, they shall be 3-ply, as indicated on RMS sheet 50, figure 5; material to be thoroughly seasoned, to prevent warping, grain of intermediate ply to be at right angles to outside strips.

Square label holder of wood shall be applied in front of horizontal partitions above top row of boxes of all cases. No label holders are required at bottom of cases. If wood holders are used, corners should be beveled 1/16 inch, forming ⅜ inch flat surface, for application of paste labels. The label holders shall be installed so that each face may be turned to the front at will and be held in position by flat springs applied in such manner as to prevent formation of shoulders. Any number of label holders up to seven may be operated by one spring. Top of label holder shall be level with bottom of box at outer edge.

Where center rod of label holder is round, countersunk pin or equivalent to be used at each end of label holder to prevent its turning on the rod. Particular care should be used to exactly center the rods through the label holders.

(*c*) Cases shall be made 12 rows high, the back of bottom rows of boxes to rest on letter table. The seven lower rows and top row of boxes shall each be 4 inches high in the clear between label holders. The eighth, ninth, tenth and eleventh rows shall be 3¼ inches high.

Letter boxes shall be 9¼ inches deep, front to back (exclusive of label holders) sloping downward from the front 1½ inches; 4¼ inches wide in the clear.

The bottom shall be made of perforated steel not less than 1/32 inch thick stamped to pattern shown on Railway Mail Service drawings, sheet 50, Fig. 2, except lower row of boxes shall have bottoms with perforations at back only, with corresponding openings through letter tables to permit dust to fall through. Bottoms shall be turned at front to meet the ½ inch square label holders in such manner as to prevent formation of shoulders as indicated on drawings. There shall be a strip 1 inch wide underneath cases, immediately in front of holes through tables, fitted snugly between partitions to prevent accumulation of dust under case. Space between bottom of case and top of table shall be closed by vertical strip placed flush with face of case.

(*d*) Back of letter cases shall be covered with sheet metal or 1/16-inch wire. If the latter is used, mesh shall not exceed ¼ inch. Triangular space back of wing letter cases in full cars should be left open to accommodate wrecking tools, and fire extinguishers, if desirable.

(*e*) If metal is used, cases shall be painted same as side walls of mail room—light buff or light brown, with dull finish. Wood vertical partitions shall be finished natural. Label holders to be left unfinished for application of labels.

(*f*) For details, see Railway Mail Service drawings.

4. Racks for Sacks and Pouches.—(*a*) Only such type of rack as has been approved by the department shall be installed in any car.

(*b*) Top frame of rack section to consist of four ¾-inch pipes, placed parallel with side of car. The rod nearest wall of car is designated as No. 1; the next, or middle top rod, as No. 2; the outside top rod, nearest center of car, as No. 3. Rods 1 and 2, and 2 and 3, shall be placed in line 13 inches center to center. Rod No. 4, same size; shall be 2¾ inches below and 1¼ inches forward of rod No. 3 (measuring center to center). This rod is used to support paper-distributing tables and bridges.

Racks shall be made in standard sections, 5 feet and 3 feet long, end to end, outside measurement including clearance at each end of ¼ inch when installed, and shall furnish not less than 4 feet 10¼ inches and 2 feet 10¼ inches respectively, clear hanging space between end members.

(*c*) Racks shall be of such construction as will permit of top frame being raised or lowered at will, that the space may be used for storage purposes.

(*d*) Two parallel rods of ¾-inch pipe, equidistant from center line of car, shall be installed to support paper-distributing tables and bridges. Rods shall be placed 4 inches apart, center to center, shall be 30½ inches from floor to center of rods, and be supported at ends and joints by single standards. Rods shall be made in sections to correspond in length with sections of racks except when plans show otherwise, and shall be installed in such manner as to be removable in pairs.

(*e*) Sections of rack as hereinbefore described shall be installed on each side of parallel center rods, 22¾ inches from nearest rod to rod No. 4 of said sections (measuring center to center). The intervening space not occupied by distributing tables and dumping tray shall be filled with bridge sections. Such section shall be of ¾-inch pipe, and be 22½ inches long and 13 inches wide, with sides elevated 4 inches above ends. Measurements to be made center to center. Rod No. 1 shall be placed 38½ inches from floor to center. The rod will be 2 inches from side wall to center, in cars 9 feet in width, inside measurement, and in wider cars racks shall be similarly located from center line of car, the additional space between wall and rod No. 1 to be taken up by blocking-out brackets. Rod No. 2 shall be 37½ and rod No. 3, 36½ inches from floor to center.

Note.—In construction of bridge sections it is preferred that fittings at corners be made of solid malleable sections. If elbows and nipples are used in place of such castings, the 22½ inch dimension shall be reduced to 22¼ inches.

(*f*) Five aluminum, malleable iron, or brass label hold-

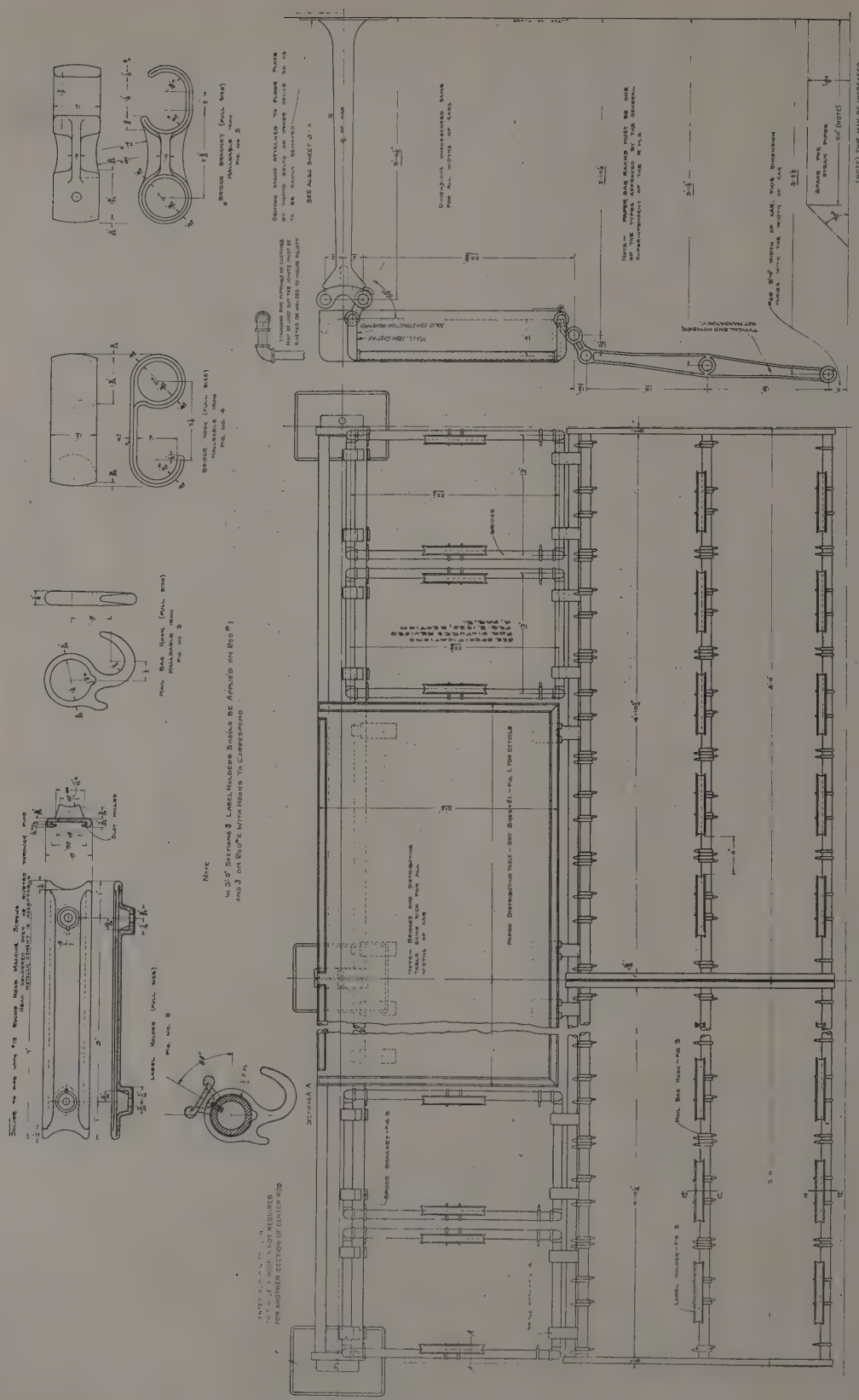


Fig. 465.—Arrangement of Mail Bag Rack and Distributing Table, also Detail of Label Holder, Mail Bag Hook, Bridge Hook and Bridge Bracket. United States Government Specifications for Postal Cars.

ers uniformly spaced, shall be placed on rods No. 1 and No. 2, of a 5-foot rack, three on Rods No. 1 and 2 of a 3-foot rack, and one in center on each side of bridges.

Label holders shall be 7 by 1¼ inches and have machine-milled slots 1/16 inch deep and 15/16 inch wide, enlarged at ends, into which folded paper labels can be inserted. Face opening of slot shall be 11/16 inch wide. Label holders shall have smooth finish, devoid of cutting edges and sharp points, and be attached to rods at an angle of 60 degrees from horizontal axis through lugs 1 inch from ends at such height as to give 5/16 inch clearance between rod and label holder, permitting free movement of hooks. Label holders should be riveted to rod or attached with machine screws, countersunk, heads to be soldered or covered with metal cement to present smooth surface and prevent loosening. (There shall be no label holders on rod No. 3.)

(*g*) Revolving-shank hooks shall be placed on the rods as follows: Rod No. 1 to have 20 hooks, all pointing toward rod No. 2. Rod No. 2 to have 40 hooks, pointing alternately toward rods No. 1 and No. 3. Rod No. 3 to have 40 hooks pointing toward 2 and 4. On rod No. 1 one hook should be placed at each end of each label holder, and two under middle parts, between lugs. On rod No. 2, two hooks pointing alternately toward rods No. 1 and No. 3, should be placed under each end of each label holder, and four hooks, similarly applied under middle part, between lugs. Adjacent hooks should point in opposite directions.

A 3-foot rack shall have 12 hooks on Rod No. 1, 24 on Rod No. 2 and 24 on Rod No. 3, applied as on 5-foot rack.

(*h*) Rods and hooks, when painted, should permit free movement.

(*i*) Hinged wire screens to be provided at end of bag racks, adjoining door openings. Hooks should be provided for securing screen to wall when not in use, and springs or bolts under paper boxes to prevent rattling when in service position.

(*j*) For details, see Railway Mail Service drawing.

5. Paper Distributing Tables and Dumping Tray.—Wood required. For details, see Railway Mail Service floor plans and drawings.

6. Package and Paper Boxes.—(*a*) Package boxes may be of wood or metal construction sufficiently heavy to prevent deformation. Paper boxes shall be of wood with wood or steel roof and back.

(*b*) Boxes for papers shall be of wood, with wood or steel roof and back. This roof or back shall not answer for headlining. Boxes shall be 11¾ inches wide, center to center, as shown on Railway Mail Service floor plans F and O, February 2, 1920. Shall be not less than 25 inches front to back in the clear, bottom sloping 6 inches toward front. Bottom line at front to be 5 feet 3 inches from floor. Boxes should conform at top to contour of deck.

When the deck of a mail car is of such width that the top of boxes for paper projects more than 5 inches into deck opening, the top of that portion of the boxes projecting into the opening shall be covered with wire screen of not less than ½-inch mesh. When the boxes project less than 5 inches, the fronts of the boxes at the top are to be beveled sufficiently to prevent the obstruction of light and to avoid a shelf upon which dust can accumulate. Beveled strip may be of wood or metal.

To reinforce bottom to prevent warping, transverse strips, about 1 inch thick by 2 inches wide, under every vertical partition should be used, strip, bottom and partition to be screwed together.

(*c*) In cars having round roof, paper boxes shall conform to details of measurement and shall have not less than the capacity indicated in paragraph (*b*).

(*d*) Paper boxes shall have wooden sliding fronts not less than 8 nor more than 10 inches high, or approximately one-third the height of front of box with 4-inch combined label holder and lift at bottom rail. Fronts shall have wire centers of ½-inch mesh.

(*e*) Brass or steel friction springs, to hold sliding fronts in a raised position, shall be placed in slide grooves in vertical partitions.

(*f*) Double or twin hooks shall be placed under each vertical partition, with points toward side of car, 1 inch back from face line of boxes.

(*g*) Paper boxes should be numbered consecutively, beginning with box nearest side door next to hopper. (See Railway Mail Service drawings, Sheet 53, Figs. 1 and 2.)

(*h*) Letter package boxes in apartment cars, and paper boxes in 8, 10 and 12 feet apartments and 6, 8, 10, 12 and 15 foot alley apartments, shall be installed as indicated on Railway Mail Service floor plans. These boxes shall follow same general constructions as overhead paper boxes described in preceding paragraphs.

(*i*) For details, see Railway Mail Service drawings.

7. Small Cases for Slips.—Small wooden pigeonhole cases for slips and schemes and a small wood box for labels from pouches shall be installed as indicated on Railway Mail Service floor plans.

8. Portable Bins for Letter Packages.—Portable bins, of substantial light wood construction, approximately 15½ inches wide, 19½ inches front to back, 14¾ inches high at back, and 10¾ inches high in front, shall be furnished, as follows:

Four for 60-foot cars.

Wire netting or perforated metal cages shall be installed in all mail cars and apartments. See Railway Mail Service drawings, Sheet 50, Fig. 1, Sheet 52, Figs. 1, 3, and 4.

9. Cage for Registered Mail.—A strong wire netting cage shall be installed in all mail cars and apartments.

10. Hoppers.—Flushing or dry hopper, former preferred, shall be installed at location in car indicated on Railway Mail Service floor plans.

Double lids shall be used on both types of hopper; dry hopper shall have large opening top and bottom, with nearly straight sides, and chute leading through and extending below floor; bottom to be free from obstruction and provided with deflector.

11. Lavatory. Lavatory located as indicated on Railway Mail Service floor plans shall be of the folding type, designed to occupy not to exceed 6½ inches front to back when folded; to have basin not less than 12 inches in diameter, 4½ inches deep, and not less than ½-inch splash rim at top. Top of basin, when lowered, to be 30 inches from floor. A steam jet or equivalent shall be introduced into basin or water system to heat water.

Waste pipe draining lavatory, where it passes through the floor and at the outlet, shall not be less than 1½ inches in diameter, and shall not extend below bottom of floor farther than necessary.

12. Water Tanks and Drinking-Water Containers.—(*a*) Drinking-water container shall be constructed to keep water and ice separate and free from foreign substances when filling, with provisions for draining each compartment at bottom, unless container is constructed in such manner as to permit of easy removal for cleaning. Container as has been approved by the department shall be installed in any car. For full cars water cooler having a capacity of not less than 5 gallons should be used. Smaller tanks (not less than 4 gallons in capacity) for apartment cars.

Waste pipe shall curve immediately under container, and follow face of bulkhead, or preferably shall empty into pipe draining lavatory. If not so connected, pipe where it passes through the floor, and at the outlet, shall be not less than 1½ inches in diameter, and shall not extend below bottom of floor farther than necessary.

(*b*) Tanks, insulated when service conditions require to prevent freezing, to contain water for lavatory and hopper, cylindrical or shaped to conform to deck of car, shall be located in deck above hopper, with provision for filling through roof or from sill or both, and shall be securely attached. Minimum capacity of overhead water tanks as follows: 60-foot full cars, 40 gallons; 30-foot apartments, 25 gallons; 15-foot apartments, 20 gallons.

When dry hoppers are used the above capacity may be reduced 50 per cent.

(*c*) For typical construction see Railway Mail Service drawings, Sheet 63. Cylindrical tanks may be hung transversely of car, if securely anchored to roof.

13. Wardrobe—Mirror.—(*a*) Wardrobe of substantial construction shall be installed as indicated on Railway Mail Service floor plans.

In 15-foot (15-foot 8-inch) mail apartment without stove, and in 30-foot apartments and 60-foot full cars, wardrobe shall extend from floor to deck of car, or shall have sloping top (not less than 30° from horizontal) to prevent accumulation of dust; shall have shelf 5 feet 6 inches from floor. In 15-foot 8-inch mail apartment which has stove, wardrobe shall be on end door of car; shall be 5 feet 6 inches long with approximately 2 inches clearance underneath, have shelf 4 feet 6 inches from bottom of wardrobe and shall have sloping top.

(*b*) All wardrobes shall have a row of substantial wardrobe hooks 6 inches apart extending around sides and under shelf. In wardrobes 12 inches wide or less hooks should be placed on end and one side only. Ventilation should be provided through holes or grille plates at bottom and top of door.

(*c*) A mirror, approximately 12 by 15 inches, should be located at most available point above lavatory.

14. Wrecking Tools.—Fire Extinguishers.—Shall be provided in accordance with existing laws and regulations. Extinguishers may be attached to ends of overhead paper boxes adjacent to side doorways.

Tools and extinguishers to be accessible, and so located as not to interfere with the handling of mail.

15. Stepladders, Stool and Chair.—(*a*) Stepladder should be furnished in gas or oil lighted cars. Hooks for hanging stepladder to be provided on side of clothes closet where practicable.

(*b*) A chair, or stout stool, 18 inches high, should be placed in all mail cars and apartments.

16. Deodorants and Disinfectants—Toilet Paper.—Toilet paper required in all cases; deodorants and disinfectants where conditions warrant.

17. Door Fixtures.—Suitable outside door fixtures shall be applied on side doors in such manner that door may be opened to full width between posts, and be locked shut with mail or other lock, as a means of safety.

A latch shall be provided to hold sliding doors in an open or closed position as desired.

Door guard should be cut away so as to avoid injury to the hand when opened to full position.

End doors shall be provided with a locking bar.

Other fixtures, standard. For details see Railway Mail Service, Sheet 58, Figs. 6, 7, and 8; Sheet 60, Fig. 5.

18. Rakes for Paper Boxes.—Two steel rakes, having crossheads 6½ inches long with 5 teeth 2½ inches long and handles 24 inches long, shall be furnished for each full railway postoffice car, and one such rake for each apartment car.

19. Catcher Arms—Safety Bars—Cinder Guards—"No Admission" Notices.—(*a*) Two catcher arms shall be furnished for each car, sockets applied to all side-door posts. Safety bars, to be secured in position by locking device, shall be installed at non-catcher doors in catcher-arm sockets.

Carbon content of open-hearth steel or round rods used in catcher-arm construction must be not less than 0.40 and not more than 0.60 of 1 per cent.

(*b*) Sockets applied to side doors for carrying catcher arms shall be located not less than 3 feet 9 inches from floor to center of core of sockets.

(*c*) Four cinder guards shall be furnished for each full and two for each apartment car, holding brackets to be applied to all side-door posts and at ends of overhead paper boxes. Wire protection over glass or cinder guards should be curved in front of same and hinged or made removable to permit of cleaning glass. Locate cinder guard brackets on side doors so that when guards are in position center of glass will be 5 feet from floor.

(*d*) Two "No Admission" notices, properly framed, must be placed in full cars, and one such notice in apartment cars. These notices should be placed on end of paper boxes or on the headlining over side doors.

Printed "No Admission" notices, without frames, are furnished by the Post Office Department.

20. Safety Rods—Window-Protection Rods.—(*a*) Two rods of 1-inch iron pipe shall be suspended 7 feet 3 inches from floor to center of rod and 19 inches from center of car. Rods to extend length of car or apartment; curved to avoid shadows on letter case and suspended by hangers not more than 8 feet apart, which shall be securely attached to reinforcement or filling blocks between ceiling and roof at each hanger. Safety rods shall be securely side-braced to deck sills at each hanger. A ⅝-inch hand rod, securely attached to side plate, shall be installed above each side door, extending full width of same.

In round-roof cars secure brace to paper boxes or ceiling.

(*b*) Five-eighth-inch rods of hardwood, hickory preferred, spaced 3 inches apart in detachable frame, shall be provided as protection for windows on inside. Windows adjacent to side doorways shall be protected by ½-inch iron rods outside, if window glass is located less than 2 feet from door opening.

21. Letter Drops.—Letter drops shall be installed as indicated on Railway Mail Service floor plans, and shall conform to Railway Mail Service drawings.

22. Movable Stanchions.—Shall be made of 1¼-inch gas pipe or steel tubing of the same outside diameter. Floor sockets to be located as shown on Railway Mail Service floor plans. Pole next to wall should be 12 and inside pole 29 inches from wall to centers.

Springs to be placed in top brackets to prevent stanchions from rattling. Stanchions shall be provided with label holders when service conditions require.

Illustrations of typical postal cars, built in conformity with these specifications, are shown in pages following.

Universal Rausch Pouch Racks for Mail Cars

In the railway mail service the use of a mail pouch rack which will fold up compactly and give a maximum amount of free space is very necessary. The United States postal car requirements call for a rack that will fold up against the side walls, under the side mail boxes and bins, and occupy a minimum amount of space when folded. When extended and in use the rack is used to hold open the mail pouches while the mail is being distributed. In this position, it occupies about one-half or more of the entire floor space of the postal car compartment. The mail pouches hang from the hooks on the rack rails clear of the floor and when the sorting is completed may be raised and swung back out of the way by locking the racks against the walls.

The Universal Draft Gear Attachment Company design and manufacture the Rausch Pouch Rack for mail car service in compliance with the United States postal car requirements. This rack is made to allow the maximum unobstructed space for storage underneath when it is folded back against the side wall.

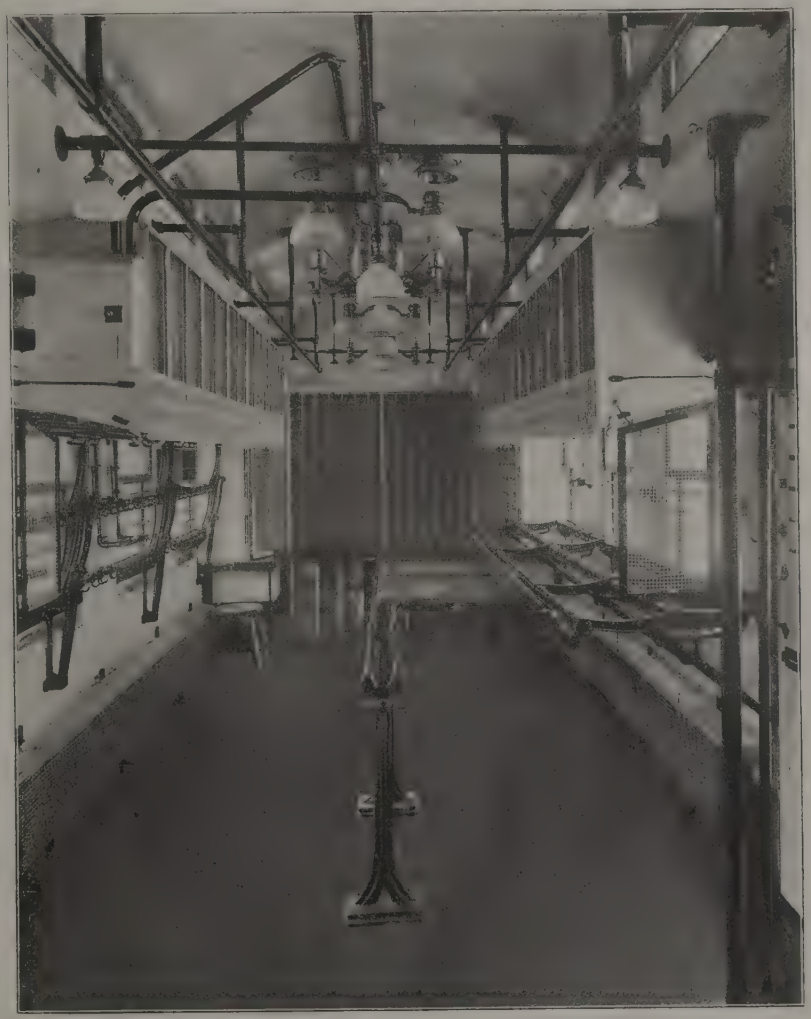


Fig. 474—Rausch Pouch Racks shown down ready for Bags—right—and folded up against wall—left.

A Postal Car using this system may be prepared for the proper sorting of mail before a run by separation of the various bags for different points, as the bags may remain on the same hooks throughout the trip whether the racks are folded or extended. This feature will greatly expedite the mail clerk's work and thus give more time for sorting.

The Rausch Pouch Rack is made of malleable iron castings, thoroughly annealed, and steel tubing. The label holders are of brass. The rack is light in weight, simple in construction and has very few operating parts. The wall rack is rigidly braced and supported preventing all lateral motion and the consequent wear of operating parts. Noise is prevented by the ingenious method employed in locking the rack sections to the wall bracket and the rack frame fulcrum eye bolts. Two automatic catchers lock themselves to the wall brackets when the rack is folded back. The clearance in the locked back position is considerable in order to give sufficient height above the floor to allow ample room for the heating pipes of the car. Attached to the front rail of the rack as shown in Fig. 474 are extensions for the front line of pouches and supports for the trays. These extensions are only used on one side of the car at any one time.

The Rausch Pouch Rack, made up in units, may be installed in remodeled equipment as readily as in new postal cars and fits easily in any allotted space whether or not of standard dimensions specified for mail cars.

One of the greatest points of advantage of this rack is the fact that it is designed to facilitate the mail clerk in his arduous and strenuous duties of sorting mail against time. It is easily handled, compactly arranged and brings within a small sorting range a large number of pouches, thus reducing the physical effort of the mail clerk. The combination of this desirable operating feature with the advantageous physical characteristics of the Pouch Rack itself has resulted in its use on many railway mail cars.

For other products and branch offices, see classified and alphabetical indexes.

Motor Passenger Cars

THE USE OF MOTOR PASSENGER CARS has become quite extensive in interurban service and in densely populated districts where smoke and other features of steam operation are objectionable, and also on branch lines of steam railways where the very light traffic makes steam train operation uneconomical. The most common types of motor cars are electrically operated—either power transmission lines or storage batteries are used; other types of motor cars are equipped with gas-electric, gasoline, or steam motors. This class of equipment is built along the same general lines as steam railway cars but are of somewhat lighter construction. They are classified by the American Railway Association as follows:

CLASS "E."

"EA"—Electric Street Railway Service Car, direct current, for transportation of passengers; without automatic couplings.

"EP"—Electric Passenger Car, for long hauls or suburban service, multiple unit and fitted with automatic couplings and air brakes. Third rail, trolley or pantagraph contact.

"EB"—Electric Baggage Car, for long hauls or suburban service, multiple unit with automatic couplings and air brakes and suitable for the transportation of baggage. Third rail, trolley or pantagraph contact.

"EM"—Electric Mail Car, for use in United States Mail Service, fitted with side doors, with or without mail hook, and suitable apparatus for the sorting and classifying of mail en route. With or without end doors or windows.

"EC"—Electric Combined. A car for long hauls or suburban service, multiple unit with automatic couplings and air brakes. This car is made up of two compartments, separated by bulkhead, one suitable for the transportation of baggage and the other fitted with seats or chairs for the use of passengers. Third rail, trolley or pantagraph contact.

"EG"—Gasoline Motor Propelled Car, for inspection or private use, or use in suburban service, hauling one or more trailers.

"ED"—Gasoline Motor Car. Gasoline engine or engine serving to run dynamo to furnish electricity for axle motors. Car to be used for inspection, private use, or as motive power to haul trailer or trailers; fitted with storage cells and with or without booster.

"ES"—Electric Passenger Car. For long hauls or suburban service; multiple unit, and fitted with automatic couplings and air brakes. Operating power, storage battery.

Among important reports on motor cars which have been presented before the Master Mechanics' Association are the following:

An individual paper by R. P. C. Sanderson on "Internal Combustion Engine in Railway Service;" Master Mechanics' Proceedings, 1903, page 263.

A report presented by a committee on electricity on steam railroads in the 1906 Proceedings, page 413, is devoted entirely to a discussion of the different types of motor cars.

A report on "Development of Motor Cars for Light Passenger Service" will be found in the 1907 Proceedings, page 194. It discusses the use of gasoline motors with both mechanical and electrical transmission and the use of steam power.

The greater part of the committee report on motor cars in the 1909 Proceedings, page 86, concerns the operation of the McKeen car on the Union Pacific.

Electric Motor Cars

Electrically operated cars have been developed in several forms: Those which receive current generated in a power station and transmitted to the motors on the cars through a trolley wire or a third-rail—operated as single units or in trains under multiple-unit control; and those which receive current generated on the car itself; and those which are equipped with electric storage batteries.

Multiple-Unit Control System

There are systems of multiple-unit control—the Sprague-General Electric and the Westinghouse.

The Sprague-General Electric system has been developed with special reference to the operation of a train consisting of several motor cars coupled together, all motors being controlled simultaneously by a single operator. Each motor car is equipped with a motor controller, one or two master controllers, and control couplers, together with such other apparatus as switches, fuses, rheostats, etc., as constitutes a complete operative motor car equipment.

The motor controller consists of a number of electrically operated switches, called "contactors," which close the various power and motor circuits, and which carry only the current for the operating coils of the contactors. These latter are designed to open the motor circuit contacts by gravity, and are provided with a magnetic blowout for quickly and positively disrupting the arc thus formed. The motor controller also includes an electrically operated reversing switch, called "reverser," the function of which is to connect the motor armatures and fields in the proper relations for giving forward or backward movement of the car. The reverser consists of a drum having two positions and carrying the necessary contacts for engaging fixed contact fingers, together with two operating coils, one for throwing the reverser to each position. The operation of this reverser is also effected by the master controller.

The master controller is similar in construction to the ordinary hand controller, but is very small and easily operated. It is provided with separate operating and reversing interlocked handles, and has a magnetic blowout for disrupting the arcs formed on opening the control circuit connections.

The combinations of motors, rheostats, etc., effected by the motor controllers are the same as those accomplished by ordinary hand controllers, giving series and parallel operation of motors and two economical running speeds.

Where several cars are coupled in a train the control circuits of the various cars are joined by means of couplers located at the end of each car, so that all motor controller operating circuits and all master controllers are connected together, making all of the motor controllers operative from

Fig. 480—All-Steel Passenger Coach for Electric Service. Length Inside 54 ft. 3½ in.; Width Inside, 9 ft. 4½ in. Builder, Standard Steel Car Company.

Fig. 481—Steel Frame Passenger Coach for Electric Interurban Service. Builder, St. Louis Car Company.

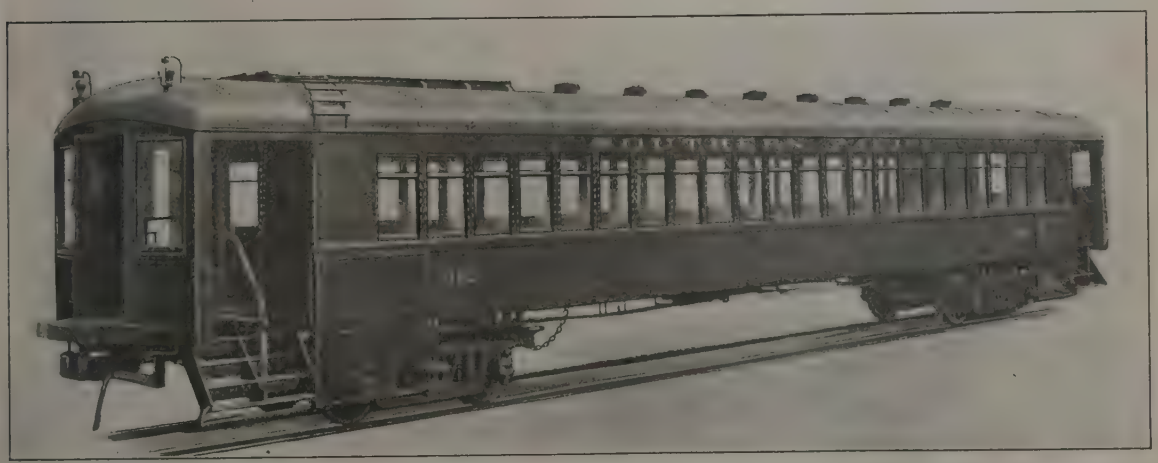


Fig. 482—Steel Vestibuled Electric Motor Car for Suburban Service. Weight, 77,600 lbs.; Length Over Buffers, 69 ft. 10 in. Builder, American Car & Foundry Company.

Fig. 483—Electric Interurban All-Steel Combination Passenger and Baggage Car, Built for Grand Rapids, Holland and Muskegon Railway by the St. Louis Car Company.

Fig. 484—Interior of car shown in Fig. 483.

Fig. 485—Interior of car shown in Fig. 486.

Fig. 486—Electric Interurban All-Steel Passenger Car. Built for Texas Electric Company by the St. Louis Car Company.

A—Main Switch
B—Main Fuse Box
C—Control Box
D—Main Grid Resistors
E—Control and Reset Switch
F—Master Controller
G—Control Junction Box
H—Train Line Receptacle
I—Control Resistor
J—Lightning Arrester
K—Control Reservoir
L—Check Valve
M—Reducing Valve (when used)
N—O. B. Strainer
O—Cut-out Cock

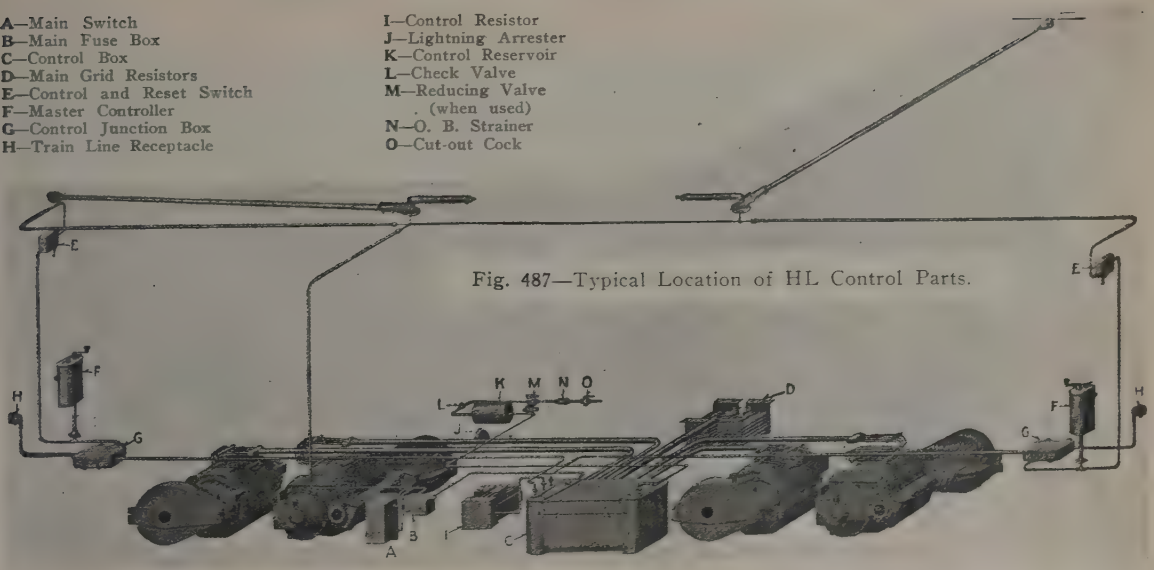


Fig. 487—Typical Location of HL Control Parts.

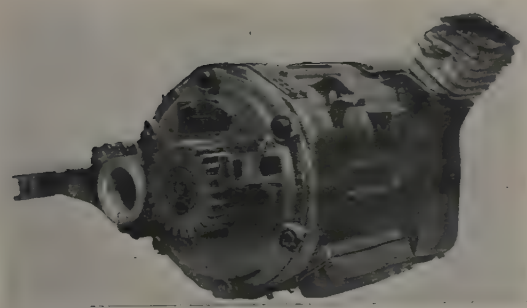


Fig. 488—Single Phase Railway Motor. Showing Pinion, Air Intake, and Flexible Air Connection.

Fig. 489—Blower Motor and Blast Wheel for Single Phase Motor Car Ventilating System.

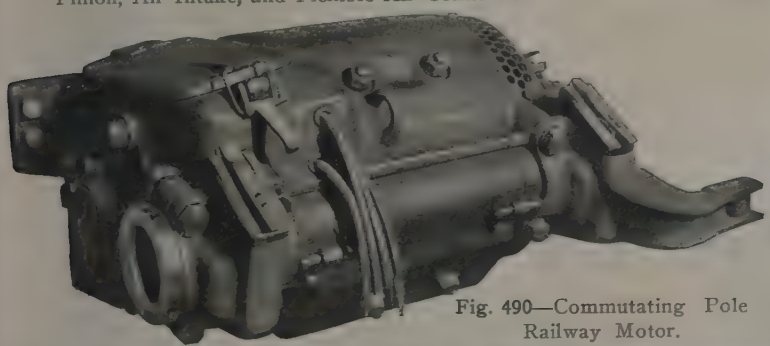


Fig. 490—Commutating Pole Railway Motor.

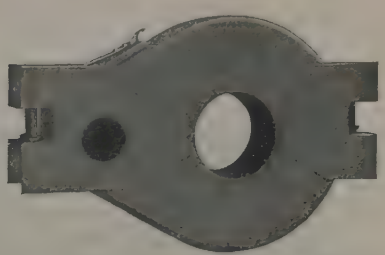


Fig. 491—Gear Case for Railway Motors.

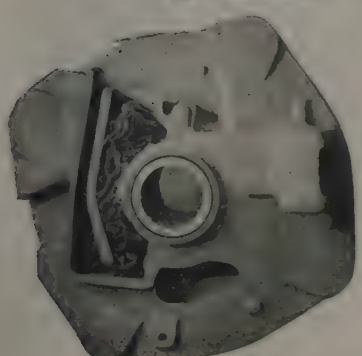


Fig. 492—Railway Motor Bearing.

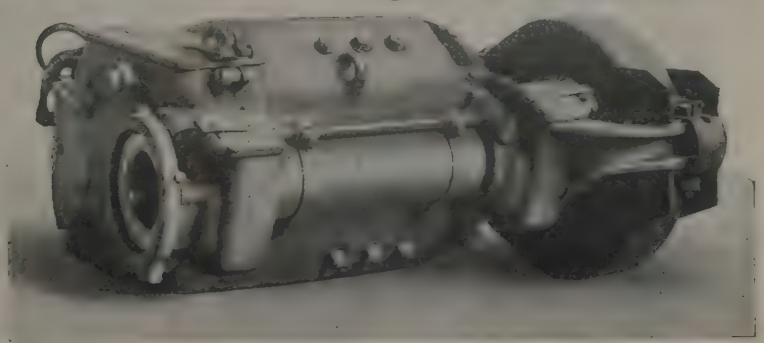


Fig. 493—Westinghouse No. 562 Railway Motor.

Westinghouse Electric and Manufacturing Company.

Fig. 494—Single Phase Transformer, Car Type.

Fig. 495—Control Resistor.

Fig. 496—Preventive Coil for Single Phase Railway Motor.

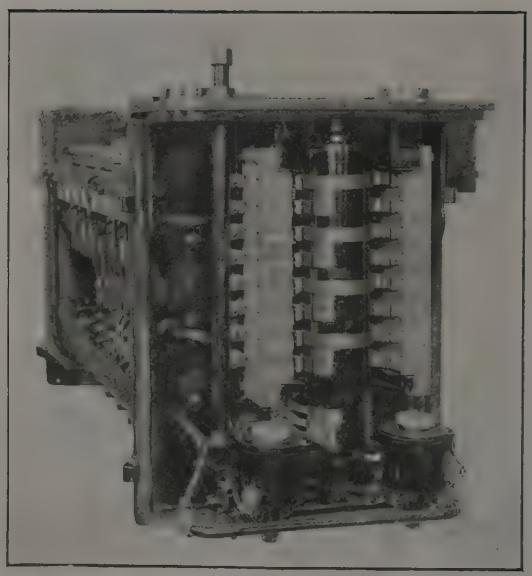


Fig. 497—Westinghouse Standard XV Reverser.

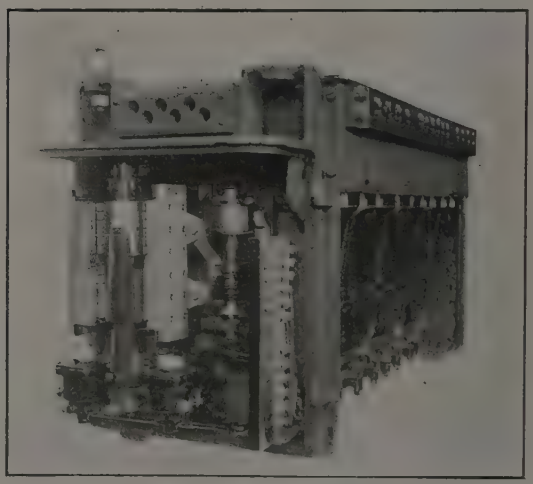


Fig. 498—Single Phase Car Switch Group.

Fig. 499—Westinghouse Car Type Circuit Breaker

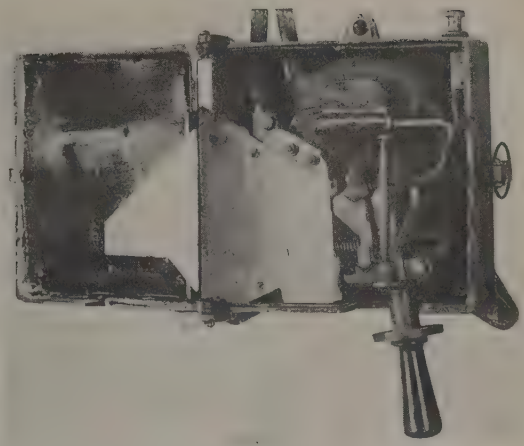


Fig. 500—Car Type Circuit Breaker—Open.

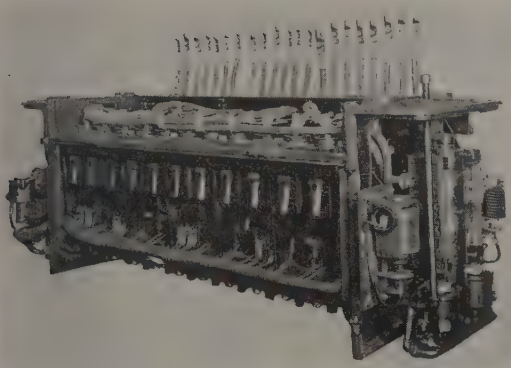


Fig. 501—Standard "HL" Switch Group—Left Hand End.

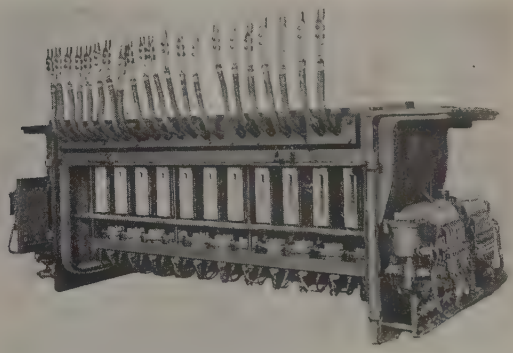


Fig. 502—Standard "HL" Switch Group—Right Hand End.

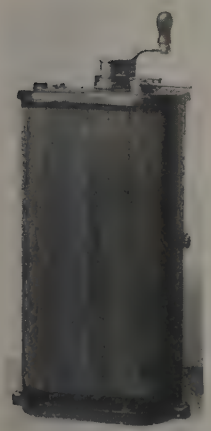


Fig. 503—"HL" Type Master Controller.

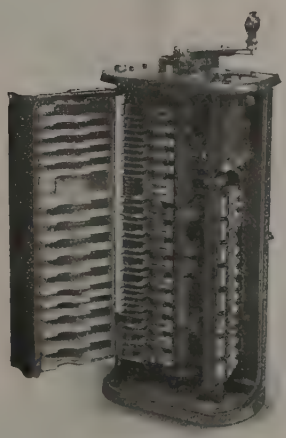


Fig. 504—Interior of Type K-64-D Railway Controller.

Fig. 505—"HL" Type Master Controller.

Fig. 506—Type 28-D Master Controller.

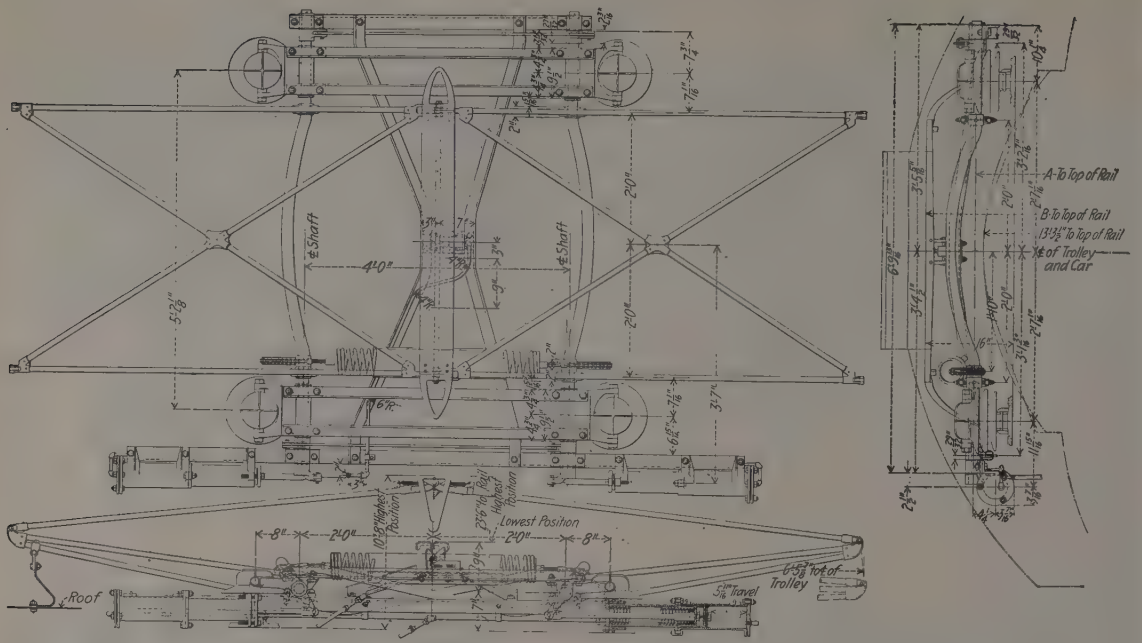


Fig. 507—Air Operated Pantagraph Trolley for Electric Railway Motor Cars. Westinghouse Electric and Manufacturing Company.

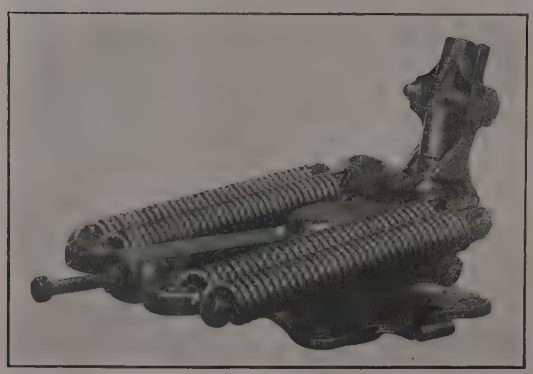


Fig. 508—U. S. 13 Form D Trolley Base. Westinghouse Electric and Manufacturing Company.

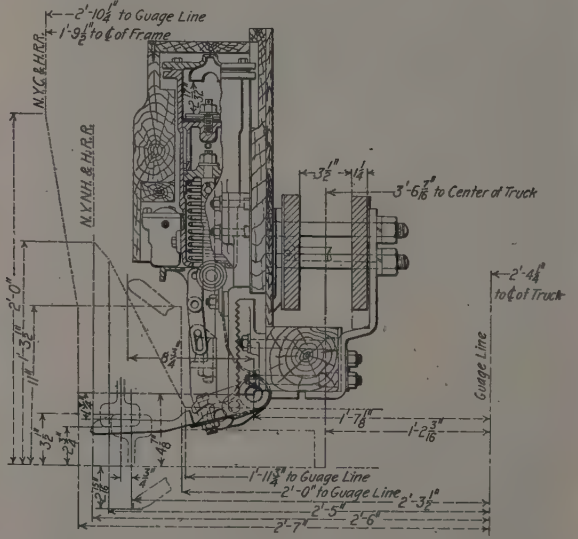


Fig. 509—Air Operated Third Rail Contact Shoe. Westinghouse Electric and Manufacturing Company.

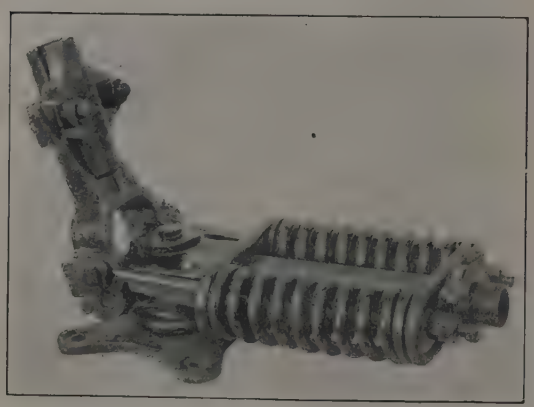


Fig. 510—U. S. 15 Form C Trolley Base. General Electric Company.

Fig. 511—Contact Shoe for Overrunning Third Rail. General Electric Company.

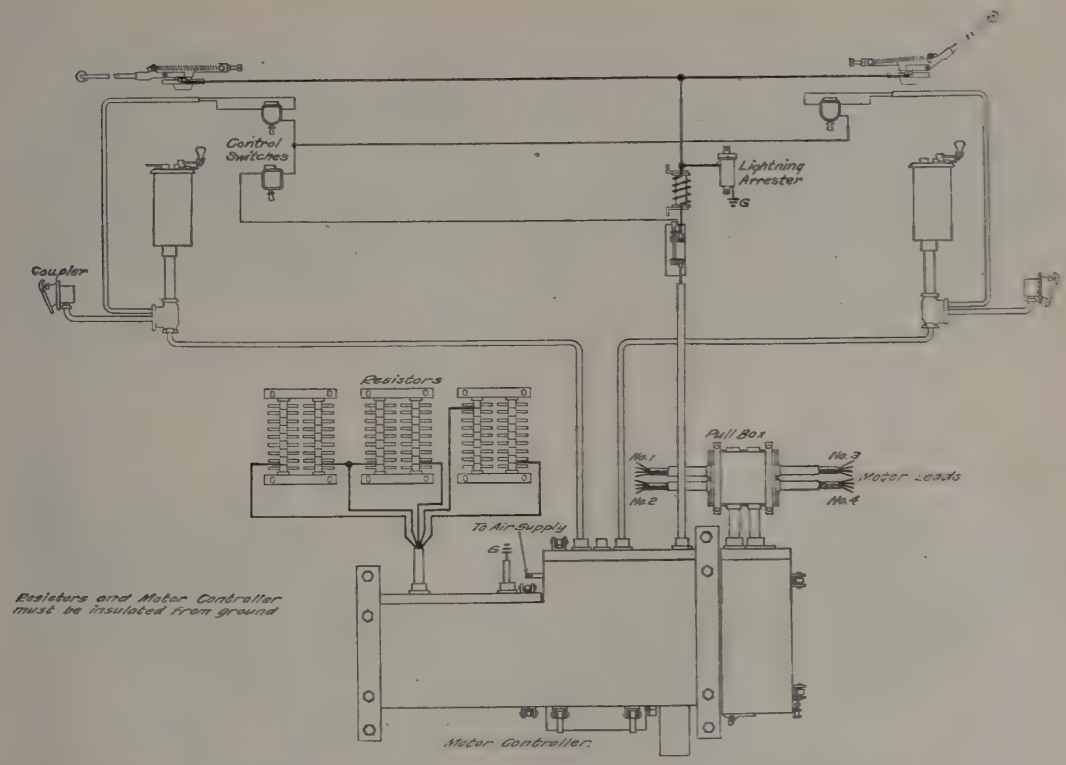


Fig. 512—Arrangement of Car Equipment with Small PC Controller.

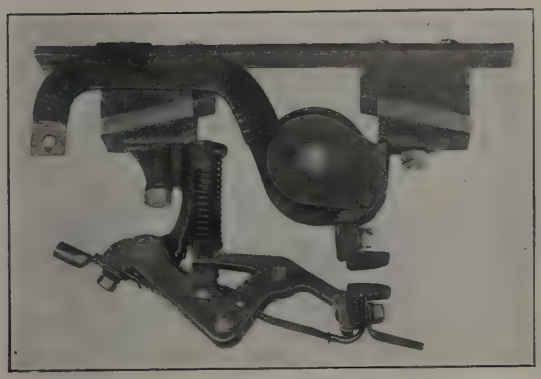


Fig. 513—Contactor Unit for Small PC Control.

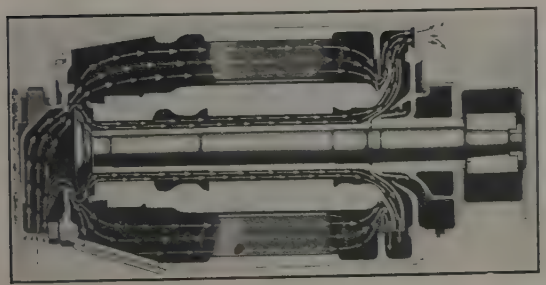


Fig. 514—Ventilation of Railway Motor with Multiple Fan.

Fig. 515—Master Controller and Control Switches for PC Control.

General Electric Company.

Fig. 516—G-E 303 P. 50 Horsepower Motor.

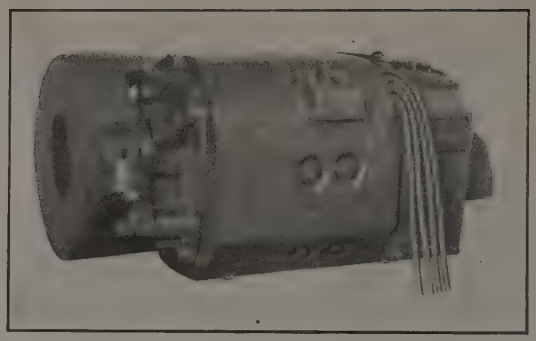


Fig. 517—G-E 240, 110 Horsepower Motor.

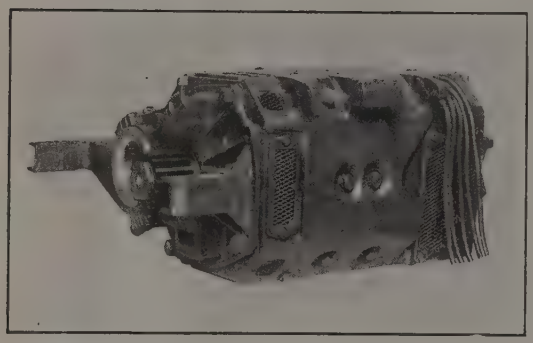


Fig. 518—G-E 259, 120 Horsepower Motor.

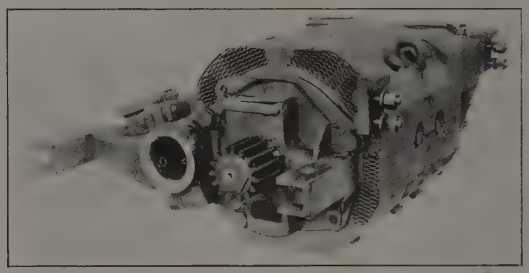


Fig. 519—G-E, 40 Horsepower 24-in. Wheel Motor.

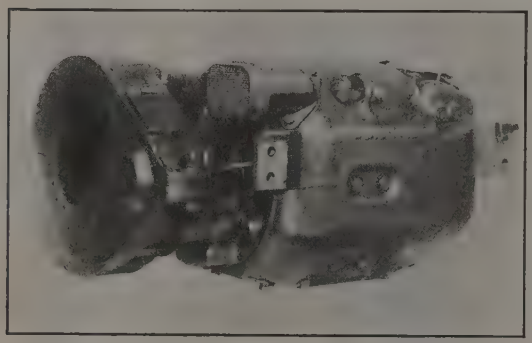


Fig. 520—G-E 201G 65-Horsepower Motor.

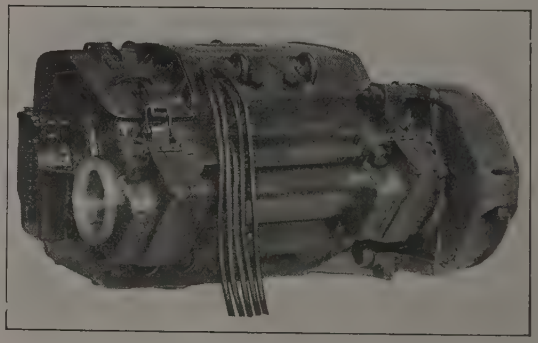


Fig. 521—G-E, 254, 140 Horsepower Motor.

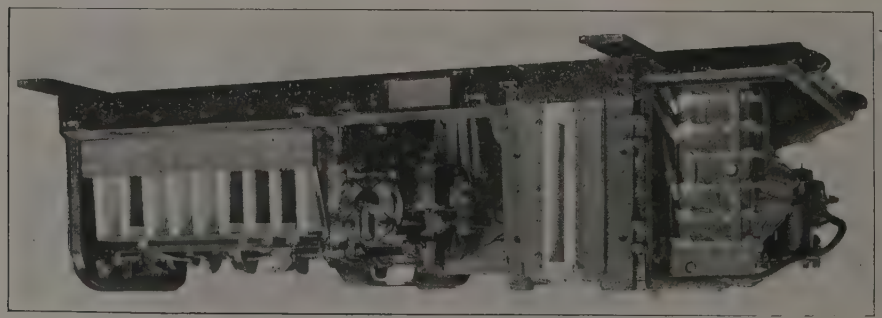


Fig. 522—600-Volt PC Controller, Small Size—Cover Removed.

General Electric Company.

Fig. 523—1500-Volt PC Controller—Cover Removed.

Fig. 524—600-Volt PC Controller, Large Size—Cover Removed.

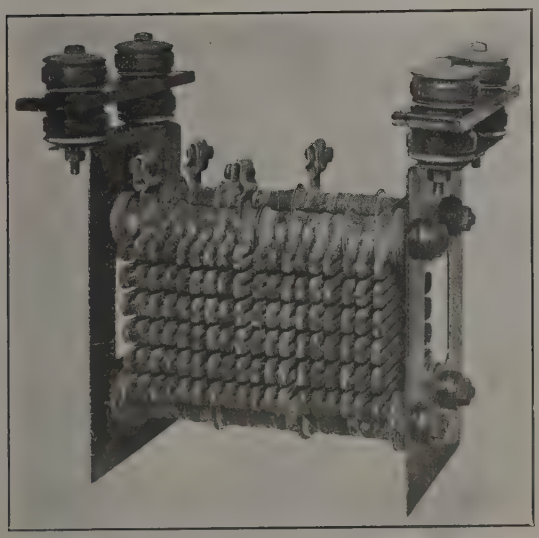


Fig. 525—Removable Grid Railway Type Resistor with Porcelain Bolt Insulators.

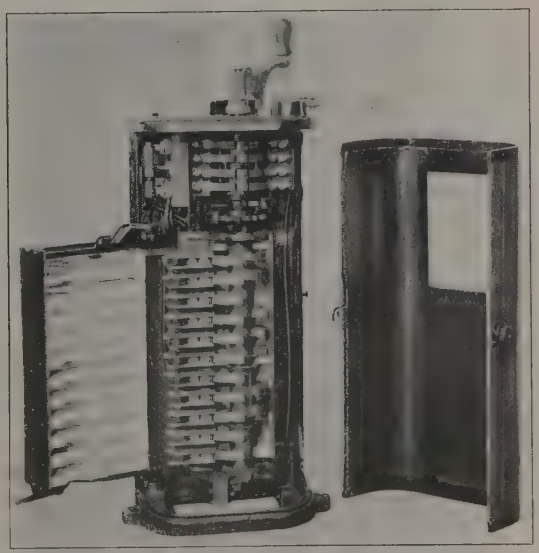


Fig. 526—Type K, 36P Controller with Ratchet Switch.

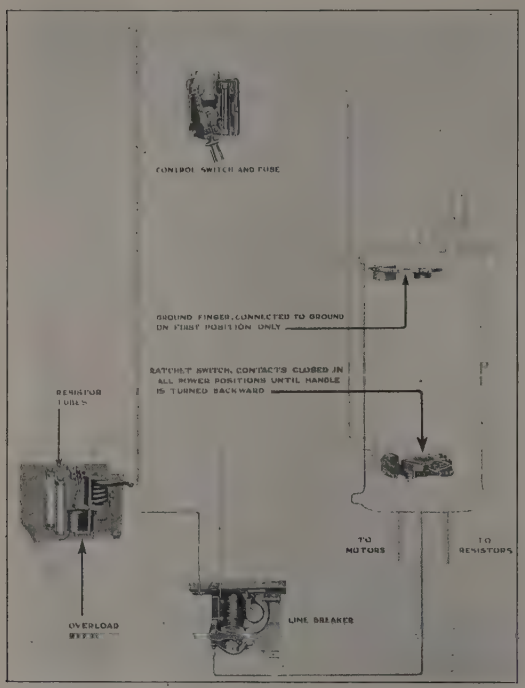

CONTROL SWITCH AND FUSE
GROUND FINGER, CONNECTED TO GROUND ON FIRST POSITION ONLY
RATCHET SWITCH, CONTACTS CLOSED IN ALL POWER POSITIONS UNTIL HANDLE IS TURNED BACKWARD
RESISTOR TUBES
TO MOTORS
TO RESISTORS
OVERLOAD RELAY
LINE BREAKER

Fig. 527—Connections of Line Breaker and Ratchet Switch for Use With Drum Controller.

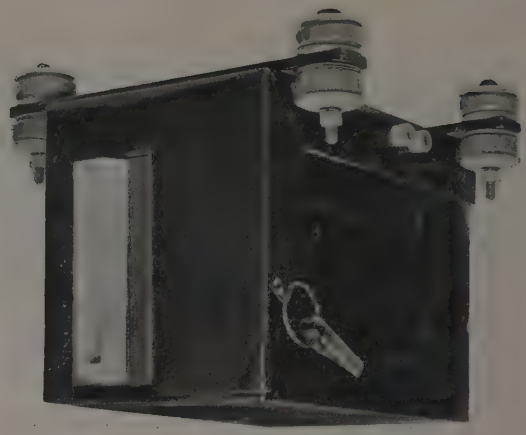


Fig. 528—Magnetic Line Breaker.

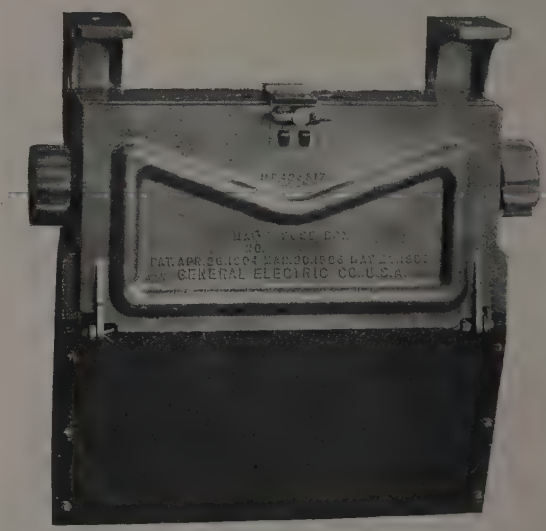


Fig. 529—Ribbon Fuse Box.

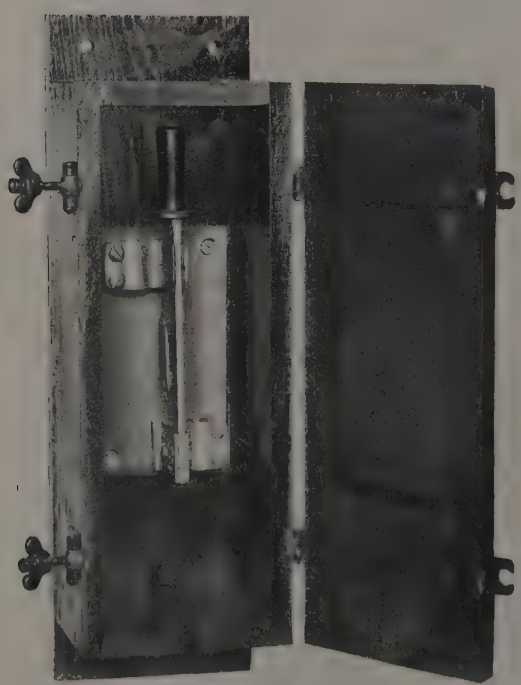


Fig. 530—MS-118 Switch.

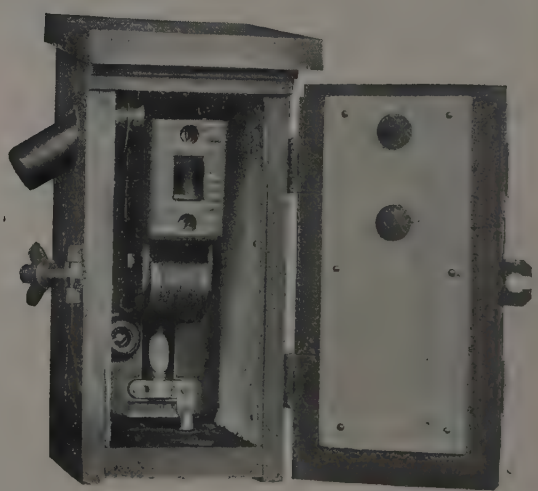


Fig. 531—Type M Form D3 Direct Current Lightning Arrestor for Line Service on 350-750 Volt Circuits.

General Electric Company.

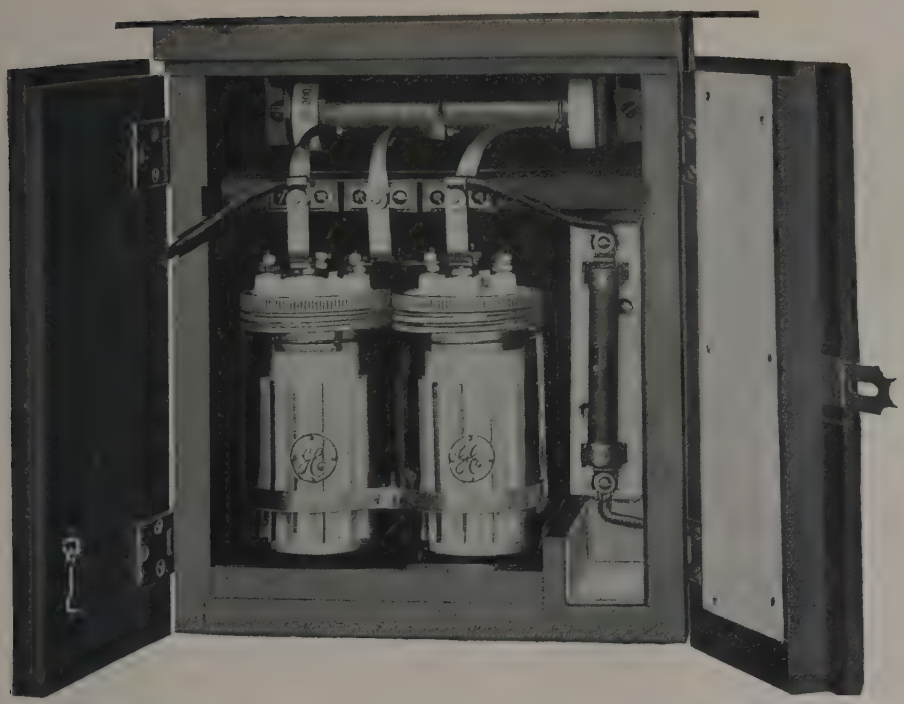


Fig. 532—Type K, Form A, 600-Volt Direct Current Aluminum Lightning Arrestor for Car Service.

Fig. 533—1,200 - Volt Lamp Receptacle.

Fig. 534—600-Volt Receptacle.

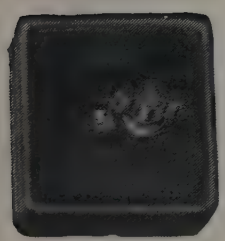


Fig. 535—Three Ampere, 600-Volt, Single Pole, Combined Indicating Switch and Enclosed Fuse Cut-out.

Fig. 536—Form 10, 2 Ampere, 550-Volt, Direct Current, Luminous Arc Headlight.

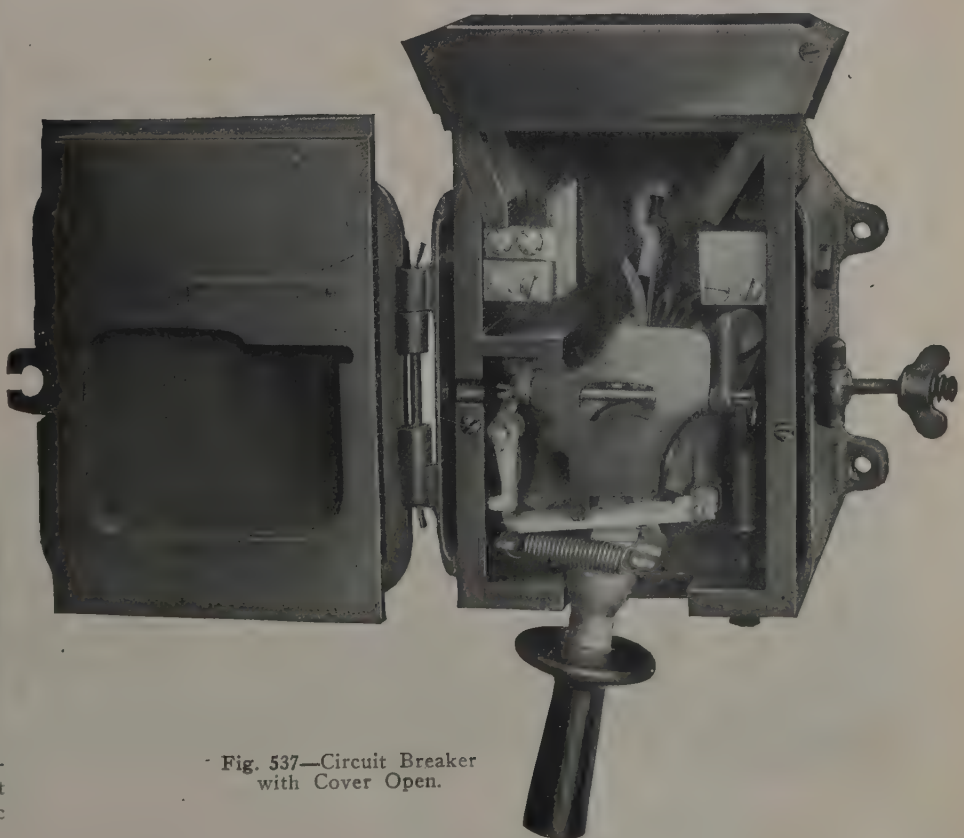


Fig. 537—Circuit Breaker with Cover Open.

General Electric Company.

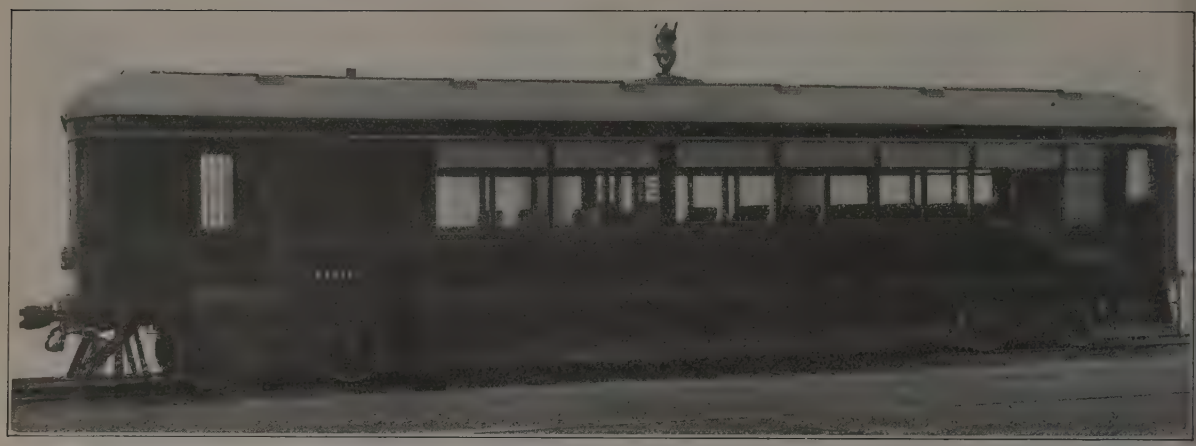


Fig. 538—Edison Storage Battery Car Equipped for Double End Operation. Railway Storage Battery Car Company

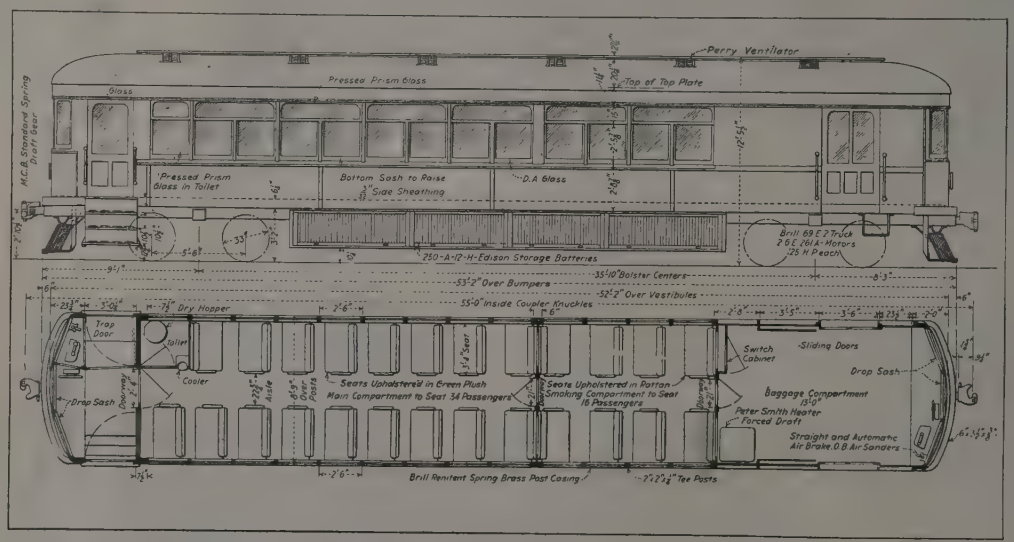


Fig. 539—Elevation and Floor Plan of Edison Storage Battery Car shown in Fig. 538

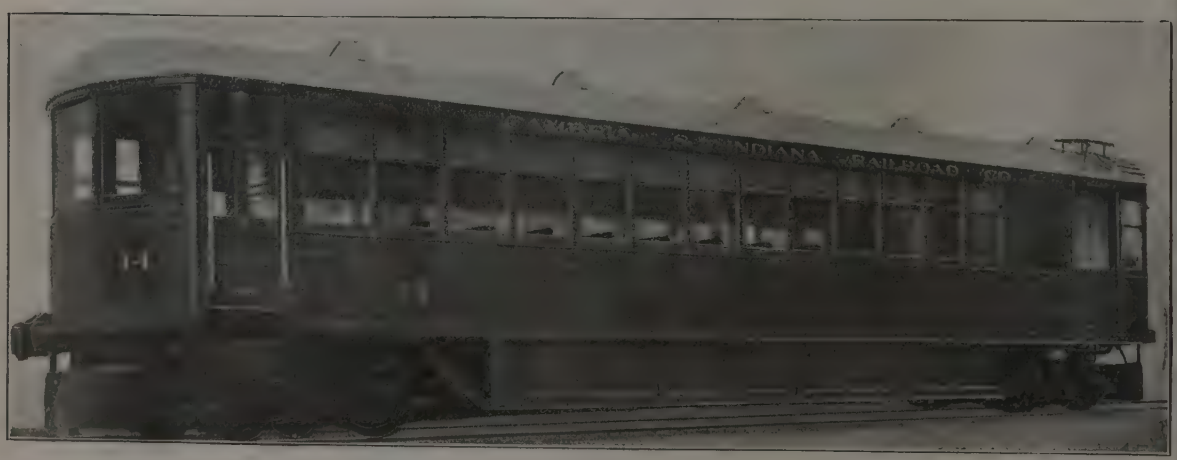


Fig. 540—Steel Vestibuled Electric Motor Car Taking Power from Storage Batteries. Weight, 59,000 lb.; Seating Capacity, 51; Length of Passenger Compartment, 32 ft.; Length of Baggage Compartment, 12 ft. 10 in.; Equipped with Four 25 hp. Motors. Railway Storage Battery Car Company.

Gasoline Driven Motor-Omnibus

Gasoline driven rail cars have been developed for operation on short line railroads or branch lines where excessively high costs make the steam locomotives and coaches as trains prohibitive from an economical standpoint. The Brill motor-omnibus consists of a special car body mounted on a motor truck chassis with a light four-wheel truck as a substitute for the front wheels.

Fig. 547—Brill Gasoline Driven Motor-Omnibus

The chassis is equipped with flanged rear wheels for rail service. The pony truck adheres better to the rails under high speeds and gives greater safety and more comfortable riding on sharp curves. The wheels on the pony truck are 20 in. diameter with A. R. A. standard width tread and thickness of flange. The chassis may be constructed for any track gage from 3 ft. to 5 ft. 2½ in.

The car body, in design and construction, conforms to the best car building practices. A seating capacity of 31 passengers is provided by eight standard Brill light weight "Waylo" type transverse seats, a long seat extending completely across the rear, a single corner longitudinal seat and two side longitudinal seats—all upholstered in Brill twill-woven seating rattan. Floor mat strips, ventilators, hand straps, windows and windshields are provided to give added comfort to the passengers, and the interior of the car is heated with the exhaust from the engine. The two-leaf folding doors at the forward end are opened and closed independently by levers from the operator's position.

The mechanical operation of Brill gasoline driven rail cars is very similar to that of the standard automobile. Power is applied only to the rear wheels and four transmission speeds, both forward and reverse, are used in accelerating the car.

The brake arrangement provides for the use of brakes on both the truck and the rear wheels. The truck brakes are controlled through the shaft and wheel which are not required for steering as in ordinary motor bus practice. In retarding the rear wheels, two sets of brakes are used. One set operates from a foot pedal and applies pressure to hub bands. The other set acts upon the transmission and is controlled by a hand lever.

Every effort has been made to secure the lightest construction consistent with the requirements of railroad service. Consequently, the complete motor car weighs only 11,000 pounds and can be operated at any speed up to 30 miles per hour.

A trailer car may be coupled to the motor car for handling more passengers or more baggage and express, during peak load periods.

The principal advantage of the Brill gasoline driven railroad motor-omnibus is the economy of operation. A small initial investment is all that is required to revise a short line schedule for rendering more frequent and more flexible service. The resulting increase in passenger, freight and express traffic, coupled with the low operating and maintenance expense, will make branch steam lines more profitable.

In regular service the Brill car has averaged as high as 14 miles per gallon of gasoline and in no case has the cost exceeded 30 cents per mile.

Only one man is necessary to perform all the duties of operation. The labor charge is therefore very small. This with the low fuel consumption and small depreciation makes the Brill motor driven omnibus an attractive proposition.

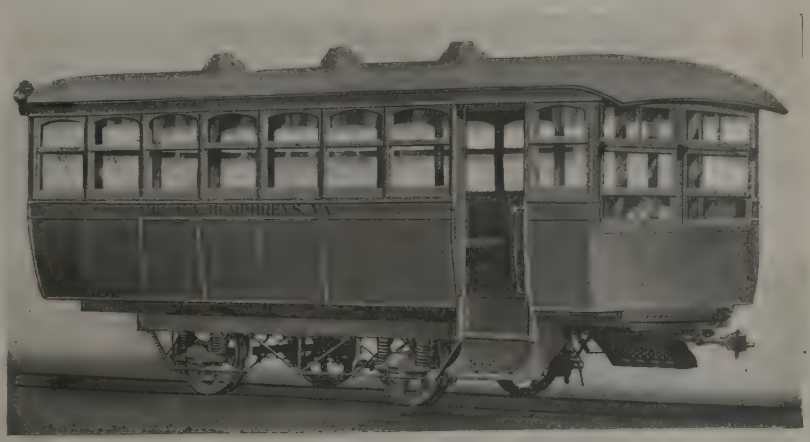


Fig. 548—Brill Trailer Car for Use With Motor-Omnibus

For other products and branch offices, see classified and alphabetical indexes.

THE J. G. BRILL COMPANY, PHILADELPHIA, U. S. A.

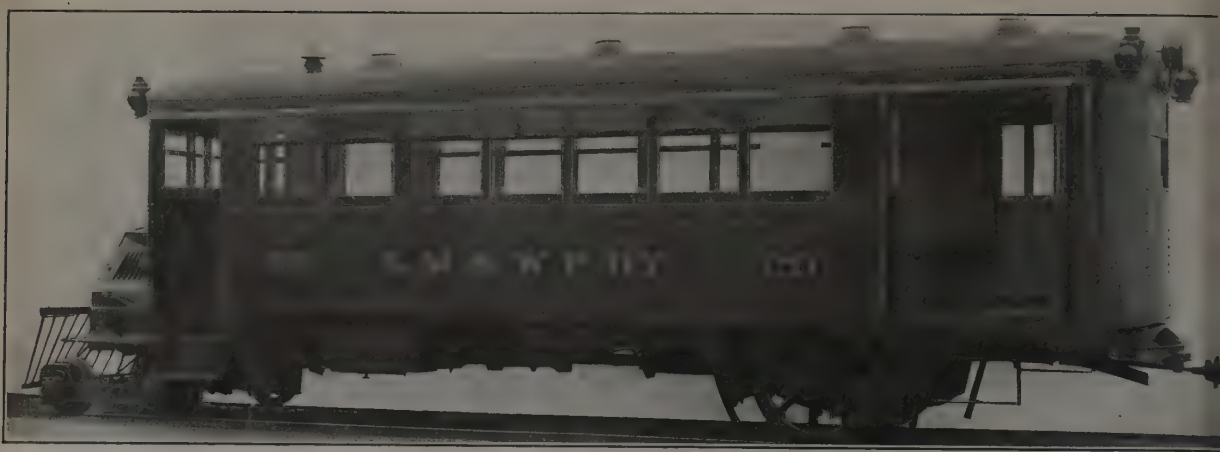


Fig. 549—Gasoline Motor Rail Car. Built for the Lewisburg, Milton and Watsontown Passenger Railway by the J. G. Brill Company.

Fig. 550—Interior of Motor Rail Car Shown in Fig. 549.

Fig. 551—Interior of Motor Rail Car Shown in Fig. 552.

Fig. 552—Four-Wheel Drive Gasoline Motor Rail Car. Built for the New Orleans & Lower Coast Railroad by the Four-Wheel Drive Auto Company.

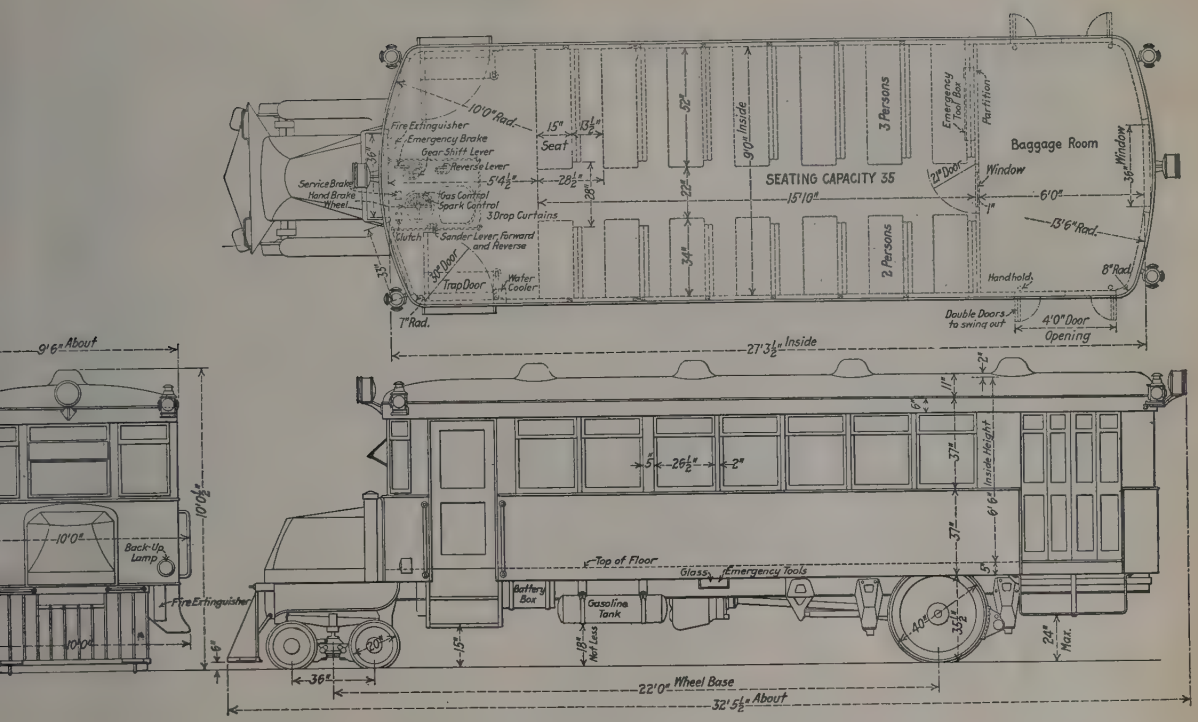


Fig. 553—Plan End and Side Elevation of Mack Rail Car Shown in Fig. 554.

Fig. 554—Mack Rail Car Used in Local Passenger Service on the New York, New Haven & Hartford. Built by the International Motor Company and Osgood-Bradley Company.

Fig. 555—Front End of Service Coach Shown in Fig. 557.

Fig. 556—Interior of Service Motor Coach Shown Fig. 5

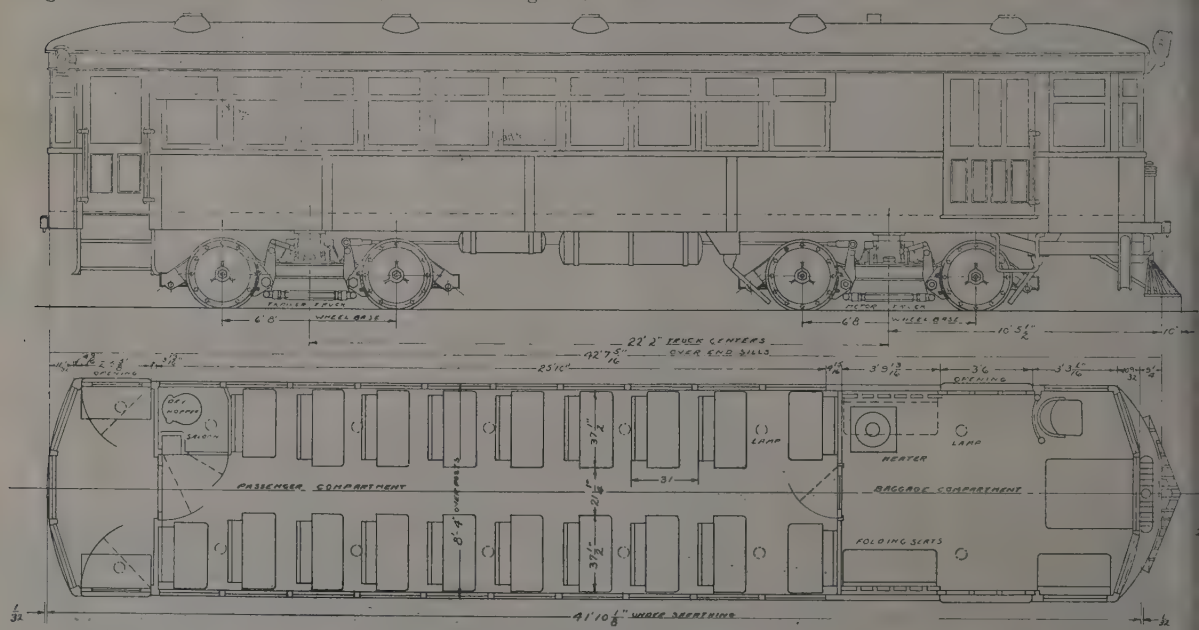


Fig. 557—Side Elevation and Floor Plan of Service Motor Coach. Builder, Service Motor Truck Company.
(*See also Figs.* 555-556 *and Page* 359.)

Fig. 558—All-Steel Gasoline Automotive Car and Trailer. Builder, The Russell Company.

Service Railroad Motor Coaches

Motor Coaches especially designed to meet the requirements of railroad service, are manufactured by the Railroad Division of the Service Motor Truck Company, Wabash, Indiana.

These coaches combine the best of automotive and railroad practice, being built on two light-weight pivotal trucks equipped with swing bolsters and rolled steel tires.

The power plant consists of a four-cylinder, four-cycle, valve-in-head engine, with 4¾ inch bore and 6 inch stroke. Its normal speed is 1500 r.p.m., developing 68 hp. The clutch and three-speed transmission are mounted in a unit with the engine; from this point the drive is through an auxiliary transmission, which is arranged to give two forward ratios and one reverse, making a total of six speeds forward and three reverse. The drive is on all four wheels of the leading truck.

All driving mechanism is isolated from the passenger compartment, eliminating many objectionable features such as noise, vibration and odor.

The body represents the highest type of modern light-weight steel car construction. A seating capacity for 38 passengers is provided in the body of the car and there are folding seats for 8 additional passengers in the baggage compartment. The body is 42 ft. 6 in. long over all and 8 ft. 4 in. wide over the posts. The engine hood, with the exception of the radiator, is included in the baggage compartment, which is 8 ft. long back of the hood, and has a sliding door on either side. The passenger compartment is entered through a vestibule at the rear end of the coach and is fitted with trap and side doors in accordance with steam railway practice. The interior may be modified to meet various conditions.

Fig. 559—Model 55 Service Motor Coach

Fig. 560—Interior of Front Compartment Showing Driver's Seat

Like parts are interchangeable all around including such items as wheels, axles, wheel-bearings, tires, brake parts, and springs. The power mechanism is divided in two units—the power plant, which can be readily removed from the front end of the car, and the driving truck, which can be removed by jacking up the car in the usual manner. This renders repair and adjustment relatively easy.

Fig. 561—Interior of Baggage Compartment

Auxiliary equipment includes Westinghouse Air Brakes, Peter Smith Heater, electric lights, saloon, water-cooler, emergency tools and a fire extinguisher.

Fig. 562—Gasoline Motor Driven Rail Car, for Branch Line Passenger, Express and Mail Service. Power Transmission on Two-Wheel Rear Truck; Total Weight of Car, 28,000 lb. Bowen Motor Railways Corporation.

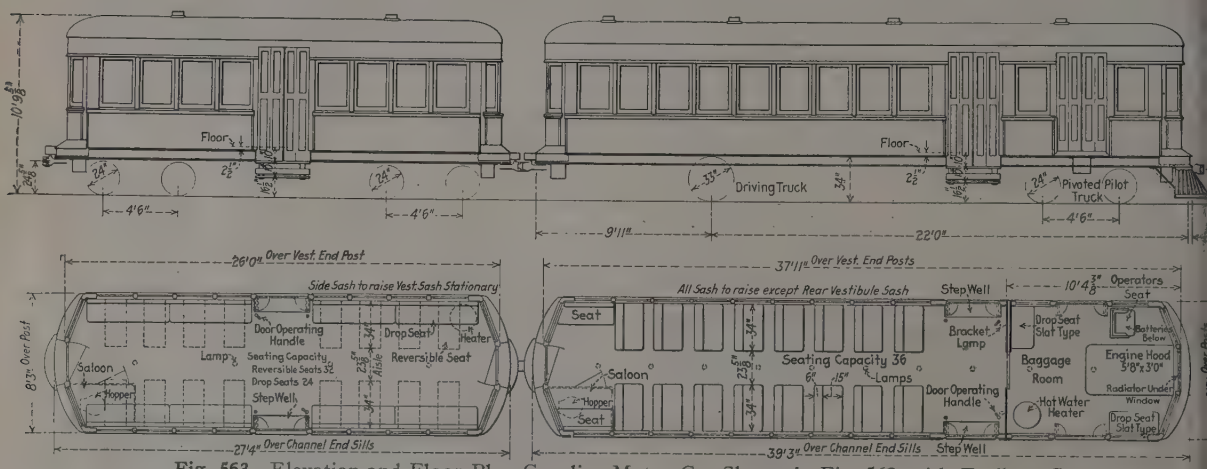


Fig. 563—Elevation and Floor Plan Gasoline Motor Car Shown in Fig. 562, with Trailer Car.

Fig. 564—Gasoline Motor Rail Car With Trailer Car. Edwards Railway Motor Car Company.

Car Construction

THE CONSTRUCTION AND OPERATION of freight cars on American railroads has resulted in the adoption of certain fundamentals of design which general practice has shown to be most practicable. This subject has for many years been studied by a committee of the Mechanical Division of the American Railway Association and the Standards and Recommended Practices which have been adopted for guidance in building such equipment, are as follows:

Standard—ADOPTED, 1920.

1. Height from rail to center of brake shoe face 13 in.
2. Height from rail to brake beam hanger fulcrum ..... 24⅞ in.
3. Height from rail to bottom of truck springs.. 10⅜ in.
4. Height from rail to top of springs (empty car) ..... 18¾ in.
5. Height from rail to center plate wearing surface ..... 26¾ in.
6. Height from rail to top of truck side bearings 27⅝ in.
7. Distance from center to center of side bearings ..... 50 in.
8. Average clearance per side bearing, per truck:
   Minimum ..... ⅛ in.
   Maximum ..... 5/16 in.
9. Height from rail to floor of box car (minimum) ..... 42 in.
10. Height from rail to floor of refrigerator car (minimum) ..... 48 in.
11. Distance between center sills..... 12⅞ in.
12. Area of center sills between rear followers (minimum) ..... 30 sq. in.
13. Distance from center of truck to end sill face for cars with 4-wheel trucks..... 5 ft. 0 in.
14. Draft gear travel (on car) ..... 2¾ in.
15. Coupler horn clearance ..... 3 in.
16. Minimum draft gear capacity .....150,000 lb.
17. Coupler shank side clearance, total..... 3 in.
18. Draft gear follower thickness..... 2¼ in.
19. Ratio of unit stress to end load (maximum) for center sills..... .05
20. Ratio of unit stress to end load (maximum) for draft attachments..... .125

For draft attachments the area of steel in square inches equivalent to the minimum required strength value is:

21. Tension or compression (square inches) grade "A" steel 12
22. For shear (sq. in.)..... 15
23. For bearing (sq. in.)..... 7½
24. Inside dimensions of box cars:
    Length .....40 ft. 6 in.
    Width ..... 8 ft. 6 in.
    Height (minimum) ..... 8 ft. 6 in.
25. Hardwood when used must have strength values four times those given for steel.

NOTE.—Standards for some of these fundamentals had already been adopted by the former M. C. B. Association, namely:

Side bearing clearance, adopted in 1914, as Recommended Practice, advanced to Standard in 1917.

Distance between center sills, adopted in 1905 as Recommended Practice, advanced to Standard in 1907.

Coupler horn clearance, adopted in 1905 as Recommended Practice, advanced to Standard in 1907.

Coupler shank side clearance, adopted in 1899 as Standard, modified in 1896, 1899, 1905, 1907 and 1909.

Draft Gear Followers, adopted as Recommended Practice in 1905. Advanced to Standard in 1907.

Height of floors, refrigerator cars, adopted as Recommended Practice in 1911.

Inside dimensions of box cars, adopted as Recommended Practice in 1904.

Height and width of cars, adopted as Recommended Practice in 1904.

Side Bearings, spread of, adopted as Recommended Practice in 1915.

In connection with the above fundamentals a standard method of designating cars, axles, journal boxes and contained parts was adopted as standard.

Axle having 3¾x7 in. journal to be designated as A axle.

Axle having 4¼x8 in. journal to be designated as B axle.

Axle having 5x9 in. journal to be designated as C axle.

Axle having 5½x10 in. journal to be designated as D axle.

Axle having 6x11 in. journal to be designated as E axle.

Axle having 6½x12 in. journal to be designated as F axle.

Classification 2A, 2B, 2C, etc., adopted for two axle trucks, the letter designating the axle used and the figure designating the number of axles in truck.

Classification 3A, 3B, 3C, etc., adopted for three axle trucks, to be used in the same manner.

Classification 4A, 4B, 4C, etc., and 6A, 6B, 6C, etc., adopted for cars, the letters designating the axles used, and the figures designating the numbers of axles under the car.

Car Sills, Steel and Wooden

Uniformity of Section

Standard—ADOPTED, 1899.

The following finished sizes for sections of longitudinal car sills have been adopted as standard of the Section.

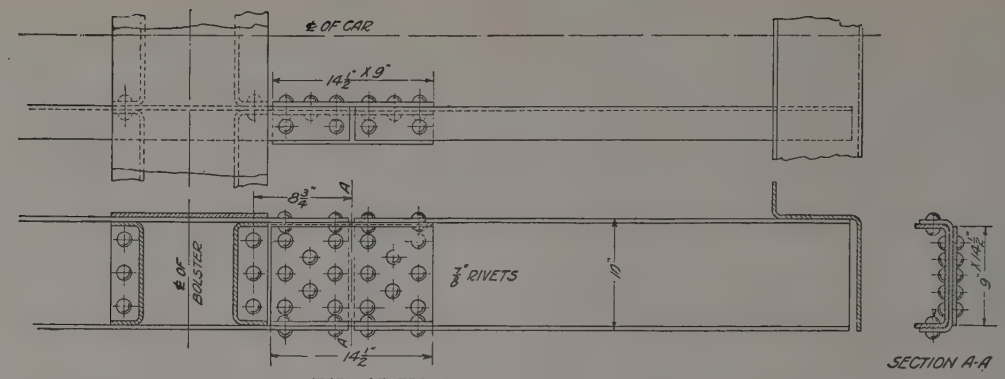
For cars such as box, stock, flat, long gondolas, refrigerators, etc., 32 ft. and over in length, but under 40 ft.:

4 " x 8"	4 " x 9"	4 " x 10"	4½" x 12"	5" x 14"
4½" x 8"	4½" x 9"	4½" x 10"	5 " x 12"	
5 " x 8"	5 " x 9"	5 " x 10"		

For cars 40 ft. long and over, such as furniture and special long gondolas:

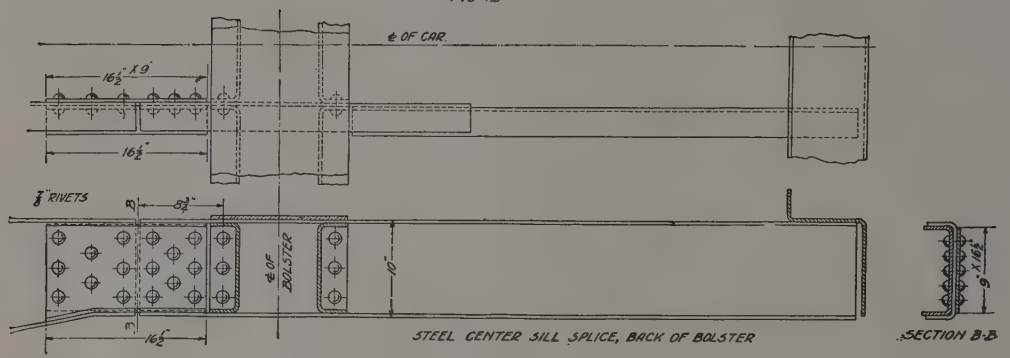
4½" x 8"	4½" x 9"	5" x 10"	6" x 12"	6" x 14"
5 " x 8"	5 " x 9"	6" x 10"		
	6 " x 9"			

It is believed that the above recommendations afford a sufficient range of sizes to cover all requirements of design; they are good merchantable sizes, and if used as suggested car repairs will be greatly expedited, as there will be less delay in getting special sizes of lumber, and requi-



STEEL CENTER SILL SPLICE, FRONT OF BOLSTER.

FIG 12



STEEL CENTER SILL SPLICE, BACK OF BOLSTER

FIG 12A

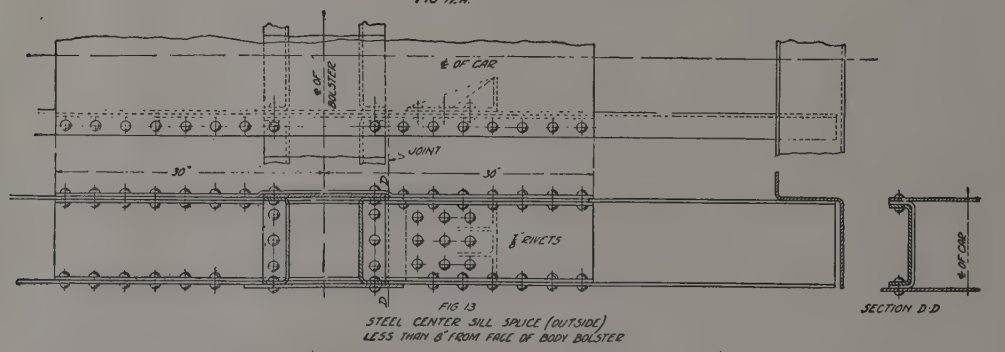


FIG 13
STEEL CENTER SILL SPLICE (OUTSIDE)
LESS THAN 8" FROM FACE OF BODY BOLSTER

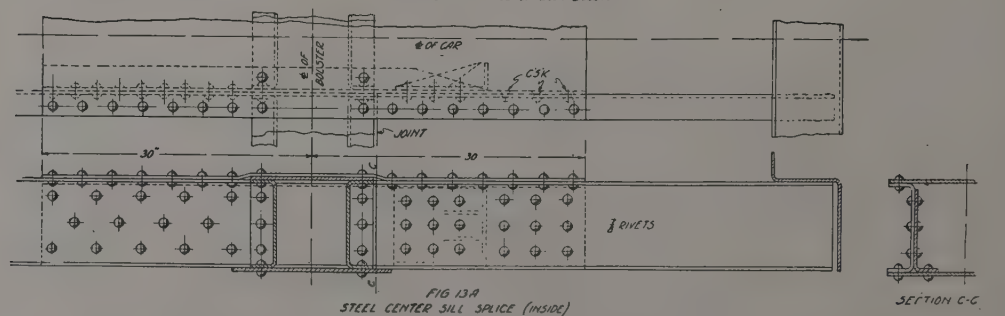


FIG 13A
STEEL CENTER SILL SPLICE (INSIDE)
LESS THAN 8" FROM FACE OF BODY BOLSTER

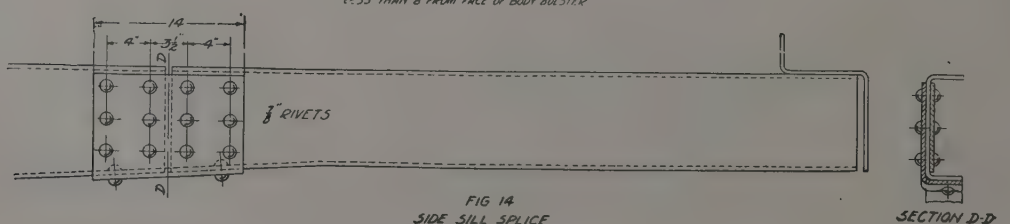


FIG 14
SIDE SILL SPLICE

FIG. 571—AMERICAN RAILWAY ASSOCIATION STANDARD FOR SPLICING OF STEEL SILLS.

sitions for regular sizes can be filled more promptly as lumbermen can saw in advance of orders with a reasonable certainty of selling their stock.

Splicing of Steel Sills

Standard—ADOPTED, 1911; REVISED, 1919.

FOR CARS HAVING STEEL CENTER SILL SPLICES LOCATED AT LEAST 7 IN. FROM FACE OF BOLSTERS

Adjacent sills may be spliced.

All splices shall be of the butt-joint type, reinforced on both sides by plates of not over 24 in. in length, and not bolster 30 in., as shown in Fig. 571, A. R. A. Figs. 13 or 13-A.

The rivets shall be spaced as shown.

SIDE SILL SPLICES.

All splices must be of the butt-joint type, reinforced on both sides by plates 14 in. long. The reinforcing plates shall be at least as thick as the web of the sill. The splice plate on the flange side of the sill shall cover the web only, while the plate on the opposite side shall be flanged over the bottom leg of the side sill, and riveted to the same, as shown in Fig. 571, A. R. A. Fig. 14. The splice may be located on either side of the body bolster.

Side sills may also be welded by the autogenous process,

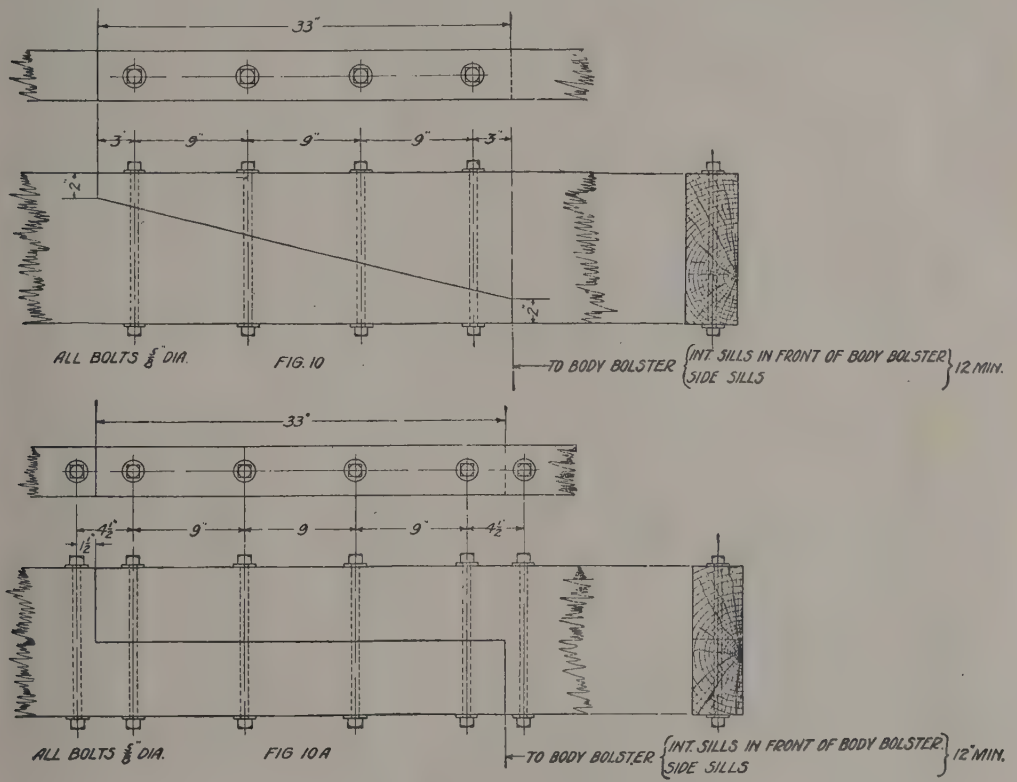


FIG. 572—SPLICING FOR WOODEN SILLS.

less than twice the length of the protruding end when the projection is less than 12 in. The reinforcing plates shall be at least as thick as the web of the sill. The splice plate on the flange side of the sill shall be U-shaped, to include flanges, while the plate on the opposite side shall cover the web only. Rivets to be spaced as shown in Fig. 571, A. R. A. Figs. 12 and 12-A.

Where autogenous welding is available, the sills may be welded after riveting the U-shaped plate on the flange side, omitting the flat plate on web side.

FOR CARS HAVING STEEL CENTER SILL SPLICES LOCATED BETWEEN BODY BOLSTER AND END SILL, AND LESS THAN 8 IN. FROM FACE OF BOLSTER:

All splices shall be of the butt-joint type, with the addition of a cover plate.

The splice plates shall be at least as thick as the web of the sill. They may be located on either side of the sill, extending forward and back of the center line of making the thickness of the metal through weld one and one-half times the thickness of the metal in the sill, in which case the reinforcing plates and rivets shown in A. R. A. Fig. 14 may be omitted.

Splicing of Wooden Sills

Standard—ADOPTED, 1911; REVISED, 1919

Draft timbers must not be spliced. Longitudinal sills must not be spliced between or over cross-bearers.

Longitudinal sills may be spliced at both ends; intermediate or side sills on either side of body bolster. The nearest part of the splice must not be less than 12 in. from edge of body bolster. Intermediate sills, spliced between body bolster and cross-bearer, must be reinforced as per Fig. 573, A. R. A., Figs. 11 or 11-A. Intermediate sills, spliced between bolster and end of car, and side sill, spliced on either side of bolster, must be in accordance with Fig. 572, A. R. A., Figs. 10 or 10-A, A. R. A.

When splicing or renewing any longitudinal sill, reinforcement shall be applied to all existing non-reinforced splices, in all sills except side sills. If the old splice is a

four-bolt splice, it shall be reinforced in accordance with A. R. A. Figs. 11 or 11-A If the old splice is a three-bolt splice, the reinforcement shall be applied in accordance with Fig. 573, A. R. A. Fig. 15.

Center sills shall be spliced only between body bolster and

2. The strength value of the draft attachments and center-sill construction must be equivalent to at least 10 sq. in. of steel in tension and compression, 6¼ sq. in. of rivet-bearing area and 12½ sq. in. in shear. The ratio of unit stress to end load must not exceed 0.15.

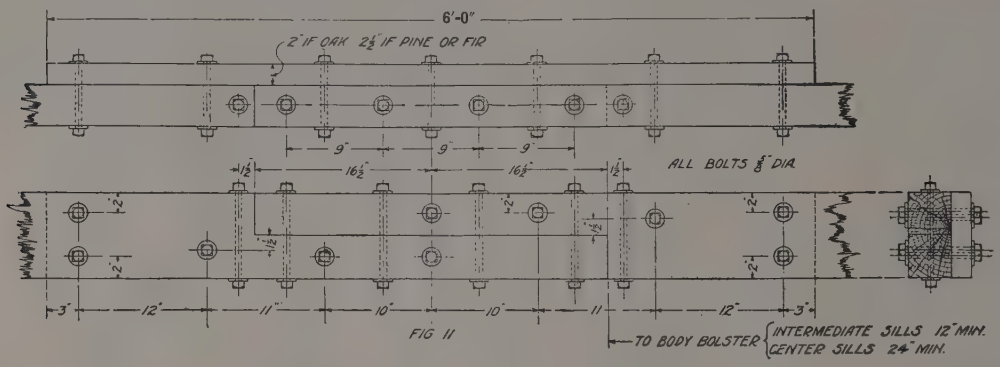


FIG 11

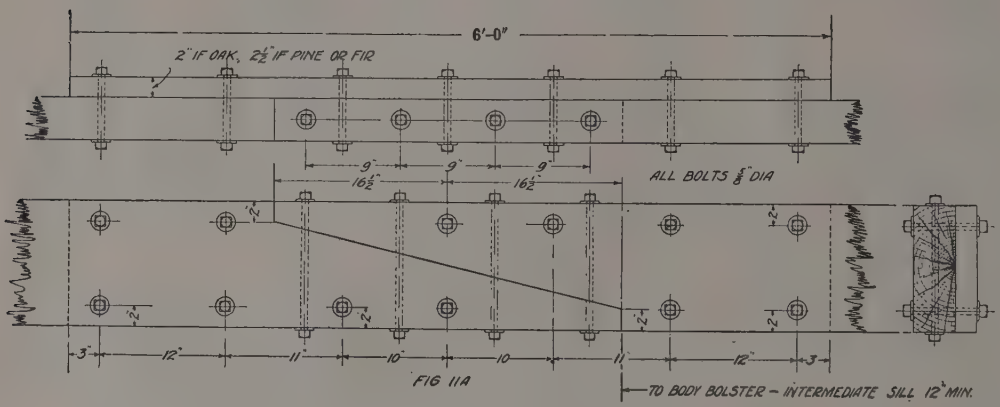


FIG 11A

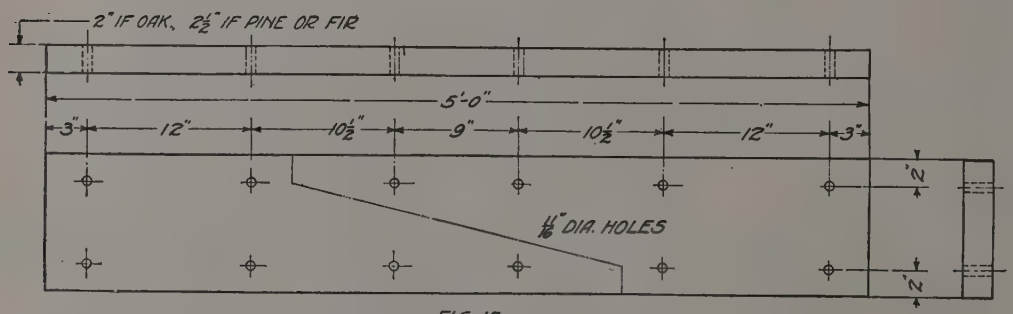


FIG. 15.

CENTER AND INTERMEDIATE SILL THREE BOLT SPLICE REINFORCEMENT.

FIG. 573—STANDARD FOR SPLICING WOODEN SILLS

cross-tie timber. The nearest part of the splice must not be less than 24 in. from edge of body bolster. Center sill splices shall be in accordance with A. R. A. Fig. 11.

The diameter of horizontal or vertical splice bolts shall be ⅝ in.

Reinforcing of Existing Wooden Cars

Recommended Practice—ADOPTED, 1915.

The following minimum strength requirements for the reinforcement of existing wooden cars should be observed:

1. The draft attachments, including draft arms, if used, must be of metal, of either integral or riveted construction.

3. Metal draft arms applied to wooden center sills must extend at least 30 in. beyond center line of bolster, toward center of car, must be securely fastened to bolster and center sills, and where possible should butt against compression members placed between draft arms and needle beams and also between the needle beams.

Hardwood or yellow pine center sills may be considered equivalent to steel in center-sill construction between bolsters, if they have four times the specified unit values, namely, 40 sq. in. tension and compression area, and a ratio of unit stress to end load not exceeding 0.0375.

Where wooden members are reinforced with metal

(composite construction), either the steel or the wood must alone meet the strength requirements.

Where horn of coupler is allowed to come in contact with the end sill, the latter must be provided with a striking plate of sufficient strength to resist its proportionate load without deformation.

4. The draft-gear capacity is indirectly governed by the rules in paragraph 2.

Design and Strength of Box Car End

Recommended Practice—ADOPTED, 1914; REVISED, 1920.

New cars should have corrugated steel ends or steel plate ends ¼ in. thick, reinforced between corner posts with the equivalent of either two vertical steel braces with a total section modulus of not less than 9; or one vertical and two diagonal steel braces with a total section modulus of not less than 10; or three horizontal steel braces with a total section modulus of not less than 10.

The attachments for the braces and the members to which they are attached must be sufficiently strong to realize the full strength of the braces.

Lining at car ends should be supported at intervals not greater than 30 times the thickness.

Two 4 by 3 in. Z bars, 12.4 lb. per ft., have a total section modulus of 9.34.

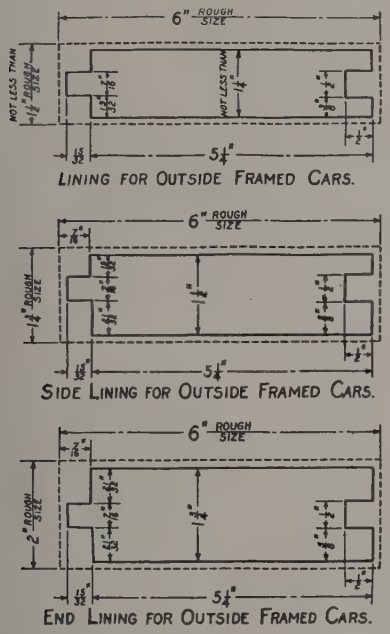


FIG. 574—RECOMMENDED PRACTICE FOR LINING FOR OUTSIDE FRAMED CARS.

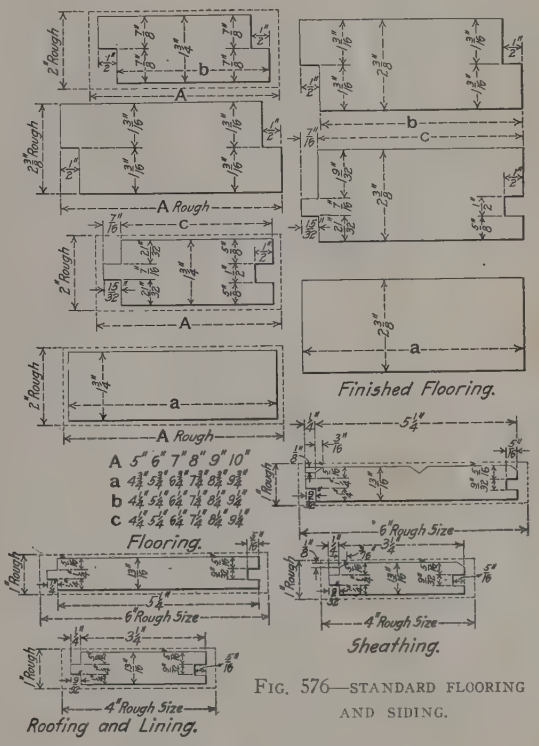


FIG. 576—STANDARD FLOORING AND SIDING.

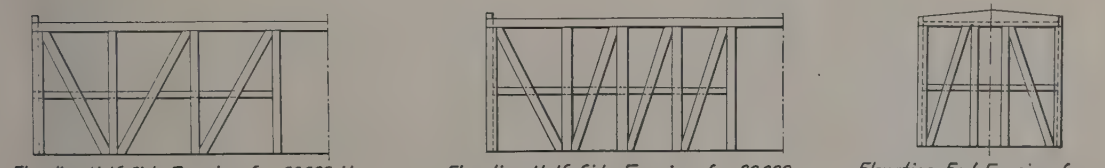

Elevation Half Side Framing for 60,000-Lb. Capacity Cars.
Elevation Half Side Framing for 80,000, and 100,000-Lb. Capacity Cars.
Framing of Box Cars.
Elevation End Framing for 60,000, 80,000 and 100,000 Lb. Capacity Cars.

FIG. 575—A. R. A. RECOMMENDED PRACTICE FOR FRAMING FOR BOX CARS

New cars may have the following alternative arrangement: Three or more steel braces, two of which run diagonally, with a total section modulus of not less than 12½, and wood lining 1¾ in. thick.

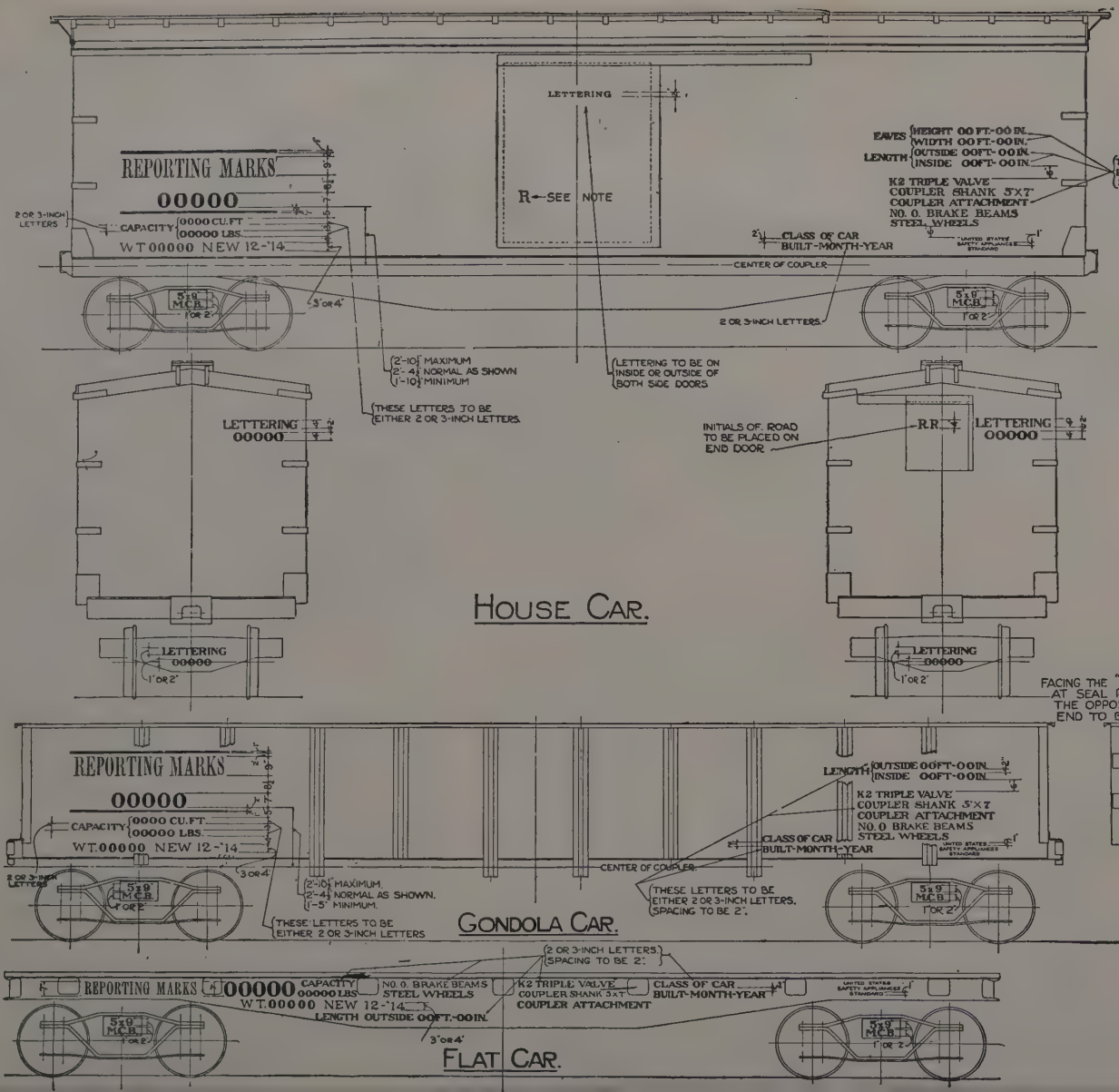
To concentrate strength at a point near floor line on vertical center line of car, diagonal braces should extend from the center sills to the side plates, and not from the bottom corner to the ridge.

Two 5-in. I beams, 9.75 lb. per ft., have a total section modulus of 9.6.

Three 4-in. I beams, 9.5 lb. per ft., have a total section modulus of 10.2.

Three 3-in. Z bars, 14.2 lb. per ft., have a total section modulus of 10.3.

The corrugated ends referred to may be made of one or more pieces. If made of one piece it should not be


REPORTING MARKS
00000
CAPACITY 0000 CU.FT. 00000 LBS.
WT 00000 NEW 12-'14
2 OR 3-INCH LETTERS
LETTERING
R—SEE NOTE
EAVES HEIGHT 00 FT.-00 IN. WIDTH 00 FT.-00 IN.
LENGTH OUTSIDE 00FT.-00 IN. INSIDE 00FT.-00 IN.
K2 TRIPLE VALVE
COUPLER SHANK 5"X 7"
COUPLER ATTACHMENT
NO. 0. BRAKE BEAMS
STEEL WHEELS
THESE LETTERS TO BE EITHER 2 OR 3-INCH LETTERS. SPACING TO BE 2".
CLASS OF CAR
BUILT-MONTH-YEAR
CENTER OF COUPLER
5'x9" M.C.B.
1 OR 2"
3" OR 4"
2 OR 3-INCH LETTERS.
2'-10½" MAXIMUM
2'-4½" NORMAL AS SHOWN
1'-10½" MINIMUM
THESE LETTERS TO BE EITHER 2 OR 3-INCH LETTERS.
LETTERING TO BE ON INSIDE OR OUTSIDE OF BOTH SIDE DOORS
LETTERING
00000
INITIALS OF ROAD TO BE PLACED ON END DOOR
R.R.
HOUSE CAR.
FACING THE "B" END OF CAR, THE LEFT-HAND SIDE DOOR AT SEAL PIN TO BE LETTERED "L"; THE DOOR ON THE OPPOSITE SIDE TO THE RIGHT FACING THE "B" END TO BE LETTERED "R" AT SEAL PIN.
REPORTING MARKS
00000
CAPACITY 0000 CU.FT. 00000 LBS.
WT. 00000 NEW 12-'14
LENGTH OUTSIDE 00FT.-00IN. INSIDE 00FT.-00IN.
K2 TRIPLE VALVE
COUPLER SHANK 5"X 7"
COUPLER ATTACHMENT
NO. 0 BRAKE BEAMS
STEEL WHEELS
CLASS OF CAR
BUILT-MONTH-YEAR
CENTER OF COUPLER
3" OR 4"
2'-10½" MAXIMUM
2'-4½" NORMAL AS SHOWN.
1'-5" MINIMUM.
THESE LETTERS TO BE EITHER 2 OR 3-INCH LETTERS.
THESE LETTERS TO BE EITHER 2 OR 3-INCH LETTERS. SPACING TO BE 2".
GONDOLA CAR.
LETTERING
00000
1 OR 2"
REPORTING MARKS 00000 CAPACITY 00000 LBS.
WT. 00000 NEW 12-'14
NO. 0. BRAKE BEAMS STEEL WHEELS
K2 TRIPLE VALVE COUPLER SHANK 5"X 7" COUPLER ATTACHMENT
CLASS OF CAR BUILT-MONTH-YEAR
LENGTH OUTSIDE 00FT.-00IN.
(2 OR 3-INCH LETTERS. SPACING TO BE 2".)
3" OR 4"
FLAT CAR.

NOTES

HOUSE CARS MORE THAN 12 FEET FROM TOP OF RAIL TO EAVES TO SHOW HEIGHT, AND WIDTH AT EAVES AS NEAR THE BOTTOM AS CONVENIENT.

FOR HOUSE AND GONDOLA CARS TRIPLE VALVE, SIZE OF COUPLER, STYLE OF COUPLER ATTACHMENT, KIND OF BRAKE BEAMS AND KIND OF WHEELS TO BE SHOWN ON SIDE OF CAR AT END OR ON END OF CAR ABOVE COUPLER.

FOR FLAT CARS TRIPLE VALVE, SIZE OF COUPLER, STYLE OF COUPLER ATTACHMENT, KIND OF BRAKE BEAMS AND KIND OF WHEELS TO BE SHOWN ON THE SIDE OF CAR IN THE BEST AVAILABLE POSITION OFFERED BY THE CONSTRUCTION OF THE CAR.

TRUCK BOLSTERS TO SHOW SIZE OF JOURNAL AND LETTERS "M.C.B." IF M.C.B. AXLES ARE USED OR DISTANCE C TO C OF JOURNAL, IF AXLES ARE NOT M.C.B.

INITIALS OF ROAD ON ONE SIDE OF TRUCK BOLSTER OR TRUCK TRANSOM.

SUBSTITUTE "STATION SYMBOL" FOR "NEW" WHEN CAR IS REWEIGHED.

TRUST MARKS, PATENT MARKS AND OTHER PRIVATE MARKS SHOULD BE 1" LETTERS OR FIGURES.

THE REPORTING MARKS ASSIGNED BY THE ASSOCIATION OF TRANSPORTATION AND CAR ACCOUNTING OFFICERS SHOULD BE PLACED BETWEEN THE HORIZONTAL BARS. IF DESIRED, THE INITIALS OF OWNER MAY BE PLACED ABOVE THE BARS

less than ¼ in. thick. If made of more than one piece the lower third must not be less than ¼ in. thick and the remainder should be not less than 3/16 in. thick.

On house cars (other than refrigerator cars) with steel underframes or steel center sills, having a center sill area of not less than 24 sq. in., when an end requires repairs consisting of new posts and braces, the ends shall be replaced with ends specified for new cars, this to be done by the railroad or private owner or under the direction of the car owner.

Stake Pockets—Permanent and Temporary

Recommended Practice—ADOPTED, 1905; REVISED, 1917

1. Permanent stake pockets should be secured to cars of wooden construction by U bolts.

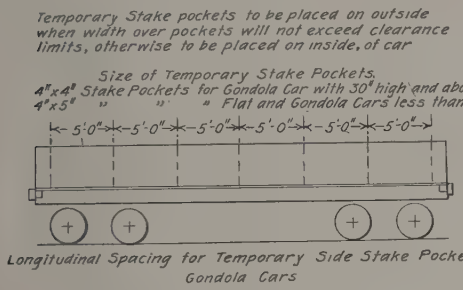

Temporary Stake pockets to be placed on outside when width over pockets will not exceed clearance limits, otherwise to be placed on inside, of car
Size of Temporary Stake Pockets
4"x4" Stake Pockets for Gondola Car with 30" high and above
4"x5" " " " Flat and Gondola Cars less than 30" high.
5'-0" 5'-0" 5'-0" 5'-0" 5'-0" 5'-0"
Longitudinal Spacing for Temporary Side Stake Pockets.
Gondola Cars

FIG. 578—DIAGRAM SHOWING LOCATION OF STAKE POCKETS

2. Permanent stake pockets should be secured to cars of steel construction by rivets or U bolts.

3. Malleable iron should be used in the manufacture of permanent stake pockets.

4. Stakes should be located to suit the construction of the car or the requirements of the service, but should not be placed farther apart than 4 ft. from center to center of stake pockets.

5. Stake pockets for flat cars should be 4 in. wide by 5 in. deep.

6. The spacing of stake pockets on flat cars should be, minimum 2 ft. 0 in., and maximum 3 ft. 6 in., center to center.

Recommended Practice—ADOPTED, 1905.

Temporary stake pockets for flat cars and gondola cars with sides less than 30 in. high should be 4 in. wide by 5 in. deep.

Temporary stake pockets for gondola cars having sides 30 in. in height and over should be made 4 in. wide by 4 in. deep.

Placard Boards for House Cars

Recommended Practice—ADOPTED, 1914.

The space available for placards should be not less than 16 in. by 24 in. on each end and each side of car. House cars with sufficient space available on wood siding, or exposed lining, should have a rectangular space, painted black, on each side and each end. Other house cars should be provided with placard boards, made of soft wood, not less than 16 by 24 by 1 in. The vertical edge should be reinforced with metal protection, and the bolts fastening the boards to the car should be not less than six in number, and should pass through the metal reinforcing pieces, three through each. The boards may be made of more than one piece, and should then be tongued and grooved. The distance from the floor line of car to bottom of board should be not less than 4 ft. 6 in.

Routing boards, preferably the same size as the placard boards described, should be placed on the side of the car, and they should be located as near as possible to the car door seal.

Lettering and Marking of Cars

Standard—ADOPTED, 1901; REVISED, 1920

1. *Letters and Figures.*—For sizes and types of letters and numerals, the following will govern:

(a) Roman letters and figures of the design shown to be used.

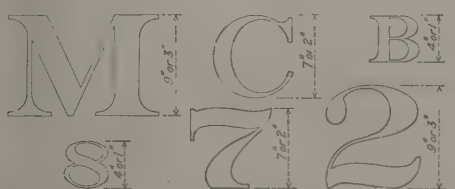


FIG. 579—STANDARD LETTERS AND FIGURES FOR FREIGHT CAR MARKING. (M. C. B. SHEET 26B.)

(b) The sizes of these letters and figures to be confined to 1, 2, 3, 4, 7 and 9 inches.

(c) 7 and 9-inch letters or figures to be used for the initials, names and numbers for the sides of cars, and 4-inch letters or figures for the lettering on the doors and ends of cars

(d) For other car-body markings on sides and ends, such as capacity, couplers, brake beams, class of car, date built, outside and inside dimensions, and markings inside of car, 2 or 3-inch letters and figures to be used, with the following exceptions:

1. All weight marks to be 3 or 4-inch letters or figures.

2. Trust marks, patent marks and other private marks should be 1-inch letters or figures.

(e) All marks on trucks to be confined to 1 or 2-inch letters or figures.

(f) Stenciling on air-brake cylinders or reservoirs to be 1-inch letters or figures.

2. *Equipment.*—All classes of cars are to have type of triple valve, size of coupler, style of rear attachments, kind of draft gear, style of brake beams and kind of wheels (other than cast iron) stenciled in 2 or 3-inch letters on each side of car at opposite ends, or on each end of car directly above coupler, where design of car permits it. For flat cars these records are to be shown in the best

available position offered by the construction of the car. Where the kind of draft gear implies the style of rear attachments, the marking for the latter may be omitted.

3. *Date Built.*—All cars are to have the month and year built stenciled on each side of car at opposite ends. Cars built prior to 1895 may be stenciled "Built prior to 1895." A badge plate may be used to give the date built.

In the case of tank cars the body and tank should bear distinctive dates unless constructed at the same time.

4. *Journal Boxes Repacked.*—The word "Repacked," together with the date (month and year), shop or station abbreviation and railroad reporting marks to be stenciled in 1-in. block letters on each side of the car to the right of the center as near the lower edge of the side sill as practical and just to the left of the body bolster.

5. *Safety Appliances.*—Designating marks for cars equipped with United States Safety Appliance Standards are as follows:

For cars built on or after July 1, 1911:

UNITED STATES
SAFETY APPLIANCES.
STANDARD

For cars built prior to July 1, 1911:

UNITED STATES
SAFETY APPLIANCES.

6. The above markings to be used on each side of the car: Letters, if stenciled, to be not less than 1 inch in height and as per A. R. A.—Sec. III, Mechanical Standards for Lettering for Freight Cars; letters, if on a metal badge plate, to be not less than 1/16 inch, and have not less than ⅛ inch bar or staff. The arrangement of the words to be as near as possible as shown above.

7. A metal badge plate, 3⅛ by 10 inches, with the proper marking is preferred, one plate to be secured on each side of the car by four bolts or rivets, if on metal cars, and by four bolts or screws, if on wooden cars, the bolts, rivets, or screws to be not less than ¼ inch in diameter. Badge plate of metal as shown on drawing.

HOUSE CARS

8. *Report Marks, Number, Capacity, Weight.*—Freight Equipment Cars that have a superstructure which will permit should be stenciled with markings on side of car, in the following order:

Lettering (Reporting marks).
Number.
Capacity (in pounds).
Cubical Capacity (excepting flat and tank cars).
Light Weight (including date and word "New" for new cars and date and station symbol for re-weighed cars).

9. This marking is to be located as nearly over the truck as the lettering will permit, preferably to the left of center line of side of car. On box and other house cars where doors slide to the left, the above markings may be placed to the right of center line of side of car. On any other cars where the construction makes it necessary, this marking may be placed either to the right of center line of side of car, or in the center of side of car. The distance from the center line of coupler to the bottom of car number to be normally 2 feet 4½ inches, with a minimum dimension of 1 foot 10½ inches, and a maximum of 2 feet 10½ inches. The spacing of the remaining marking to be as shown on diagram.

10. *End Marking.*—The ends should show the initials or name of road and car number in the upper half of end of car. On box or other house cars having end doors this lettering should be so located that it will not be obscured when doors are open.

11. *Doors.*—Side and end doors should be stenciled with the initials or name of road either on the outside or inside of door. If placed on the inside the stenciling should be so located that it will not be defaced by the sliding of the door.

12. Side doors on the left hand side and on the right hand side when facing the "B" end of the car to be lettered "L" and "R" respectively at the seal pin.

13. *Eave Clearance.*—On all box or other house cars standing more than twelve (12) feet from top of rail to eaves, the height and width at eaves is to be stenciled in 3-inch letters on side of car, as near the bottom as convenient.

Where latitudinal running board is flush with eaves, the height should be given to top of latitudinal running board.

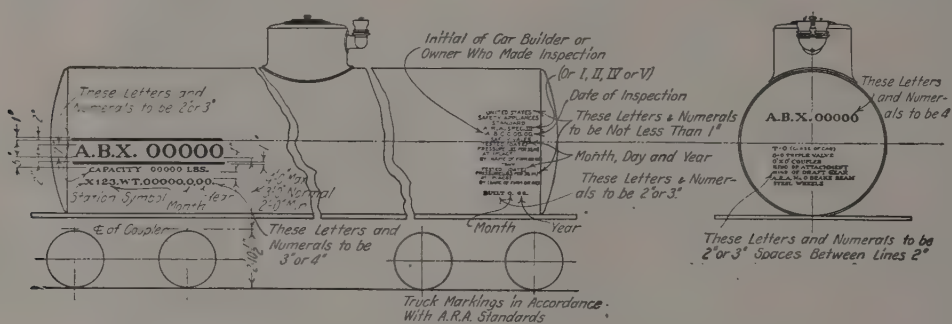

Initial of Car Builder or Owner Who Made Inspection
(Or I, II, III or V)
Date of Inspection
These Letters & Numerals to be Not Less Than 1"
Month, Day and Year
These Letters & Numerals to be 2 or 3"
These Letters and Numerals to be 3" or 4"
Truck Markings in Accordance With A.R.A. Standards
These Letters and Numerals to be 2" or 3" Spaces Between Lines 2"
A.B.X. 00000
CAPACITY 00000 LBS.
X123 WT. 00000.000
Station Symbol
Month
Year
Month
Year
C of Coupler

FIG. 580—AMERICAN RAILWAY ASSOCIATION STANDARD MARKING FOR TANK CARS.

GONDOLAS

14. Drop end gondola cars should be stenciled with length of car inside of drop end doors, measured at the center; this stencil, "Inside length 00 feet," to be located on side of car.

15. The minimum height of number on steel underframe gondola cars above the center line of the coupler is 1 foot 5 inches.

FLAT AND LOW GONDOLAS

16. Flat and low-sided gondola cars should show the lettering (initials or name of road), number, capacity in pounds and light weight on the side of car in the best available location offered by the construction of the car. Suggestions as to the arrangement of this lettering and figures should correspond with Standard Practice. The end marking on flat cars may be omitted.

17. Flat cars should be stenciled with the length of car

over end sills, measured at the center. The stencil, "Length 00 ft." to be located on side of car.

Tank Cars

18. On tank cars the class of car and equipment markings shall be placed on the head of tank at each end of car below the initials and number.

19. Each tank car shall have stenciling in the order given on this page located on each side of tank as nearly on the right hand end thereof (when facing side of car) as the lettering will permit:

20. Tank cars shall be stenciled with the following markings on each side of tank, in the order given:

Initials and number.
Capacity, in pounds.
Light weight.

21. This marking is to be located as nearly to the left hand end of tank (when facing side of car) as the lettering will permit. The distance from the center line of coupler to the bottom of initials and numbers shall be normally three (3) feet (0) inch, with a minimum dimension of two (2) feet (0) inch and a maximum dimension of four (4) feet (0) inches. On each end of car tank head shall be stenciled with the initials and number of car above center line of tank.

Baggage and Express Cars

22. Each baggage or express car shall have the marked capacity in pounds stenciled on the inside of the car, the stenciling to be placed over the side door on each side of the car.

Trucks

23. Where the construction of the truck permits, trucks shall be stenciled on each side, giving the size of journal and the letters "A. R. A." if the axle is A. R. A. standard axle. If the axle is not A. R. A. standard, use dimensions from center to center of journal in place of A. R. A. This stenciling to be in 1 or 2-inch letters, and to be put on end of bolster in Diamond trucks, and on side truck frame in center on pedestal type of trucks.

24. Initials of the road should also appear in letters 1 or 2 inches high on one side of bolster or transom of each truck.

United States Safety Appliances. Standard.

Or

United States Safety Appliances—
M. C. B. Construction.

For Class I and II:

Initial of railroad or company who made inspection, month, day and year. Date of inspection, month, day and year.

Or

For Classes II and III Cars:

Initial of car builder or owner who made inspection. Date of inspection, month, day and year.

Safety Valves

(If Car Is Equipped With Safety Valves.)

Tested .....
(Month, day and year.)

Pressure .....
(Lb. per sq. in.)

At .....
(Place.)

By .....
(Name of firm or railroad.)

Tank

Tested .....
(Month, day and year.)

Pressure .....
(Lb. per sq. in.)

At .....
(Place.)

By .....
(Name of firm or railroad.)

Illustrations of car parts constructed in conformity with the foregoing specifications are shown in pages following.

Fig. 581—Bettendorf Steel Underframe for Wooden Freight Cars.

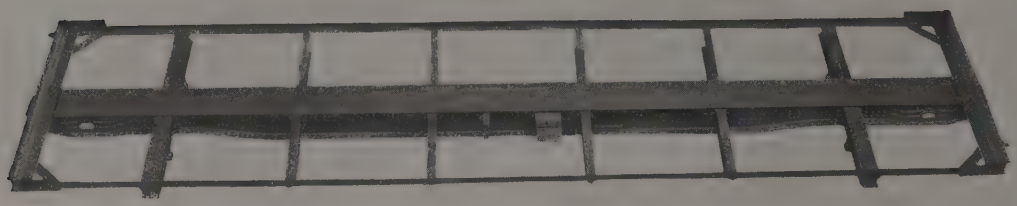


Fig. 582—Bettendorf Steel Underframe for Refrigerator Cars.

Fig. 583—Bettendorf Steel Underframe for Reinforcing Wooden Baggage Cars.

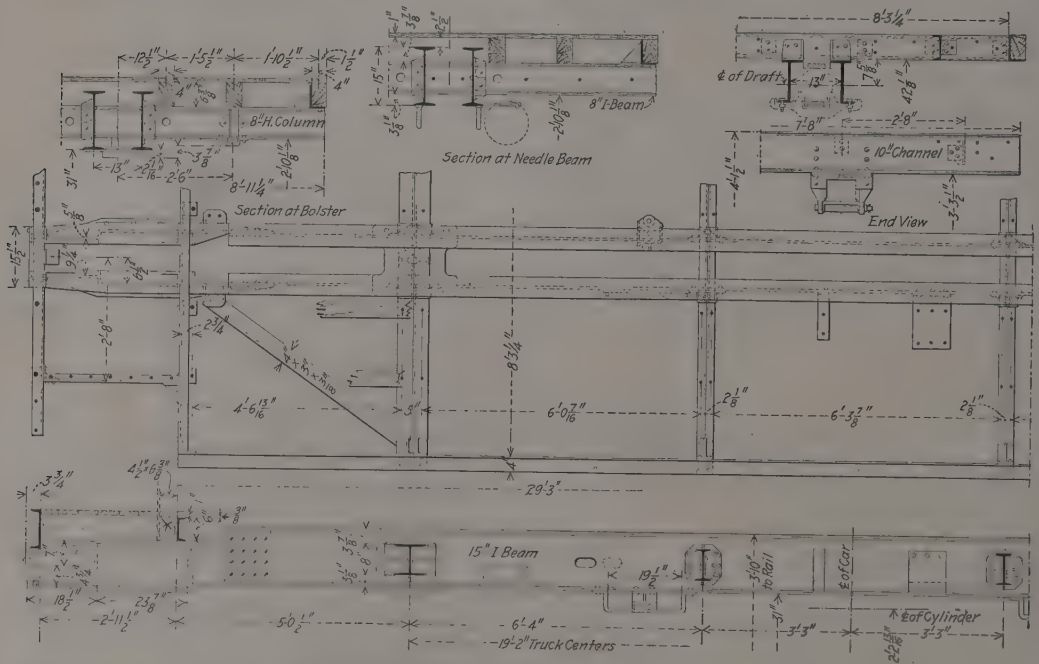


Fig. 584—Steel Underframe for Caboose.

Fig. 585—Bottom View of Steel Underframe for Caboose.

The Bettendorf Company.

(See also Page 373.)

Bettendorf Steel Underframes

Steel underframes manufactured by the Bettendorf Company combine the elements of strength, durability and simplicity with the least possible weight. The degree of success attained by Bettendorf engineers in developing steel underframes of these characteristics may be attributed largely to the care with which they analyze service conditions, study the loads to be imposed and the scientific determination of the maximum stresses that each part will be called upon to resist.

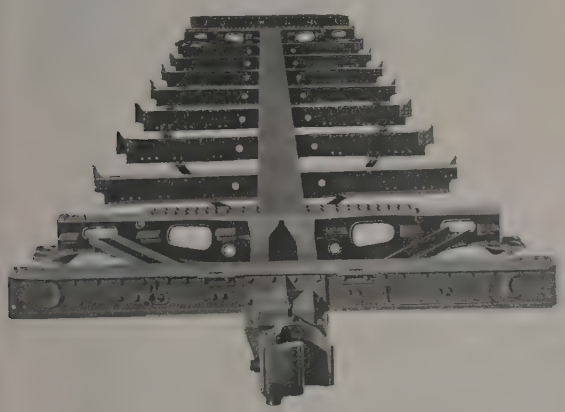


Fig. 586—Single Center Sill Type

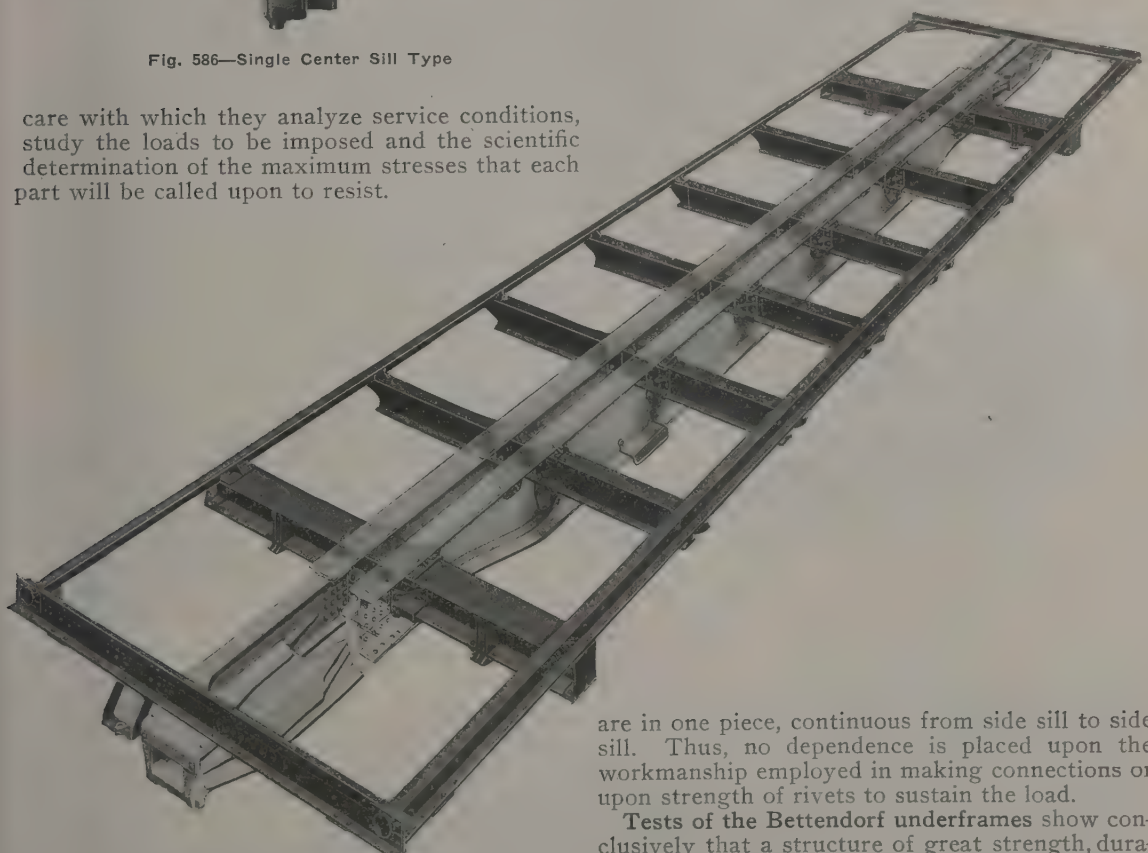


Fig. 587—Double Center Sill Type

Few engineering structures exist that are subjected to a greater multiplicity of inter-acting stresses or require a higher degree of engineering skill in design, than the steel underframe of a railroad freight or passenger car. If the requisite engineering skill has not been employed in the design of a steel underframe, the fact is not always in evidence, but exists nevertheless as a steady drain upon the finances of the operating company. This is particularly the case where underframes are so designed as to contain excess weight or poorly distributed metal which serves no useful purpose. On the other hand structures lightly built or improperly connected are a constant source of maintenance expense.

If an ordinary underframe weighing 5 tons were to be replaced by a Bettendorf underframe of greater strength but weighing only 4.15 tons there would be a saving of 1,700 lb. per car in dead weight.

The Bettendorf underframe absolutely eliminates draft sill troubles by the use of cast steel draft sills having cast integral with them the stops and pockets necessary to accommodate the draft gear. Other important advantages lie in the needle beam and body bolster construction. These are in one piece, continuous from side sill to side sill. Thus, no dependence is placed upon the workmanship employed in making connections or upon strength of rivets to sustain the load.

Tests of the Bettendorf underframes show conclusively that a structure of great strength, durability and simplicity has been produced with a reduction in weight, an increase in buffing area and a large reduction in the total number of parts as compared with other underframes designed for similar service.

For other products and branch offices, see classified and alphabetical indexes.

THE BETTENDORF COMPANY, BETTENDORF, IOWA

Fig. 588—Steel Underframe for Passenger Train Cars.

Fig. 589—Steel Underframe for Passenger Train Cars. The Bethlehem Shipbuilding Corporation, Ltd.

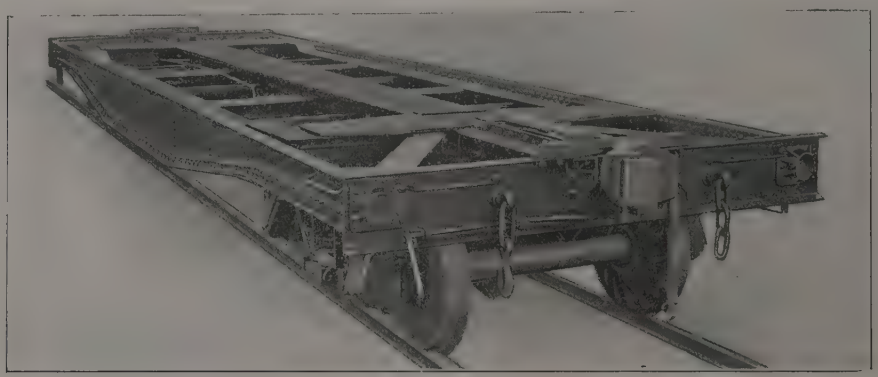


Fig. 590—Steel Frame for 75-Ton Capacity Flat Car. Builder, American Car & Foundry Company.

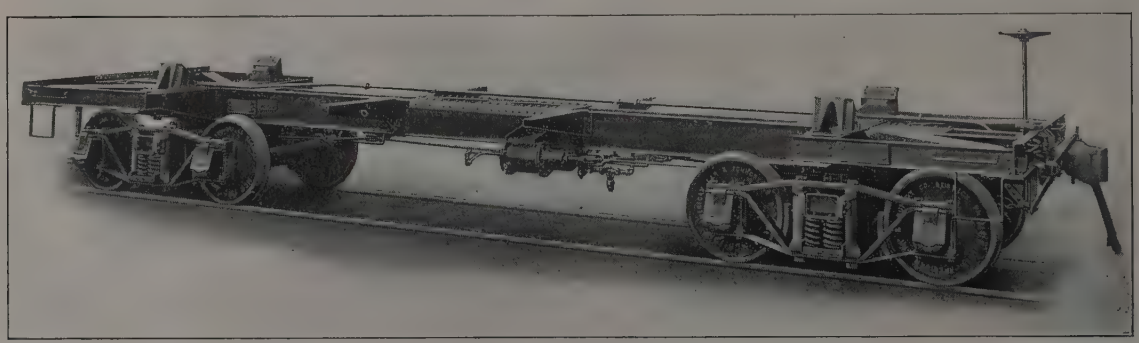


Fig. 591—Steel Underframe for Tank Cars of 10,000 U. S. Gallons Capacity. American Car & Foundry Company.

Fig. 592—Underframe for Erie Railroad Steel Suburban Coach.

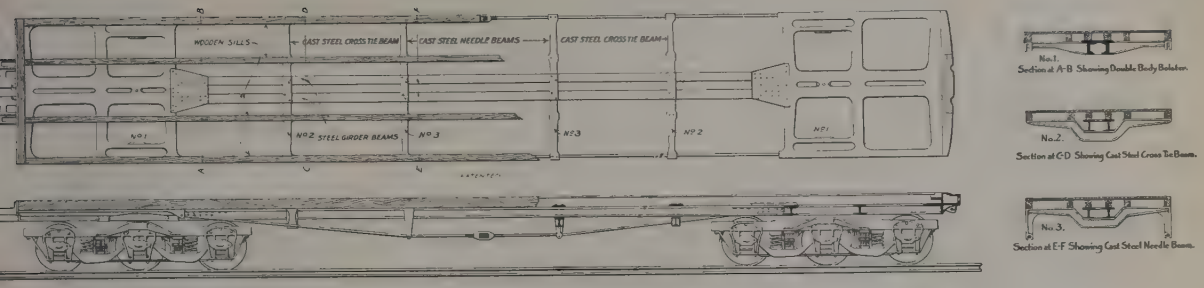


Fig. 593—Combined Wood and Steel Underframe for Passenger Train Cars with One Vestibule and One Non-Vestibule End, Using Commonwealth Steel Company's Cast Steel Combined Platform and Double Body Bolsters.

Fig. 594—Commonwealth Steel Underframe for Strengthening Old Postal Cars.

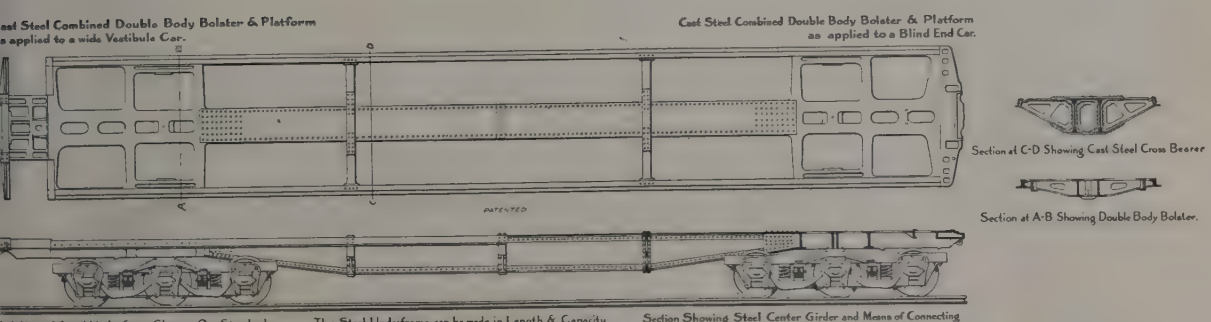

Cast Steel Combined Double Body Bolster & Platform as applied to a wide Vestibule Car.
Cast Steel Combined Double Body Bolster & Platform as applied to a Blind End Car.
PATENTED
Section at C-D Showing Cast Steel Cross Bearer
Section at A-B Showing Double Body Bolster.
Side View of Steel Underframe Showing Our Standard Cast Steel 6 Wheel Truck.
This Steel Underframe can be made in Length & Capacity to suit any Car and for either 4 or 6 Wheel Trucks.
Section Showing Steel Center Girder and Means of Connecting to Combination Double Body Bolster & Platform.

Fig. 595—Steel Underframe for Passenger Train Cars.

Commonwealth Steel Company.

(See also Pages 376 and 377.)

Commonwealth Cast Steel Frames

At the time when many of the wooden passenger cars now in service were designed, the buffing stresses and shocks to which the underframes and car structures were then subjected could be successfully withstood by wooden construction. However, the advent and use of the heavy steel equipment, which is now general, has rendered necessary the use of some means for reinforcing the older wooden construction, if the operation of this class of equipment is to be continued.

Fig. 596—Steel Underframe for Wooden Passenger Train Car, Embodying Commonwealth Platform and Double Body Bolster, Cast Integral, Connected by Steel Girders

The Commonwealth Double Body Bolster and Platform consists of a single steel casting which can be fastened directly to an existing wooden underframe without necessitating any alterations. This casting may be extended to include end framing, and different styles, which are suitable for either blind ends or platform ends, are available. Ample provisions are made for the draft gear, coupler, and buffing equipment. The simplicity and strength which are afforded, make this type of construction ideal for mail, baggage and express cars, as well as for passenger cars.

The Commonwealth Steel Underframe for platform or blind-end wooden passenger equipment, new or old, consists of the combined double body bolster and platform at each end of the car, these two parts being connected by steel girders. Additional bracing is provided by truss rods, cast steel cross ties and needle beams.

remodeled has a blind-end or a platform end. The design of the underframe is such that the height of the sills, with the new underframe in place, will not be increased.

Reinforcement for equal service with steel cars is provided for wooden cars by this underframe, since it, alone, is designed to stand all the live and dead loads, and the full buffing force, without considering the added strength of the wooden sill underframing, to which it is securely attached. This makes wooden cars as strong as steel cars, and meets the extensive demand for reinforcements for wooden cars.

The cost of application is low, since neither

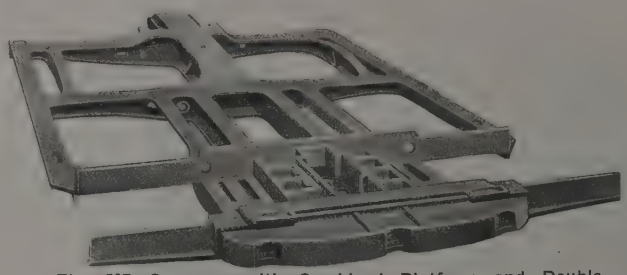


Fig. 597—Commonwealth Combined Platform and Double Body Bolster for Wooden Vestiblue Car (Patented)

Commonwealth underframes nor double body bolsters and end frames require that alterations be made in existing wooden construction. All the requirements of the Postal Department are met and efficient protection for both life and property is afforded. Not only is the car itself protected against shocks and buffing stresses, but also the reinforcement prevents "working" of the

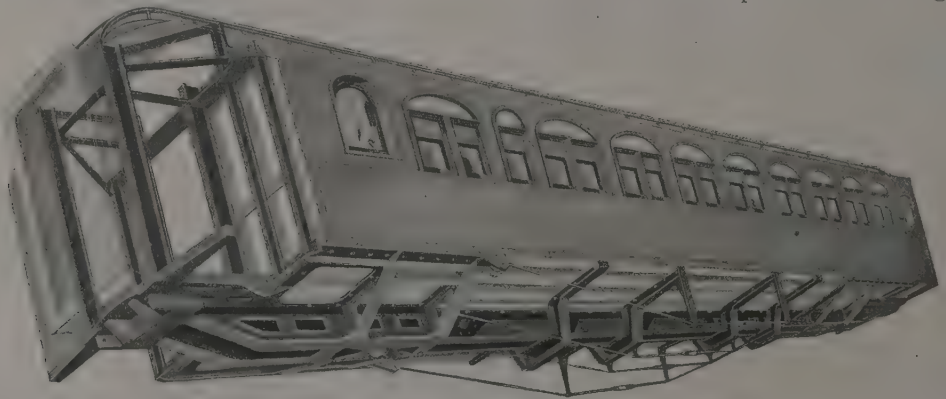


Fig. 598—Commonwealth Steel Underframe for Vestibule Wooden Car (Patented)

The old car body intact, can be set down on this underframe and the type of body bolster can be selected according to whether the car to be car structure, so that the value of the lengthened life of the car more than offsets the expenditure required for installing Commonwealth devices.

For other products and branch offices, see classified and alphabetical indexes.

COMMONWEALTH STEEL COMPANY, ST. LOUIS, MISSOURI

Commonwealth Cast Steel Frames

Considerations of safety as well as demands for more intensive use of railway equipment, have compelled, among other changes, the universal adoption of the steel underframe and heavy steel vestibule construction for all passenger train cars. The advantages afforded by modern methods in the manufacture of steel castings are particularly significant and have been made available at both these points in car structures by the Commonwealth Steel Company.

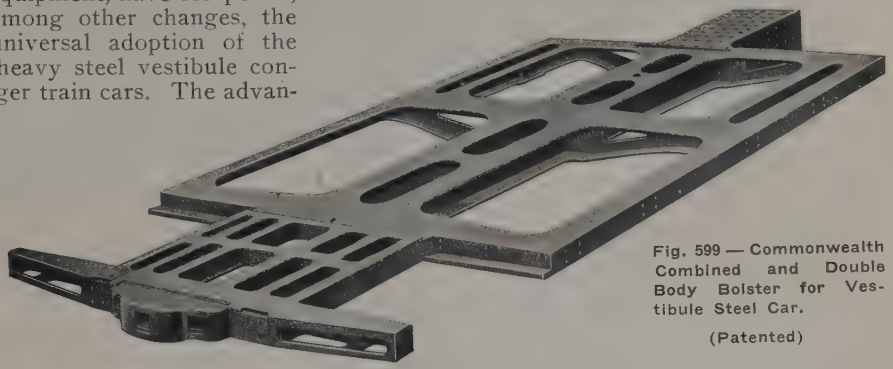


Fig. 599 — Commonwealth Combined and Double Body Bolster for Vestibule Steel Car.

(Patented)

The Commonwealth combined platform and double body bolster simplifies construction and provides great strength. It is planed for all sill connections and has uniform sections with concerted action of all members. Many failures which so often occur with ordinary built-up construction, are avoided by the use of this device.

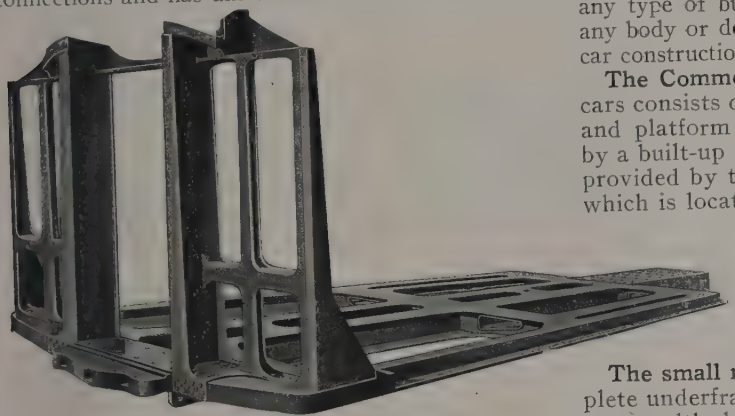


Fig. 600—Commonwealth End Frame for Blind End Car

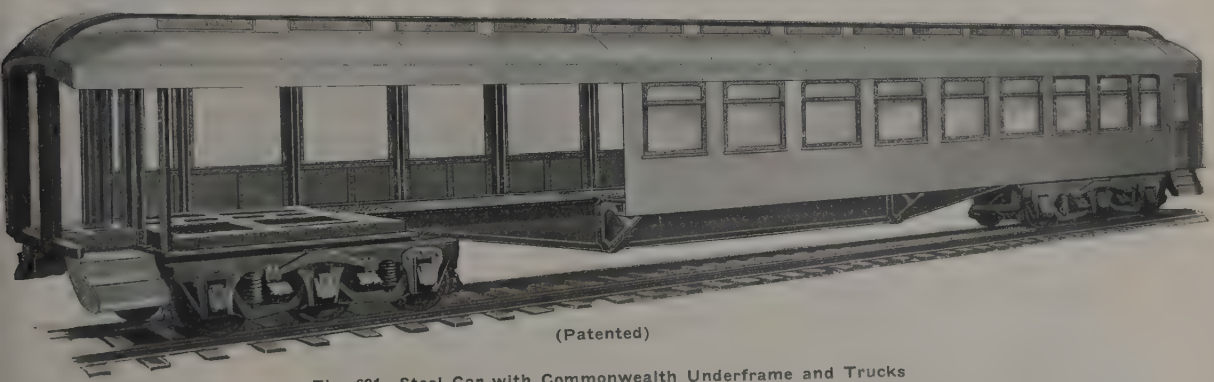
(Patented)

double body bolster, it provides an end construction having great integral strength, which is augmented by strong corner bracing and brace stops on the side sills, while the simultaneous action of all parts provides unified resistance to shocks.

These devices are designed for vestibule, blind end, or observation cars, and can be arranged for any type of buffer, coupler or draft gear, and for any body or deck sill arrangement common to steel car construction.

The Commonwealth steel underframe for steel cars consists of the combined double body bolster and platform at each end of the car connected by a built-up steel column. Additional bracing is provided by two cast steel cross bearers, each of which is located about midway between the center of the car and the trucks. The complete arrangement makes a simple, but very strong and durable underframe, which absorbs the shocks, minimizes damage to cars, and protects life and property.

The small number of parts required for a complete underframe is an important feature of Commonwealth design. A riveted or bolted joint, no matter how perfectly made, never has the strength of the integral metal of adequate section and always presents a tendency to work loose. By making the bolster, platform, and end framing of a single casting, much of the trouble and expense incidental to ordinary built-up construction can be avoided and safety promoted.



(Patented)

Fig. 601—Steel Car with Commonwealth Underframe and Trucks

The Commonwealth End Frame is an effective solution of the telescoping problem. When used in conjunction with the combined platform and

For other products and branch offices, see classified and alphabetical indexes.

COMMONWEALTH STEEL COMPANY, ST. LOUIS, MISSOURI

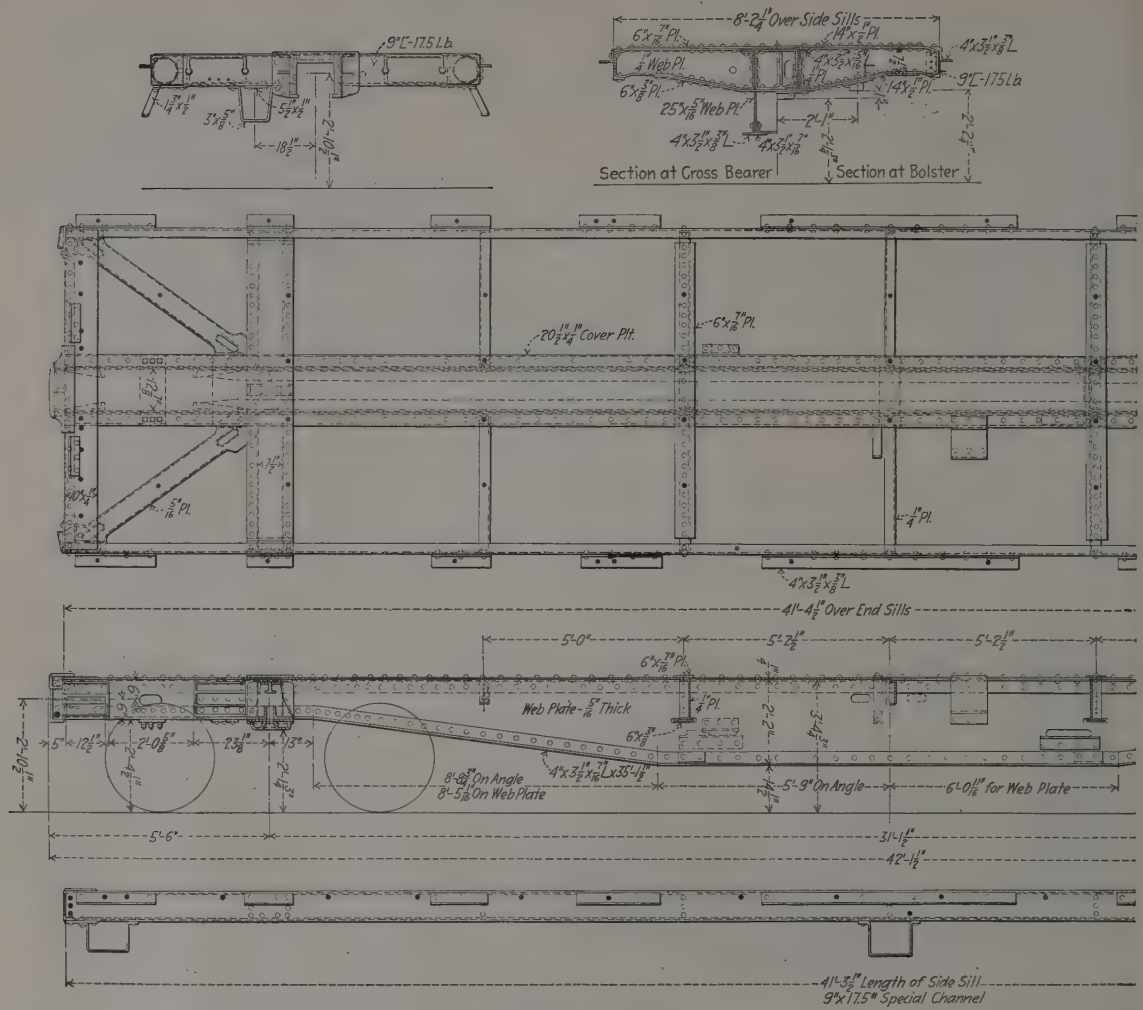


Fig. 602—Steel Underframe for U. S. R. A. Standard Design for Refrigerator Car.

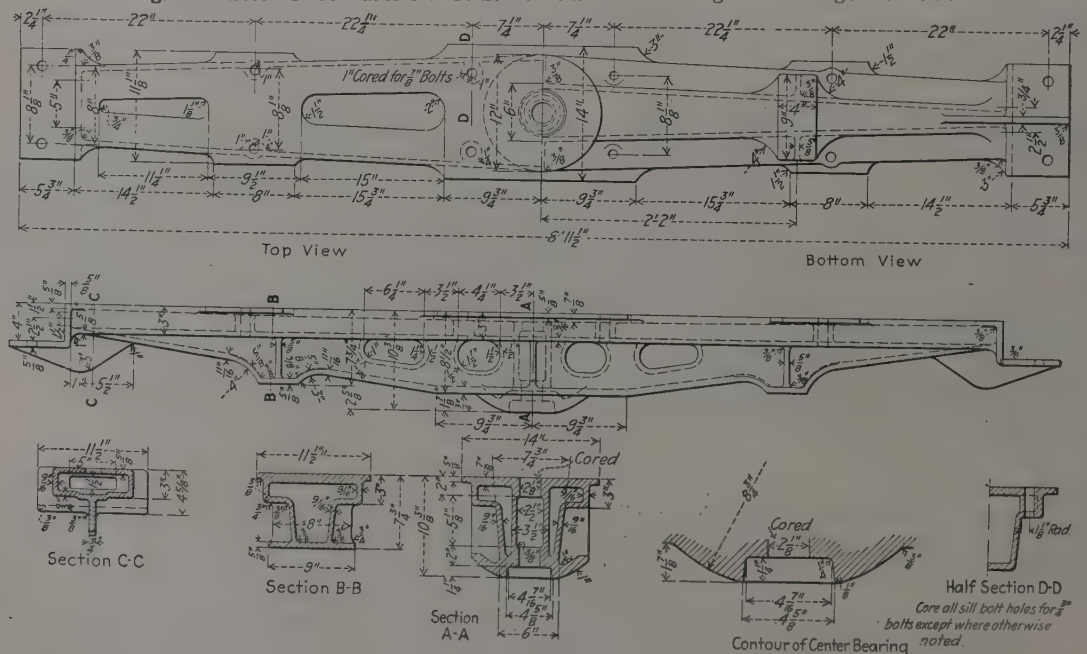


Fig. 603—Cast Steel "Z" Body Bolster for Rodger Ballast Car. Gould Coupler Company.

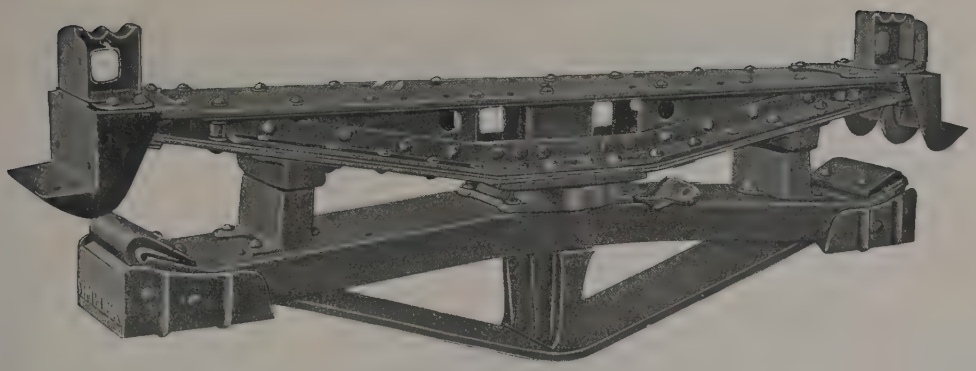


Fig. 604—Simplex Body and Truck Bolsters for Freight Cars with Long Draft Sills and Deep Side Sills.

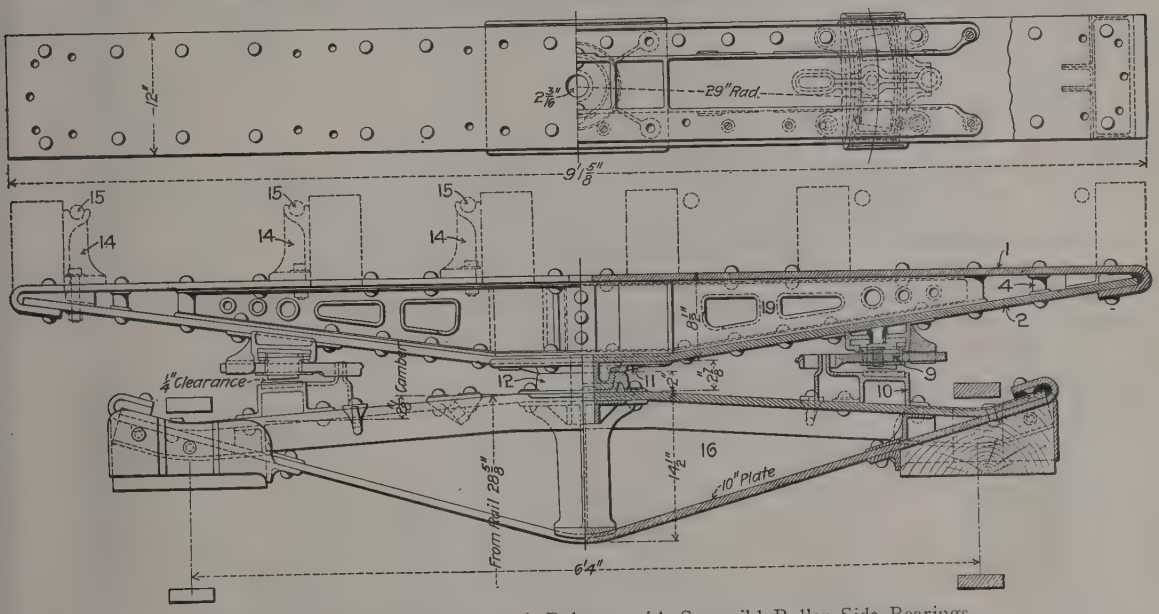


Fig. 605—Simplex Body and Truck Bolsters with Susemihl Roller Side Bearings.

Fig. 606—Simplex Body Bolster with Cast Steel Web Filler, in Position on Simplex Truck Bolster with Susemihl Roller Side Bearings.

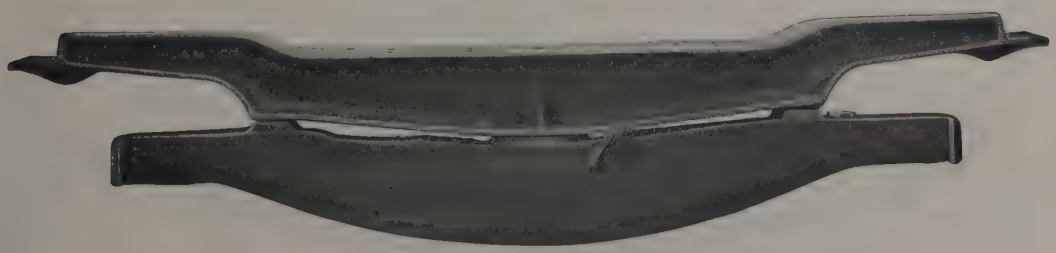


Fig. 607—Cast Steel Truck and Body Bolsters for Freight Cars.
American Steel Foundries.

Fig. 608— Cast Steel Body Bolster with Box Section Center and I-Section Ends.

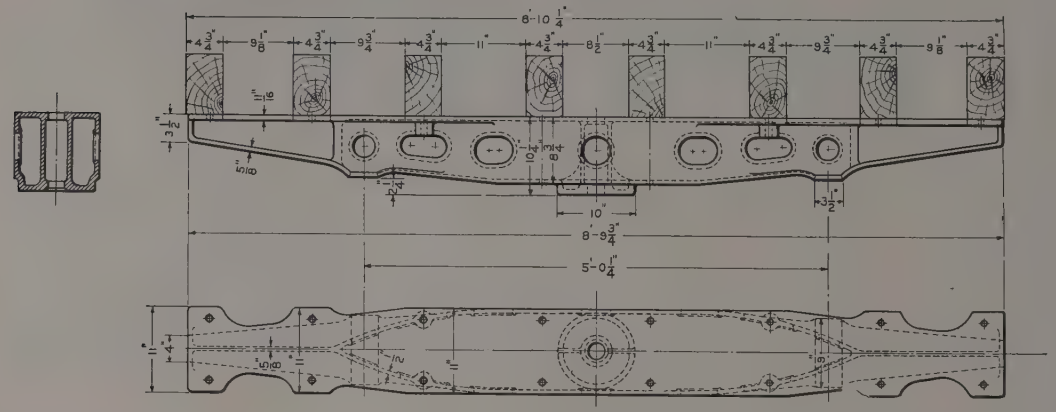


Fig. 609—Cast Steel Body Bolster with Box Section Center and I-Section Ends.

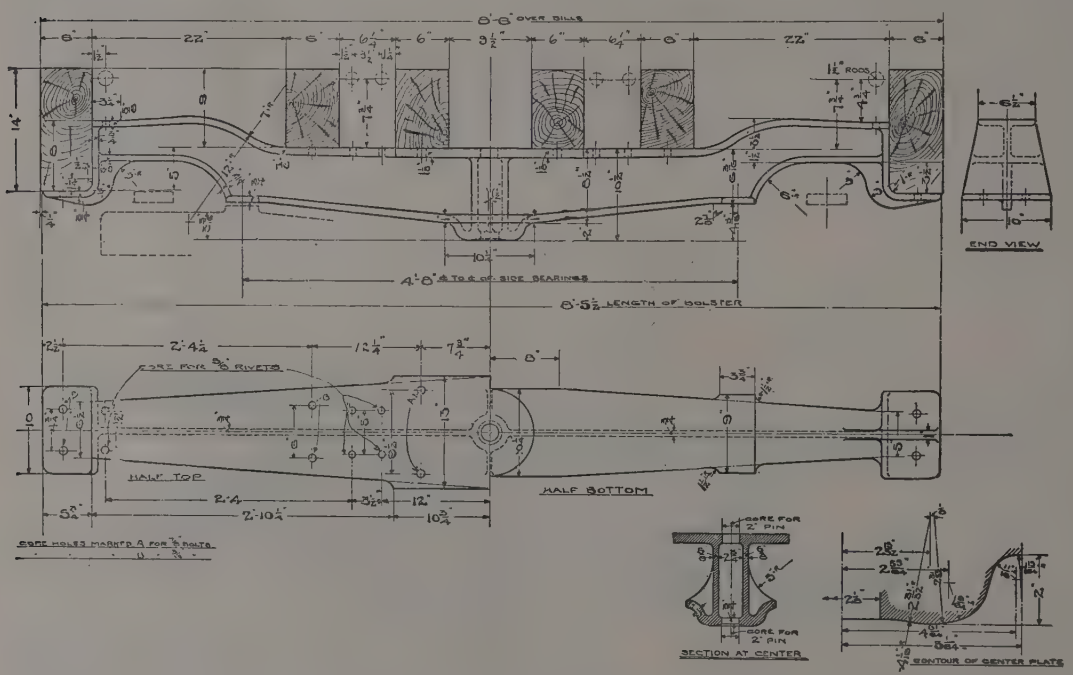


Fig. 610—Cast Steel Body Bolster for Wooden Underframe Flat Car.
American Steel Foundries.

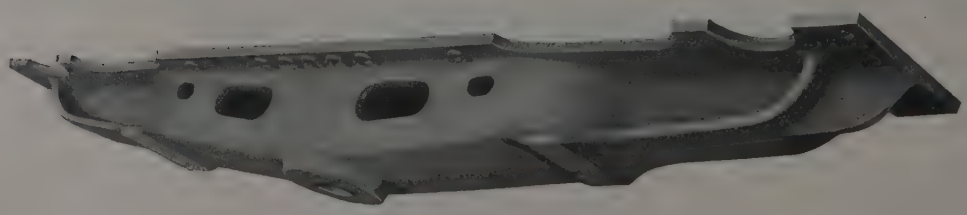


Fig. 611—Cast Steel Body Bolster, Box Section. The Buckeye Steel Castings Company.

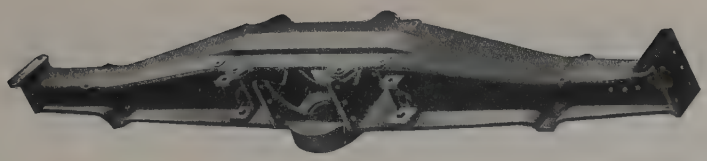


Fig. 612—Commonwealth Steel Company's Cast Steel Separable Body Bolster for Steel Freight Cars.

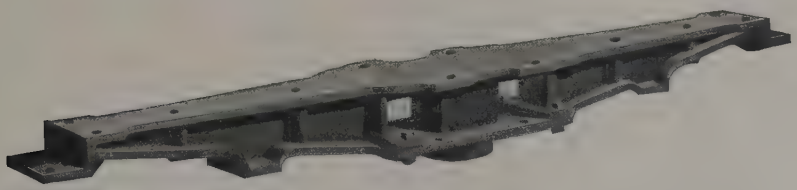


Fig. 613—Commonwealth Steel Company's Cast Steel Separable Body Bolster for Wooden Freight Cars.

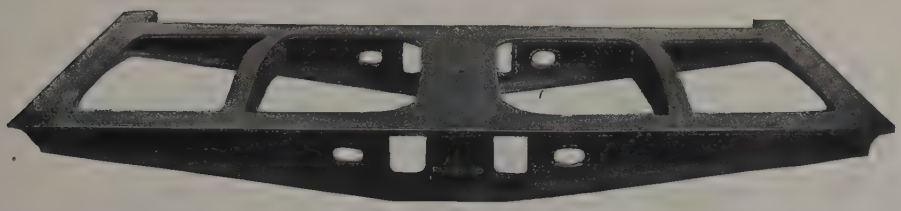


Fig. 614—One-piece Cast Steel Double Body Bolster for Passenger Train Cars.

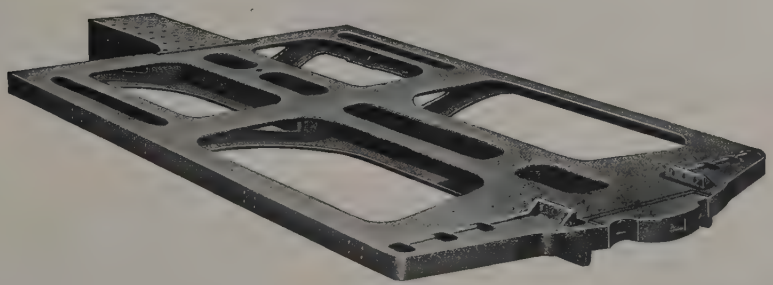


Fig. 615—Commonwealth Steel Company's Cast Steel Combined Platform and Double Body Bolster for Non-Vestibuled Steel Cars.

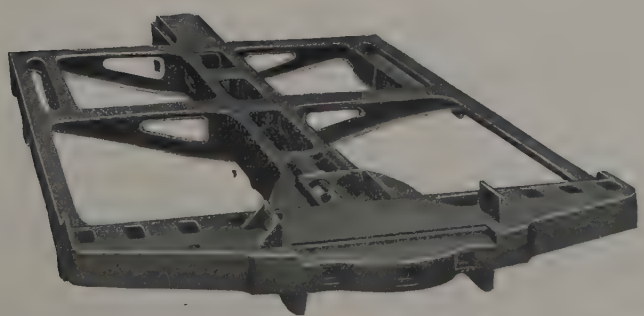


Fig. 616—Commonwealth Steel Company's Cast Steel Combined Platform and Double Body Bolster for Non-Vestibuled Cars with Combined Wood and Steel Underframe.

Commonwealth Steel Company.

(See also Pages 376 and 377.)

Fig. 617—Commonwealth Steel Company's Cast Steel End Sill for Freight Cars, with Flory Carry Iron.

Fig. 618—Commonwealth Steel Company's Cast Steel Combined End and Buffer Sill.

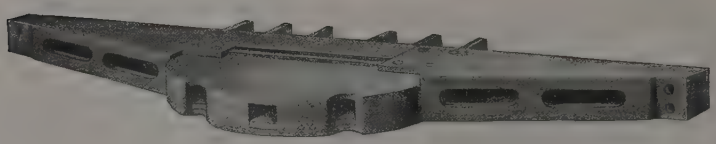


Fig. 619—Commonwealth Steel Company's Cast Steel Buffer Sill for Passenger Train Cars.

Fig. 620—Cast Steel Needle Beams.

Fig. 621—Commonwealth Steel Company's Upright End Frame in One Piece, and Commonwealth Combined Platform and Double Body Bolster for Vestibuled Cars.

Commonwealth Steel Company.

(See also Pages 376 and 377)

Fig. 622—Steel Frame for Chicago, Rock Island & Pacific Box Car.
Builder, Western Steel Car & Foundry Company.

Fig. 623—Steel Body Framing for Canadian Northern Baggage Car.

Fig. 624—Interior of Steel Frame for Sleeping Cars.
The Pullman Company—Pullman Plant.

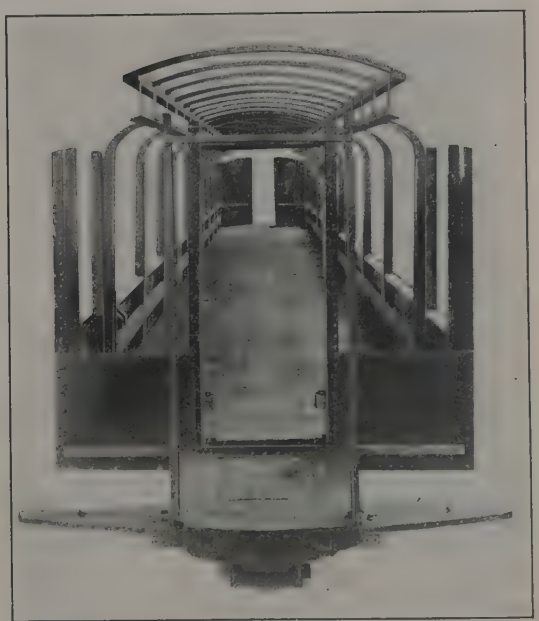


Fig. 625—Steel Frame for Pennsylvania Railroad Day Coach.

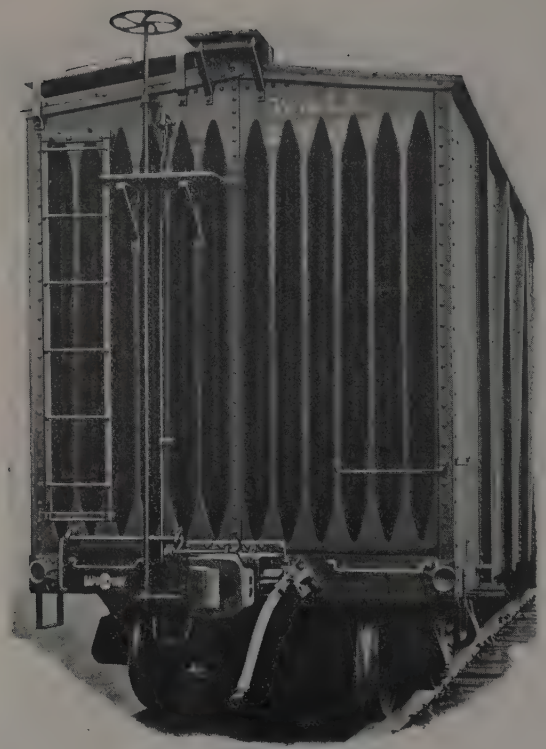


Fig. 626—Vulcan Vertical All-Steel End for Box Cars. Chicago-Cleveland Car Roofing Company.

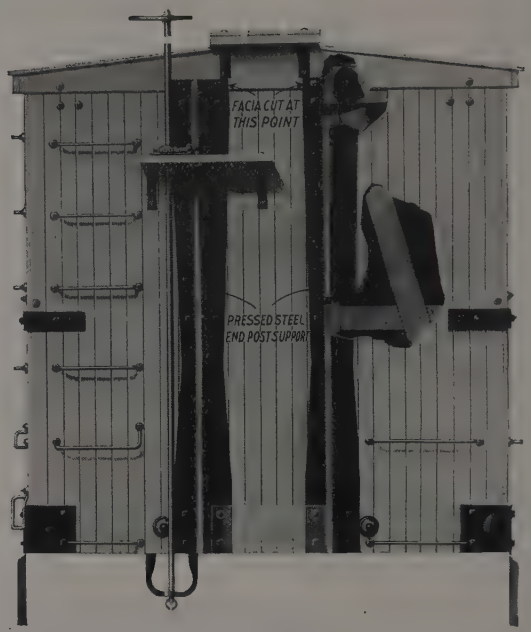


Fig. 627—Chicago Steel Reinforced End for Old Equipment.

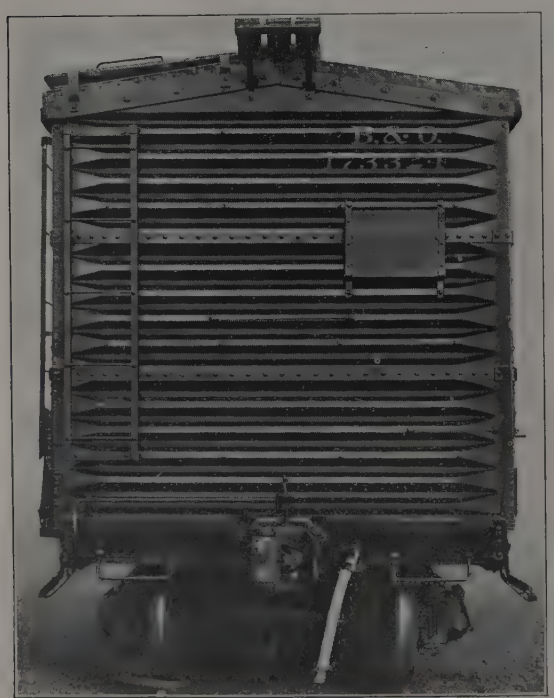


Fig. 628—Vulcan Horizontal Corrugated All-Steel End with Flat-Faced Corrugations.

Fig. 629—Indestructible Steel Reinforced End for Box Cars.

Chicago-Cleveland Car Roofing Company.

(*See also Page* 385.)

Steel Reinforced Ends

The shifting of such lading as lumber, pipe, brick, bar steel, ingots, machinery or other heavy articles, due to sudden shocks of cars in the yards or in train operation, has made it imperative to strengthen the car ends. Many railroads consider all steel freight equipment too heavy but recommend the use of steel in reinforcing car ends. This has resulted in the wide spread use of steel reinforced ends.

The Economy Steel Reinforced End, Design 100-C offers an efficient method of reinforcement. The end plate is stiffened by a heavy angle, running the full length of the end plate and bolted to the end plate and to Z-bar end posts. Gussets are riveted to the angle near the side plate and secured by bolts passing through the gusset flange, the side plate and the outside corner-band. Diagonal braces are riveted to the end plate angle and the center gusset plate located back of the end posts; the opposite end of the braces are riveted to the gussets which are bolted to the side plate and the outside washer plate. The device is designed to stiffen the entire end structure, in an efficient and economical manner, thus lengthening the service of both the roof and the car.

The Indestructible Steel Reinforced End—shown in Fig. 630—has a heavy pressed steel end plate which takes the place of the old wooden end plate and a heavy pressed steel carline is located about four feet back from the end of the car, anchoring the end plate to the carline with two diagonal tie bars and two straight tie bars.

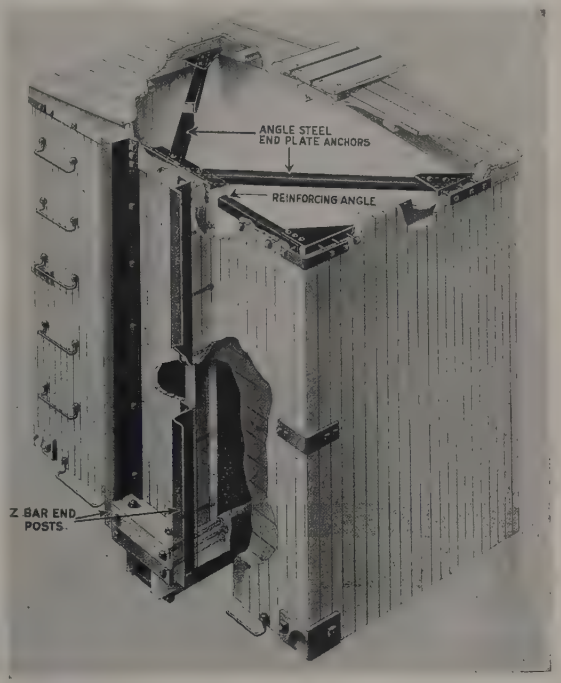


Fig. 631—Economy Steel Reinforced End, Design 100-C

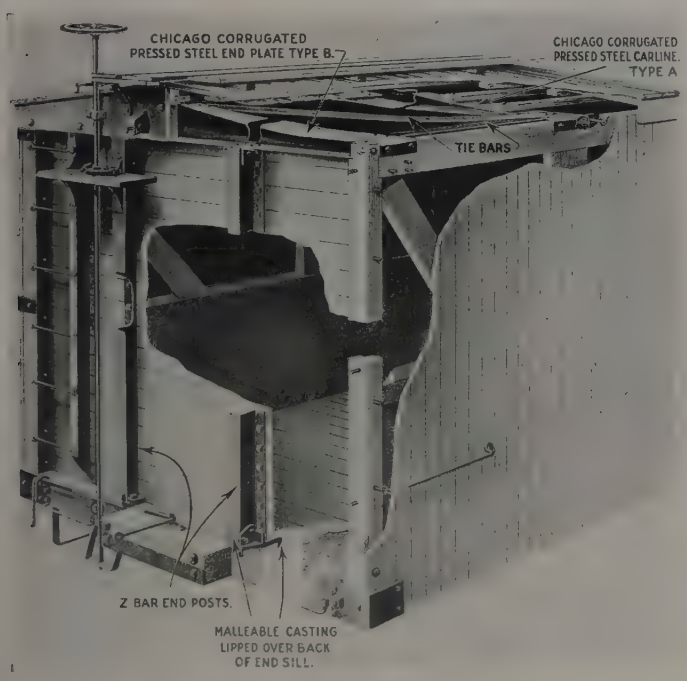

CHICAGO CORRUGATED PRESSED STEEL END PLATE TYPE B.
CHICAGO CORRUGATED PRESSED STEEL CARLINE. TYPE A
TIE BARS
Z BAR END POSTS.
MALLEABLE CASTING LIPPED OVER BACK OF END SILL.

Fig. 630—Indestructible Steel Reinforced End

The diagonal bars extend to near the center of the car and help to stiffen the pressed steel end plate at the center. The Z-bars used for end posts, have their top end attached to the bottom horizontal flange of the end plate, and their bottom end to heavy malleable castings lipped over the back of the end sills.

The Chicago Steel Reinforced End—shown in Fig. 627—is designed particularly to strengthen old cars. It is applied outside the sheathing. The reinforcement consists of pressed steel shapes with a broad flange on either side, bolted at the bottom to the end sill and at the top to a heavy pressed steel end plate stiffener having at each end riveted gussets which are bolted to the side plates. Thus the corners are braced and the car held square. The corrugation of the stiffeners is increased in depth from each end to a point about one-third of the distance from the floor to the top of the car, thus offering the greatest resistance to heavy loads when the capacity of the car is reached by a comparatively low pile of material. In case of broken end posts or end plates, the same reinforcement may be used without removing the broken parts. The steel reinforcement does not depend in any way for its strength, upon the wooden structure of the car.

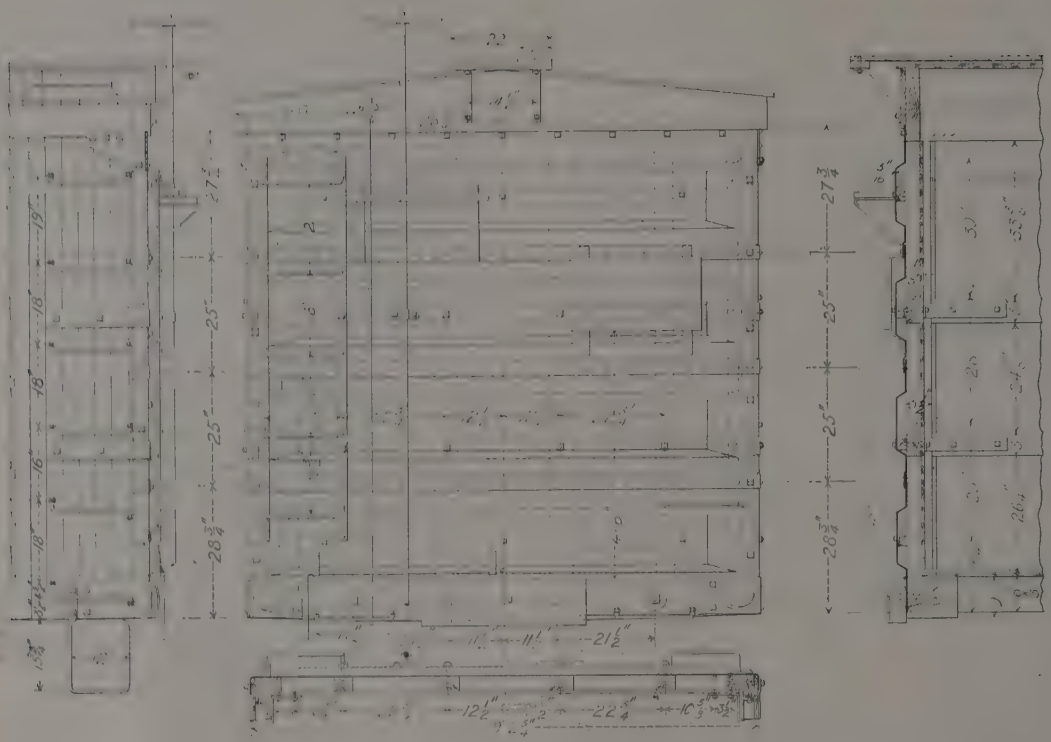


Fig. 632—Application of Hutchins Steel End to Wood Frame Box Cars. Hutchins Car Roofing Company.

(*See also Page* 387)

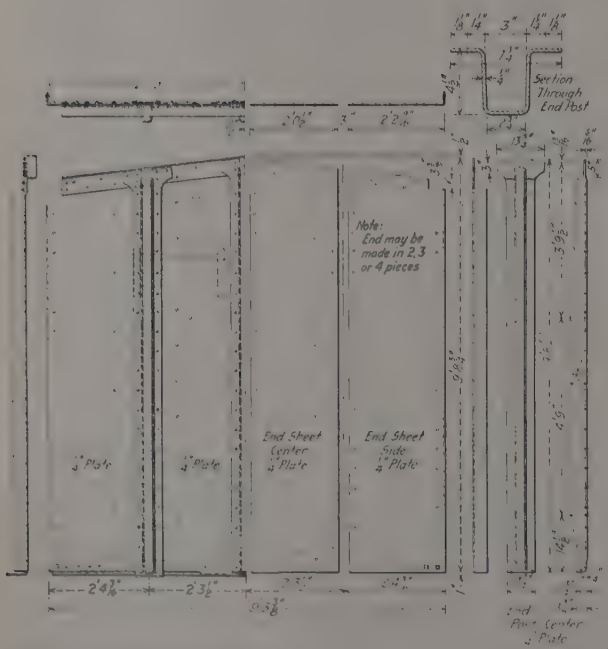

Section Through End Post
Note: End may be made in 2, 3 or 4 pieces
End Sheet Center ¼" Plate
End Sheet Side ¼" Plate
End Door Center ½" Plate

Fig. 633—Plain Steel End for the U. S. R. A. Standard Steel Box Car.

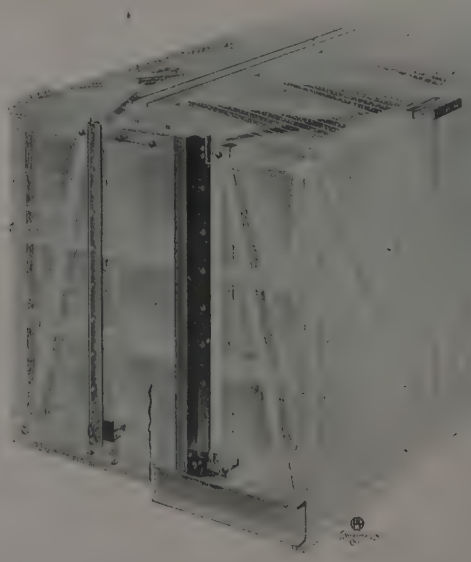


Fig. 634—Burnett Box Car End Reinforcement. Hutchins Car Roofing Company.

Hutchins Channel Steel End

The abrupt stops which are so common in switching practice furnish a striking illustration of the extremely severe treatment which a freight car must undergo, and the necessity for a strongly constructed end. It is estimated that the blow thus delivered by the lading of a car traveling at the rate of only three miles per hour is equivalent to a free fall of about 6 in., and for greater speeds, there is a corresponding increase in the shock to be sustained.

The Hutchins Channel Steel End for both box cars and gondola cars not only offers a solution of this problem in car design, but meets another important requirement of a car end—that of providing the necessary strength without adding needless weight. This factor not only keeps down the first cost, but also effects a reduction in operating cost, which continues throughout the life of the car. The design of this type of end has been developed along lines which secure a maximum of strength and stiffness while using plates of light section, and light in aggregate weight.

A complete Hutchins end is made up of sections, which are riveted together horizontally, a single riveted lap joint being used for the purpose. For box cars, either three or four sections are used, and for gondola cars, it is made in three sections. The sections, being comparatively narrow, are easily handled for assembling and in the event of their being damaged are easily repaired or replaced.

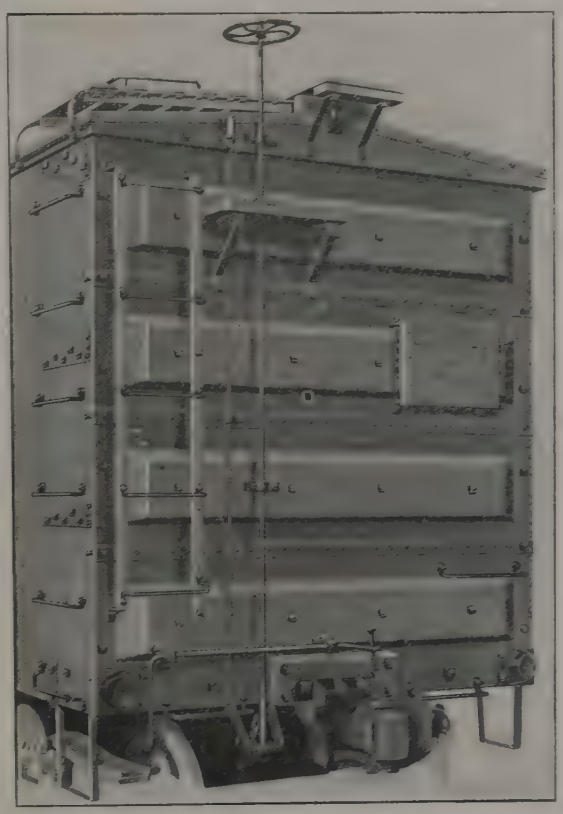


Fig. 635—Application of a Hutchins Channel Steel End to a Wooden Box Car

A fundamental principle of structural design has been utilized in determining the shape of the individual sections. They closely resemble the trough flooring used in bridge construction and the strength is in entire keeping with this appearance. Each section has a trough-like depression, which has sloping sides, and extends for the full width of the car. It is because of the similarity of the cross section through the face of the end, to channels riveted together at their flanges with the webs placed alternately inward and outward that it sometimes has been designated the double channel end. In the manufacture of the sections comprising the end, it has been found that the metal, being free along the edges permits of the channel formation without any perceptible drawing or thinning of the section, and that the completed section is of substantially uniform thickness. Another advantage claimed for the use of a narrow section is that of the additional strength obtained from the greater number of overlapped and riveted seams, each seam acting as an additional rib spanning the distance between corner posts.

The normal depth of each channel is 2¼ in. from out to out, but this dimension may be increased if desired. The inside surfaces are made flush with the outside faces of the corner posts of the car. The channels may, however, be pressed inward in cases where the construction of the car makes this formation desirable.

The steel plates may be either ¼ in. or 3/16 in. thick throughout; or the lower portion may be of ¼ in. material and the remainder of 3/16 in. plates.

The section modulus of a Hutchins steel end, when made of 3/16 in. material throughout is greater than the A. R. A. requirement for box cars having reinforced ends. When any or all of the sections are made of ¼ in. material, the construction is correspondingly stronger.

Flat bearing surfaces are provided for brake step brackets or other attachments. The lining and the nailing strips are also allowed to bear on broad surfaces where they come in contact with the steel ends.

Either composite or all-steel cars can be adapted for the application of Hutchins Channel steel ends; old wooden cars can be strengthened and their life lengthened by the application of this device since the additional strength provided for the end also adds to the durability of the remaining body structure. The security afforded at this vital point effectively aids in reducing both damage claims and maintenance costs.

The strength, durability and simplicity of the Hutchins Channel End are effective in obtaining more service from freight equipment. The installation of these ends will do much toward eliminating the condition of car ends as one of the causes for delays which prevent reaching or exceeding the desired average of 30 miles per car per day.

For other products and branch offices, see classified and alphabetical indexes.

HUTCHINS CAR ROOFING COMPANY, DETROIT, MICH.

Fig. 636—The "Brascott" Freight Car Ladder. The Damascus Brake Beam Company.

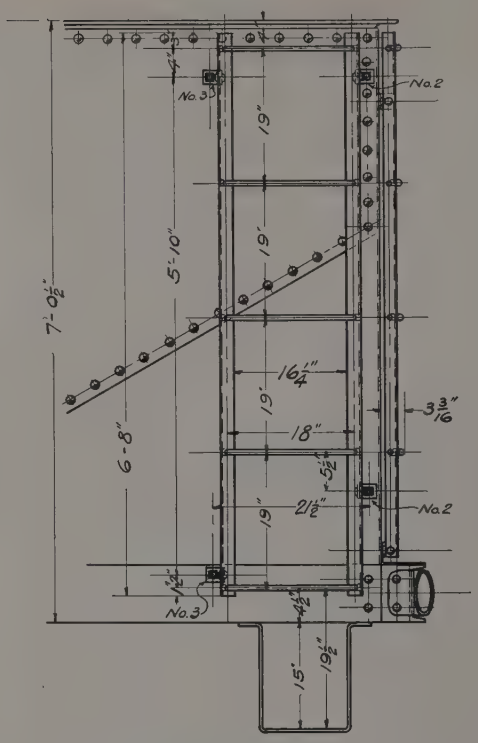


Fig. 637—Application of Wine Ladder to Hopper Cars. The Wine Railway Appliance Company.

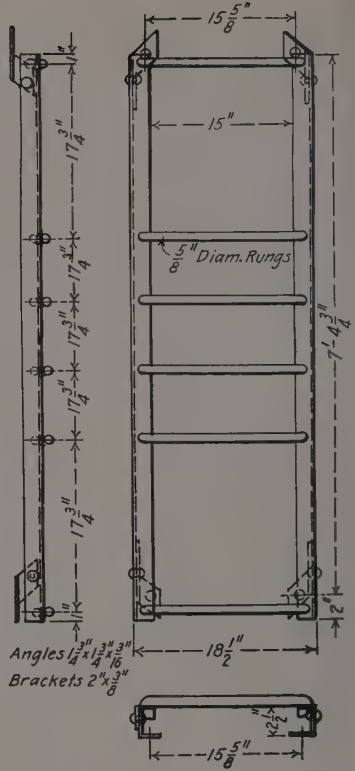


Fig. 638.—Safety Appliance Ladder. Allegheny Forging Company.

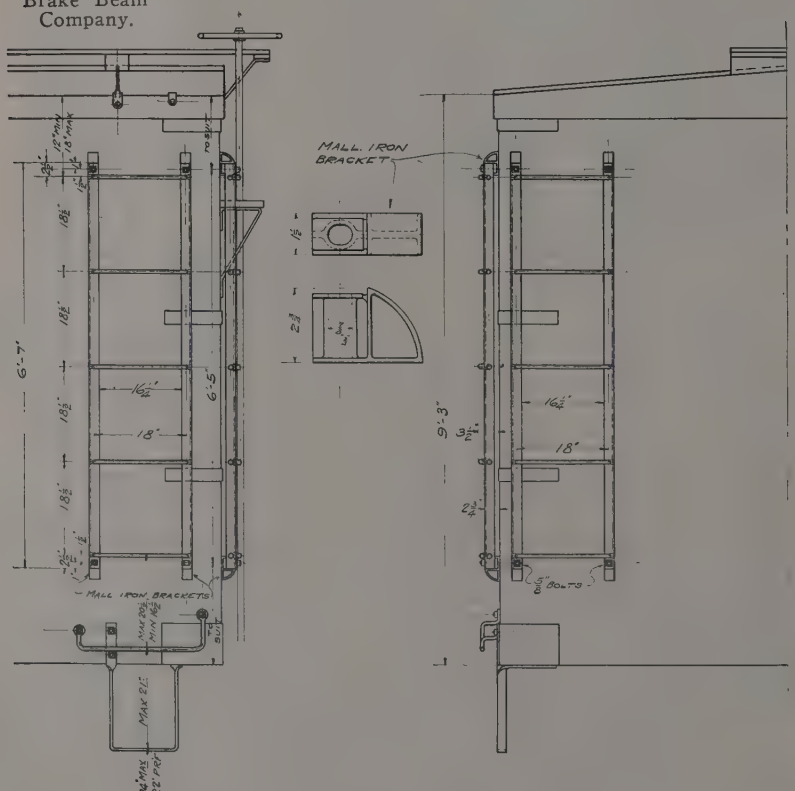


Fig. 639—Application of Wine Steel Ladder to Box Cars. The Wine Railway Appliance Company.

(See also Page 389.)

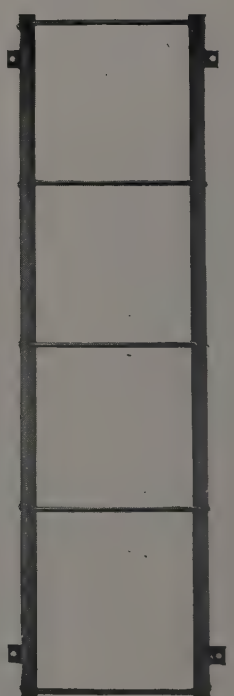


Fig. 640—Wine Steel Ladder for Freight Cars.

Wine Safety-First Steel Ladder

The Wine Appliance Company have made a specialty of building steel ladders for all classes of equipment in accordance with the Safety Appliance Regulations of the Interstate Commerce Commission and the Mechanical Section of the American Railway Association. Different types are designed for use on Box, Stock, Hopper, Coal, Coke Rack, Gondola and special cars of every description.

A high standard is maintained in the manufacture of Wine Ladders, and every part is made with the aim of strength and safety. The material used is new low carbon, open hearth steel and no re-rolled rail or scrap is used in any part. Every piece used has passed a severe test and the dependability of every bolt and rivet proved before installation. Only skilled workmen are employed in the manufacture of Wine ladders and a rigid system of inspection assures a high grade finished product.

Fig. 641—Application of the Wine Ladder

The rungs of the ladder—as shown in Fig. 642—are not riveted or bolted to the stiles but clamped in two holes in each angle—illustrated in Fig. 640—insuring a tight fit and preventing them from turning. Thus each rung is fastened at four points, two at each end, providing great rigidity. The strain is carried, therefore, on four bolts instead of two, as with the ordinary grab iron or wood stile ladders.

The maintenance cost is low as this ladder can be quickly removed without going inside the car—particularly important with loaded cars—and only two bolts need to be loosened in order to remove one or all of the treads of the ladders; this results in a great saving in time and prevents many delays that might otherwise occur due to ladder failures.

Fig. 642—Wine Steel Ladders

Fig. 643—Wine Safety Steel Ladders

The Wine Ladders are delivered with clips or brackets riveted to the angle stiles, complete and ready to attach to the car.

For other products and branch offices, see classified and alphabetical indexes.

THE WINE RAILWAY APPLIANCE COMPANY, TOLEDO, OHIO

Ladders and Stake Pockets

The risk of life and limb encountered by trainmen due to the use of the old style ladder rung, fastened by bolts through the car side in such a way that proper inspection was impossible, is a thing of the past, so that the safety of the trainmen no longer depends upon a single bolt holding one end of a step iron. Modern practice also requires that a ladder be installed in such a way that it can be removed without going inside the car.

The Brascott Freight Car Ladder built by the Damascus Brake Beam Company embodies every feature desirable both from a safety standpoint and the ease by which it may be detached and replaced. The rungs of round bar are firmly riveted to the stiles forming a solid ladder. The stiles are of steel angle and are locked securely in end brackets of forged steel. These brackets fit the ends of the stiles closely and are permanently fastened to the car side. The stiles and the rungs, may be released from the brackets by merely loosening two bolts conveniently located in the lower bracket and then stepping the ladder out of the brackets. The ladder is not only supported by these bolts but is held in place by the pockets in the lower bracket.

Fig. 644—Brascott Freight Car Ladder

In event of damage to the Brascott Ladder it can be removed and replaced in a few minutes without entering the car. The small cost of repairs and the short time involved mean a minimum of maintenance expense. If adopted as a standard—as has been done in many cases—it enables the repair man to have a number of ladders in stock and take care of such repairs promptly. The Brascott Ladder is made to fit any height of car and is applicable to all cars.

The Damascus Brake Beam Company manufacture stake pockets, both of the collapsible and anti-creeping type for use on gondola and flat cars.

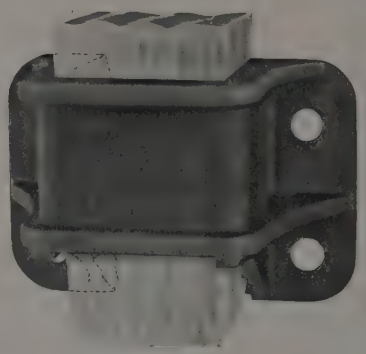


Fig. 645—Anti-Creeping Stake Pocket

The Damascus Collapsible Stake Pocket is made up of three links of forged chain attached to the sides of the car with brackets through the end links. It is particularly designed for the inside of gondola cars as, being collapsible, it hangs down against the side of the car, out of the way, when the stake is removed. Unlike the rigid stake pocket when used on the inside of the car, it is not easily distorted and put out of commission by the placing or shifting of the load. The link construction makes an effective pocket for use with wooden stakes.

Fig. 646—Collapsible Stake Pocket

The Damascus Anti-creeping Stake Pocket is designed for use on flat cars where it is difficult to keep a stake from working loose. Deep corrugations on the inside hold the wooden stake securely.

Fig. 647—Section Through Anti-Creeping Stake Pocket

The Damascus Brake Beam Company manufacture a forged steel door handle for freight cars. The use of a strongly shaped forging instead of a casting considerably reduces the maintenance costs; the Damascus Forged Steel Door Handle withstands the rough service encountered under modern traffic conditions.

For other products and branch offices, see classified and alphabetical indexes.

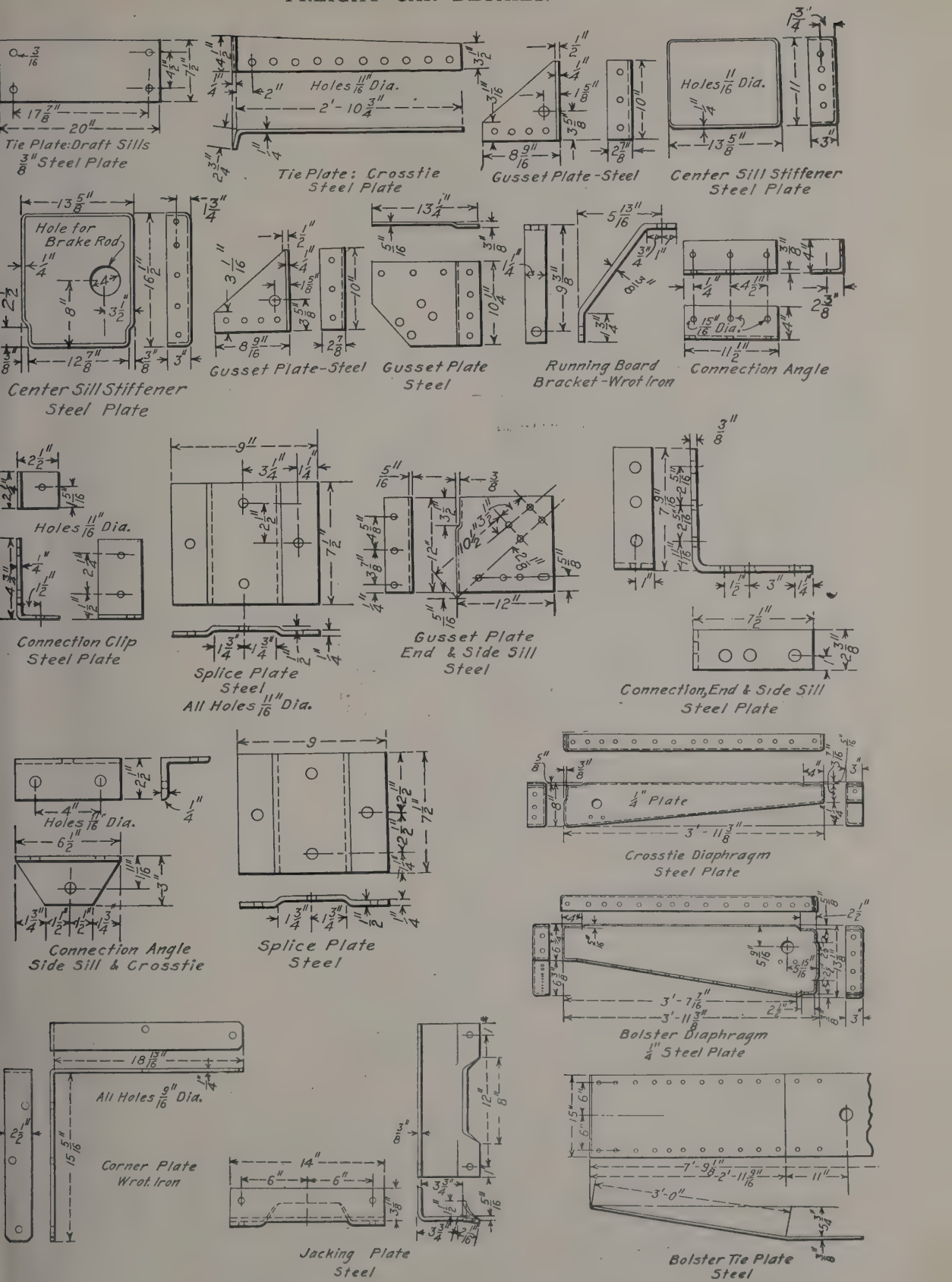


Fig. 648—Details of New York Central Box Cars.

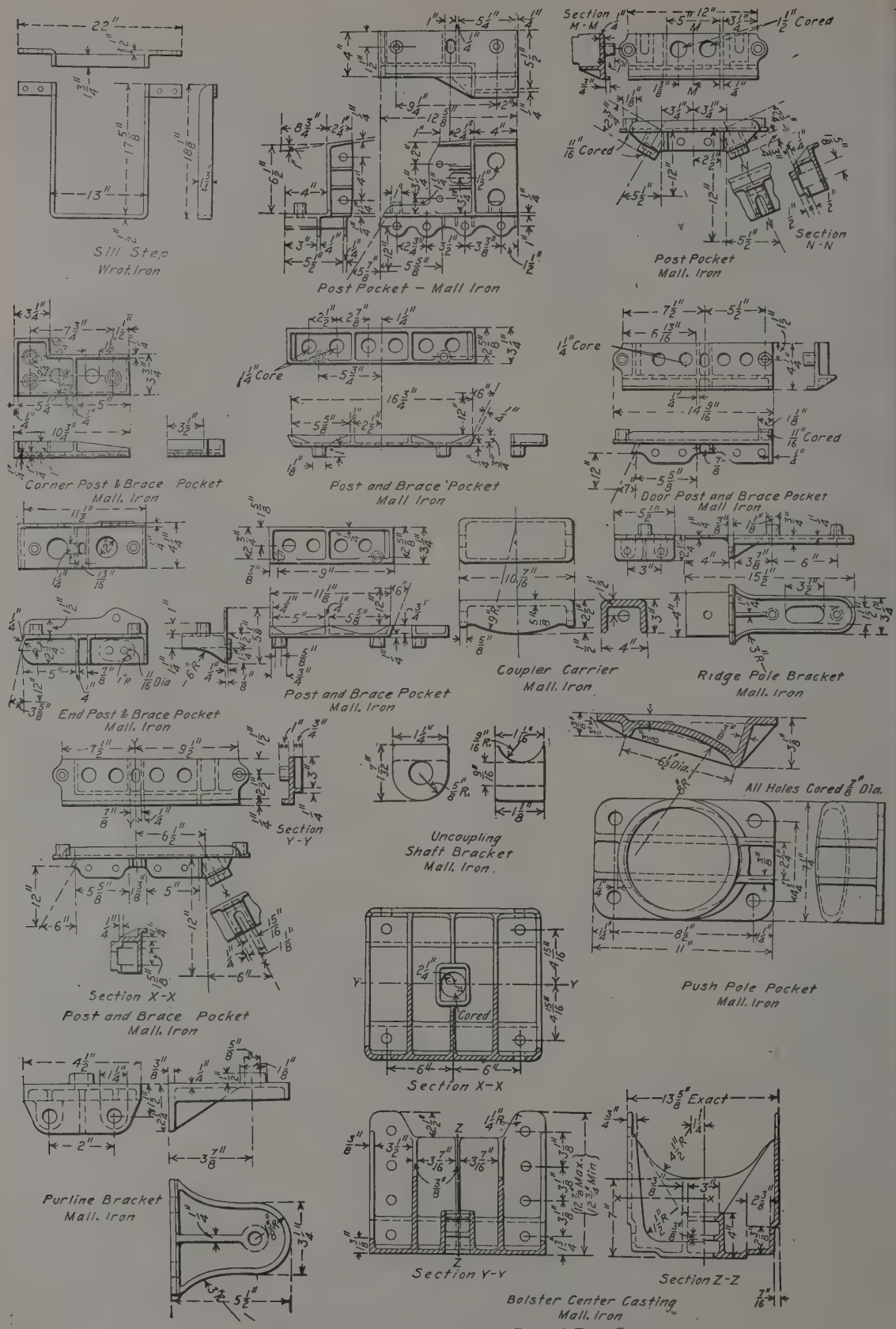


Fig. 649—Details of New York Central Box Cars.

Car Doors and Fixtures

THE DESIGN OF DOORS AND FIXTURES for freight cars has been the subject of consideration by a committee of the American Railway Association for many years. The Standards and Recommended Practices adopted as a result of the work of this committee are as follows:

Outside Hung Doors for New Cars.

Recommended Practice—ADOPTED, 1915; REVISED, 1920.

1. Means must be provided for continuous weatherproofing and fireproofing around the top, bottom, front and back edges of door when closed.

2. Top of door must be continuously supported against outward pressure, and this support must also form the weatherproofing.

3. Closed door stop must be of metal, preferably continuous from top to bottom of door. If continuous door stop does not support the door against outward pressure, such support must be provided by not less than two brackets with lips, equivalent to brackets shown on Fig. 650 and located as shown on Fig. 651.

4. Metal open door stops are recommended, one or more in number, equivalent in strength to design shown on Fig. 650 securely bolted to the belt rails or framing of the car with at least two ½-in. bolts or their equivalent. If wood open stop is used, it should extend the entire height of the door and be reinforced by clip washers or through bolts to prevent splitting.

5. Bottom of door must be supported against outward pressure at not less than two points for any position of the door.

If individual bottom door guides, fastened to car body, are used, they must be at least four in number, one located adjacent to each door post, one in the middle of the doorway, and one between the back door post and the open door stop, approximately as shown on Fig. 651 and similar in design to those shown on Fig. 652, with particular reference to height of lip, which should be not less than 1¼ in.

6. If door hangers are fastened to door with bolts, the design of door fastenings must be such that with hangers broken or removed the door can not be removed from the car, except by removal of either track, door guides or door stops. When substantial hangers are riveted to steel doors, or to steel frames of wooden doors, with not less than four ⅜-in. rivets or their equivalent, this provision need not apply.

7. When hangers or rollers are fastened directly to sheathing of wooden doors, bolts must be not less than ⅜ in. in diameter, at least four in number for each hanger and spaced not less than 4 in. apart horizontally and 5 in. vertically, hangers preferably located so bolts will pass through two or more boards.

8. Door track may be located either above or below the door opening and the door supported so that under any service conditions there will be no binding of the door from vertical interference with door guides or track. The upper door track, if used, must be continuous in one piece, strong enough so that it will not sag, and securely fastened to car; proper flashing, if necessary, to be provided over door track. If door is supported at bottom, means for keeping the supports in alignment must be provided.

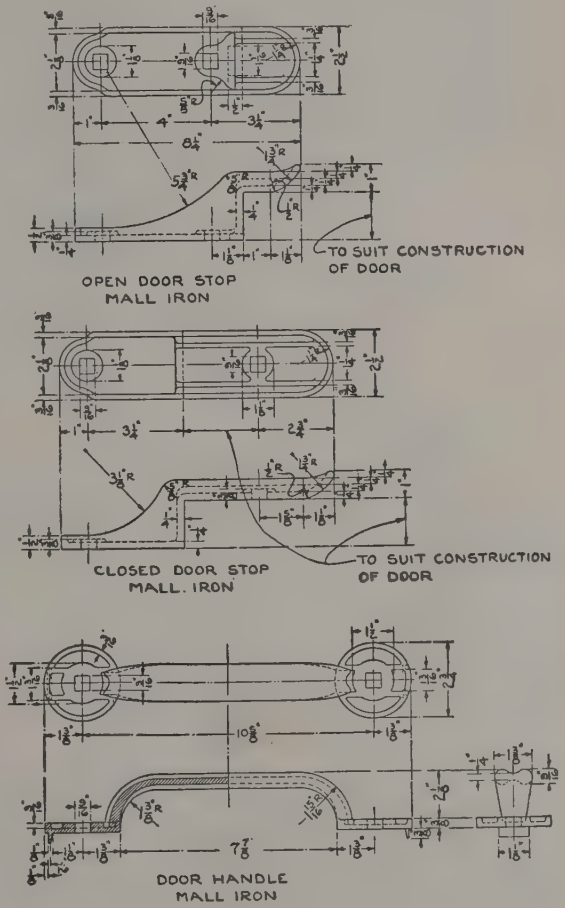

TO SUIT CONSTRUCTION OF DOOR
OPEN DOOR STOP MALL IRON
CLOSED DOOR STOP MALL. IRON
TO SUIT CONSTRUCTION OF DOOR
DOOR HANDLE MALL IRON

FIG. 650—FIXTURES FOR OUTSIDE-HUNG SIDE DOOR FOR BOX CARS

9. For wooden doors, the door-hasp fastener must be at least 24 in. long, fastened with not less than five ⅜-in. bolts, with nuts on the inside of the door. The door-hasp fastener must be of such design that the hasp cannot be removed without removing the bolts from the fastener. The door-hasp fastener must be secured to the steel frame of the door by at least one bolt or rivet—see Fig. 651. For steel doors, the door-hasp fastener must be rivented to the door.

10. Door starters should be provided to move the door 2 inches or more from its fully closed position.

11. Means shall be provided where necessary for forcing the door to its fully closed position.

12. Lumber used in the construction of doors shall not contain more than 5 per cent moisture.

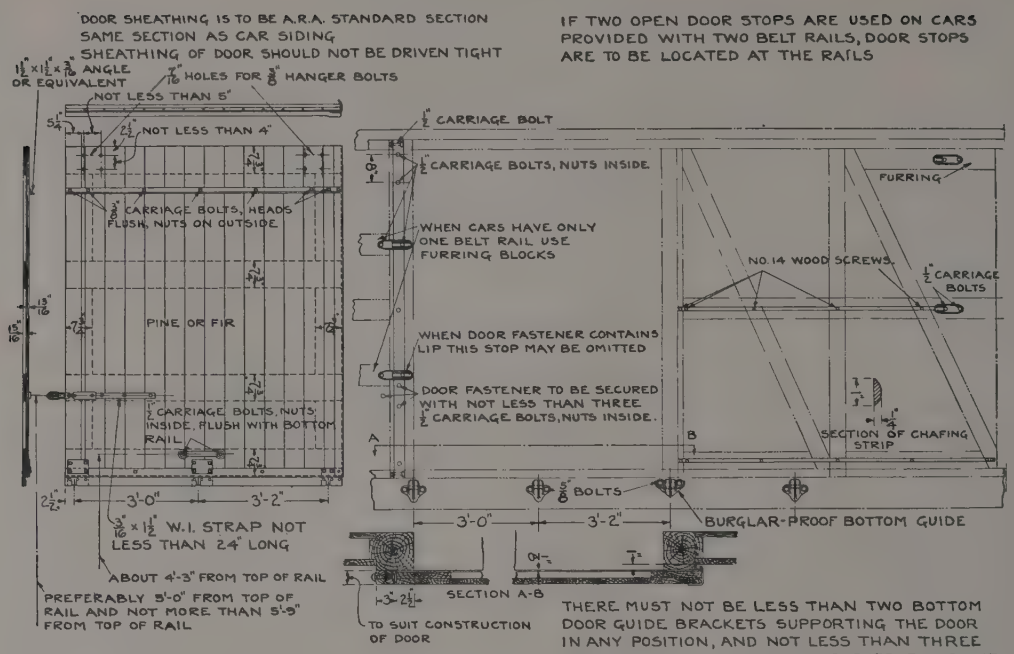

DOOR SHEATHING IS TO BE A.R.A. STANDARD SECTION
SAME SECTION AS CAR SIDING
SHEATHING OF DOOR SHOULD NOT BE DRIVEN TIGHT
IF TWO OPEN DOOR STOPS ARE USED ON CARS PROVIDED WITH TWO BELT RAILS, DOOR STOPS ARE TO BE LOCATED AT THE RAILS
ANGLE OR EQUIVALENT
HOLES FOR HANGER BOLTS
NOT LESS THAN 5"
NOT LESS THAN 4"
CARRIAGE BOLTS, HEADS FLUSH, NUTS ON OUTSIDE
PINE OR FIR
CARRIAGE BOLTS, NUTS INSIDE, FLUSH WITH BOTTOM RAIL
3'-0"
3'-2"
W.I. STRAP NOT LESS THAN 24" LONG
ABOUT 4'-3" FROM TOP OF RAIL
PREFERABLY 5'-0" FROM TOP OF RAIL AND NOT MORE THAN 5'-9" FROM TOP OF RAIL
CARRIAGE BOLT
CARRIAGE BOLTS, NUTS INSIDE.
WHEN CARS HAVE ONLY ONE BELT RAIL USE FURRING BLOCKS
WHEN DOOR FASTENER CONTAINS LIP THIS STOP MAY BE OMITTED
DOOR FASTENER TO BE SECURED WITH NOT LESS THAN THREE CARRIAGE BOLTS, NUTS INSIDE.
FURRING
NO. 14 WOOD SCREWS
CARRIAGE BOLTS
SECTION OF CHAFING STRIP
BOLTS
BURGLAR-PROOF BOTTOM GUIDE
SECTION A-B
TO SUIT CONSTRUCTION OF DOOR
THERE MUST NOT BE LESS THAN TWO BOTTOM DOOR GUIDE BRACKETS SUPPORTING THE DOOR IN ANY POSITION, AND NOT LESS THAN THREE BOTTOM DOOR GUIDE BRACKETS SUPPORTING THE DOOR IN THE CLOSED POSITION.

FIG. 651—A. R. A. STANDARD FOR OUTSIDE-HUNG BOX CAR DOOR

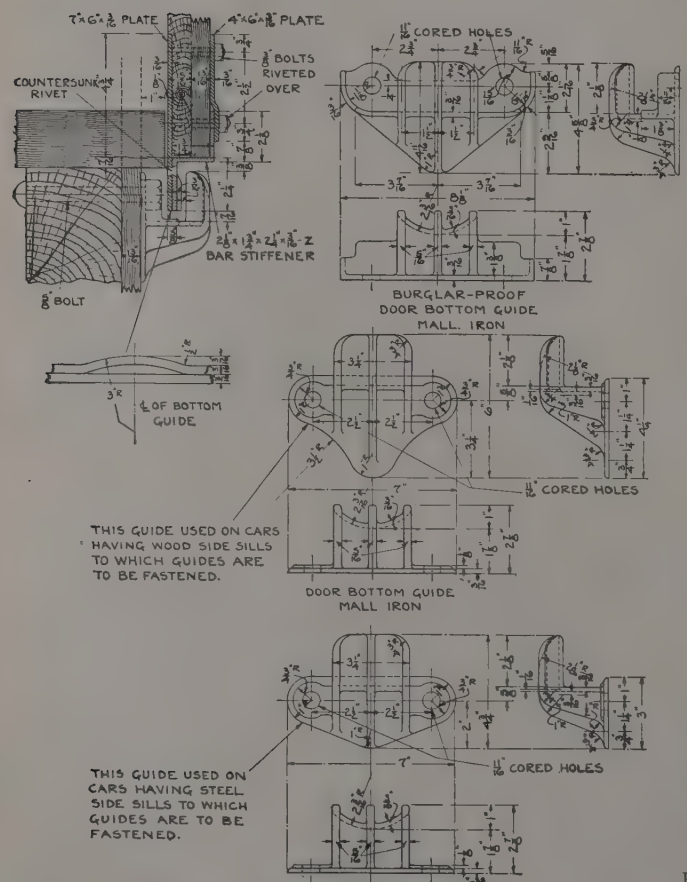


PLATE
PLATE
COUNTERSUNK RIVET
BOLTS RIVETED OVER
BAR STIFFENER
BOLT
CORED HOLES
BURGLAR-PROOF DOOR BOTTOM GUIDE MALL. IRON
OF BOTTOM GUIDE
THIS GUIDE USED ON CARS HAVING WOOD SIDE SILLS TO WHICH GUIDES ARE TO BE FASTENED.
CORED HOLES
DOOR BOTTOM GUIDE MALL IRON
THIS GUIDE USED ON CARS HAVING STEEL SIDE SILLS TO WHICH GUIDES ARE TO BE FASTENED.
CORED HOLES
DOOR BOTTOM GUIDE MALL. IRON

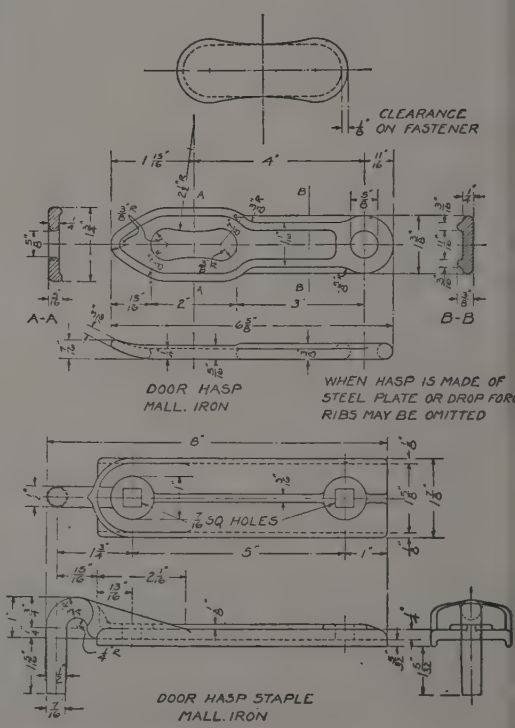

CLEARANCE ON FASTENER
A-A
B-B
DOOR HASP MALL. IRON
WHEN HASP IS MADE OF STEEL PLATE OR DROP FOR RIBS MAY BE OMITTED
SQ HOLES
DOOR HASP STAPLE MALL. IRON

FIG. 652—DETAILS OF FIXTURES FOR OUTSIDE-HUNG BOX DOORS

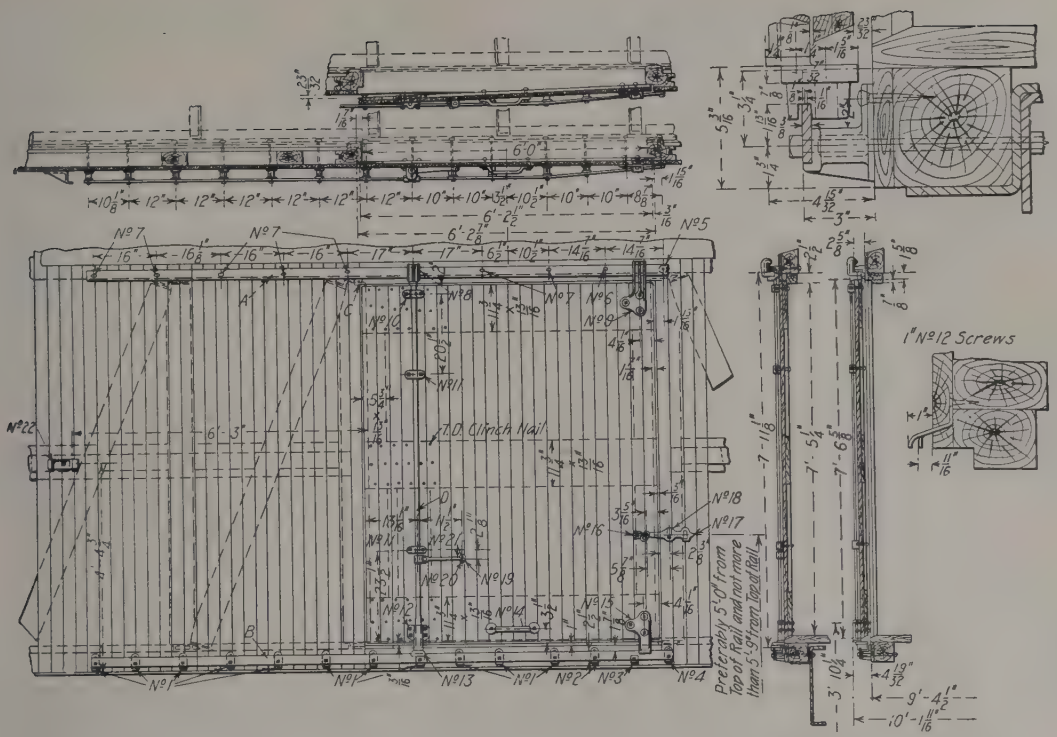


FIG. 653—A. R. A. STANDARD FLUSH SIDE DOOR FOR BOX CARS.
(See also Figs. 654-655.)

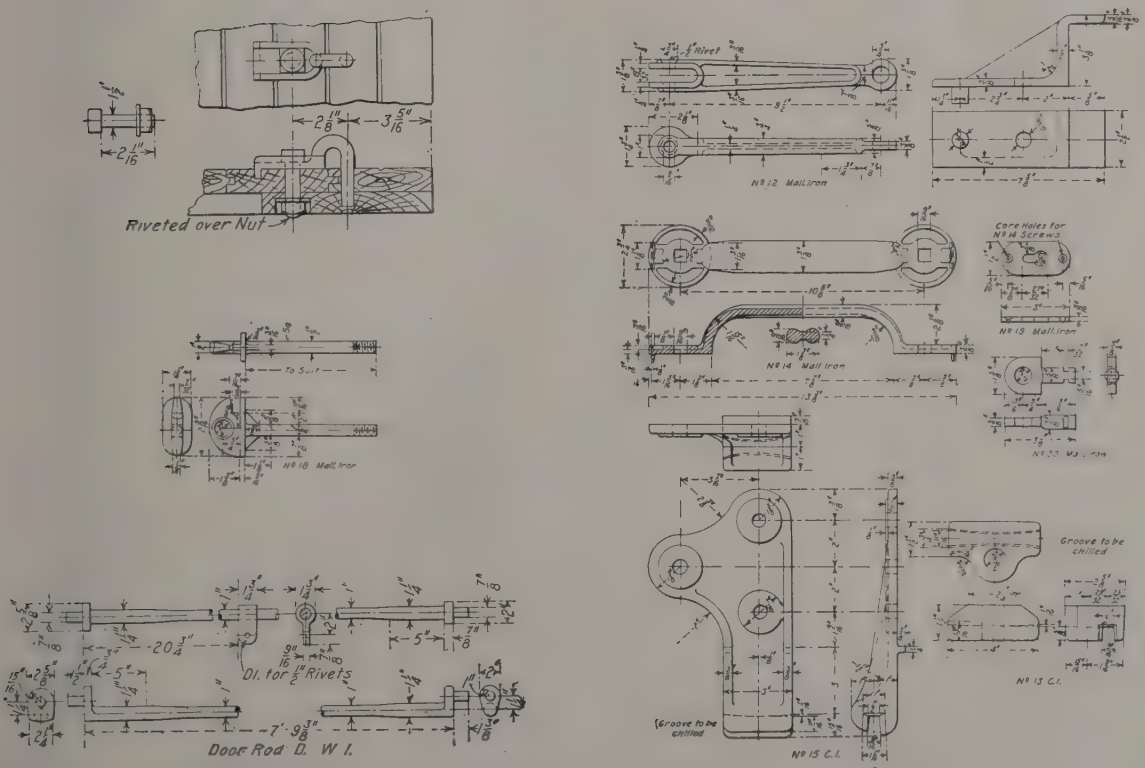

Riveted over Nut
No 12 Mall Iron
No 14 Mall Iron
No 15 C.I.
No 18 Mall Iron
No 19 Mall Iron
Core Holes for No 14 Screws
Groove to be chilled
Door Rod D. W. I.

FIG. 654—A. R. A. STANDARD FOR DETAILS OF FLUSH SIDE DOOR FOR BOX CARS.

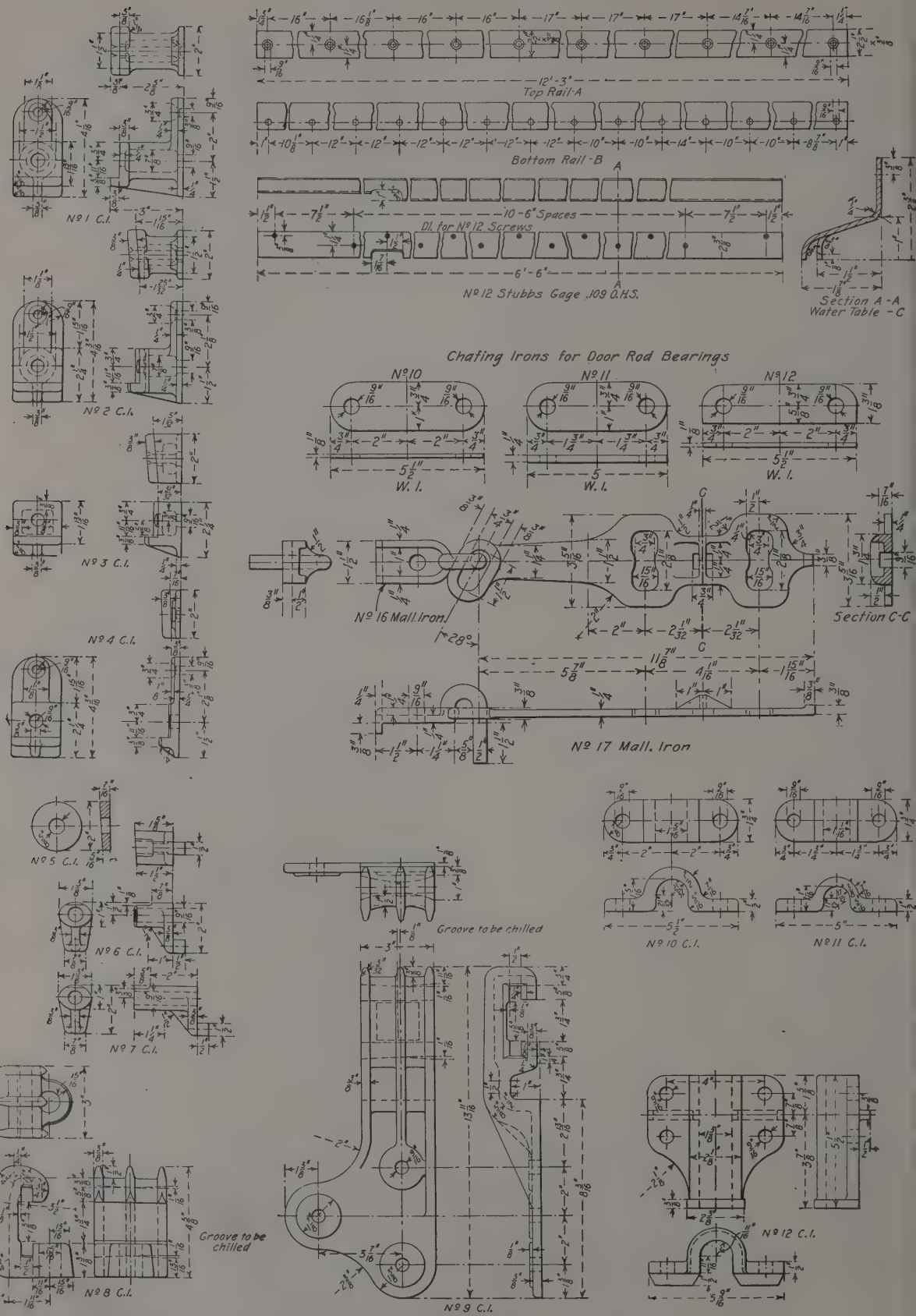


FIG. 655—DETAILS FOR A. R. A. STANDARD FLUSH SIDE DOOR FOR BOX CARS.
(See also Figs. 653-654.)

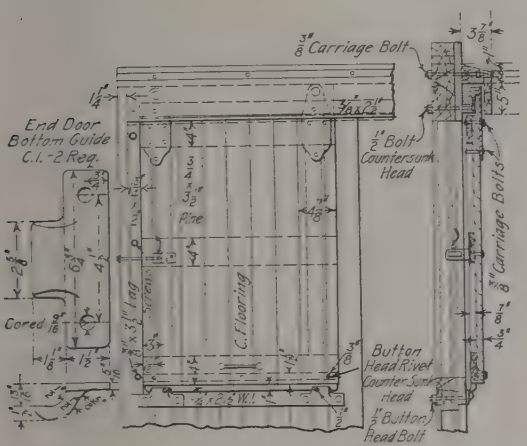
13. Door rollers must be carried on turned or cold-rolled steel pins. Pins must be a driving fit in bracket or housing. Rollers must be drilled not more than 0.01 in. larger than pin, and outside of roller must be turned or ground so that it will be round and concentric with the bore.

14. If bottom supported door is used, the lap of the Z-bars, both top and bottom, shall be equivalent to bottom Z-bar, as in Fig. 652. on page 394. Rollers must conform to the above specification, and there shall be sufficient rollers provided so that door is always carried on at least two rollers.

15. Proper clearance must be provided so that ⅜ in. bulging of the side of car will not interfere with the free movement of the door. Door mechanism must be so designed that in a closed position the door is drawn reasonably tight against side of car. It should be possible for one man to open or close the door readily from the ground without tools.

16. All the above specifications apply particularly to cars with 6-ft. door openings and single outside hung side doors, and in all cases where a particular construction is described, or specific dimensions are given, their equivalent will be acceptable.

17. The above specifications for new outside hung box car side doors shall also cover the application of complete new doors and door fixtures to existing cars.



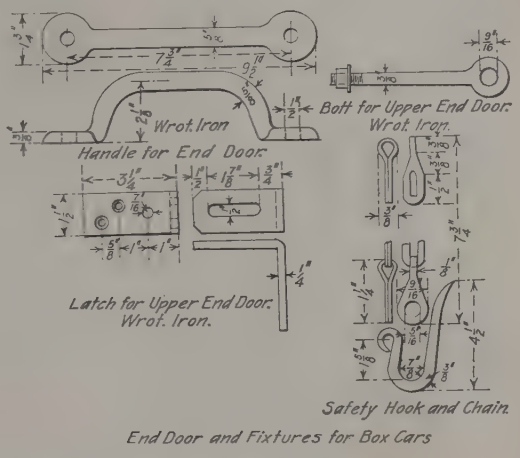

Wrot. Iron
Handle for End Door.
Bolt for Upper End Door. Wrot. Iron.
Latch for Upper End Door. Wrot. Iron.
Safety Hook and Chain.
End Door and Fixtures for Box Cars

Fig. 656—A. R. A. Recommended Practice for Box Car End Door and Fixtures.

Specifications for Reinforcing Outside Hung Doors

Recommended Practice—adopted, 1920.

1. Top of door shall be reinforced by a 1½ in. by 1½ in. by 3/16 in. angle, or its equivalent, extending horizontally the full width of the door and not more than 12 in. from the top.

2. Bottom of door must be reinforced by 2⅛ in. by 1¾ in. by 3/16 in. Z-bar, or its equivalent, applied as shown on Fig. 652.

3. Depending leg of Z-bar, or other construction which engages bottom guides, must not be less than 1¾ in.

4. There shall be not less than four bottom door guides on each side of car, located as shown on Fig. 651, and of the same or equivalent design to that shown on Fig. 652.

5. If the design of door is such that the removal of the door guide next to the back door post would permit the door to be pulled away from the car, then this door guide shall be of the same design as shown on Fig. 652, or its equivalent, for this particular location.

6. Door hasp fastener shall be at least 24 in. long, the same as, or equivalent to, the design on Fig. 652, fastened with not less than five ⅜-in. carriage bolts, with nuts on inside of door and bolts riveted over. Fastener shall be of such design that hasp can not be removed without removing bolts from fastener.

7. Door locks shall be secured by not less than two ½-in. carriage bolts through the closed door stop, and one additional ½-in. bolt through the side of car, with all nuts on inside and bolts riveted over nuts.

8. Closed door stop shall have two or more lips extending at least 1½ in. over the door to support it against bulging outward. Where all-wood closed door stops are used, they should be strengthened against splitting, and should have at least two metal reinforcement brackets similar to closed door stop casting on Fig. 650.

9. Open door stops, if all-wood, should extend the full height of the door, and be strengthened against splitting.

10. Door starters shall be provided to move the door 2 inches or more from its fully closed position.

11. Means shall be provided, if necessary, for forcing the door into its fully closed position.

12. Lumber used in construction of doors shall not contain more than 5 per cent moisture.

13. Lap of door over door post shall not be less than 2½ in.

14. The proper clearance must be provided so that ⅜ in. bulging of side of car will not interfere with the free movement of the door.

15. Door rollers must be carried on turned or cold-rolled steel pins. Pins must be a driving fit in bracket or housing. Rollers must be drilled not more than 0.01 in. larger than pin, and outside of roller must be turned or ground so that it will be round and concentric with the bore.

16. Door must be designed and vertical clearance provided so that under any service conditions there will be no binding of the door on account of vertical interference of door guides or track.

17. If the bottom supported door is used, the lap of the Z-bars, both top and bottom, shall be equivalent to

bottom Z-bars, as shown on Figure 651. Rollers must conform to the above specification, and there shall be sufficient rollers provided so that door is always carried on at least two rollers.

Box Car Door Fixtures

Standard—ADOPTED, 1912; REVISED, 1920.

The outside hung side door shown on Figs. 000, 000, 000, and 000, A. R. A., and flush side door shown on Figs. 000, 000, 000, and 000, A. R. A. represent the minimum requirements in door construction and details shown.

The door hood coverings shall be omitted from new cars, and, as much as possible in repairs to old cars.

The location of center of hasp or sealing eye shall be preferably 5 ft. from top of rail, and not more than 5 ft. 9 in. from top of rail.

Recommended Practice—ADOPTED, 1897; REVISED, 1912.

The box car end door fixtures are shown on Figure 9.

Seal Records of Box Car End Doors

Standard—ADOPTED, 1921.

End doors used for loading lumber in box cars are essential only on roads having long lumber loading in box cars as an essential feature of traffic.

End doors must be so constructed that when closed they lock automatically by means of a lock accessible from the inside of the car, thus avoiding the necessity of seal records.

Seal appliances now in use, and not accessible from the ground or from end ladders, should be revised so as to be accessible from the ground or end ladders, to promote the safety of employees.

Rounding of Corners—Stock Car Doors

Recommended Practice—ADOPTED, 1910

Doors, door jambs and all other inside exposed corners of stock cars should be rounded to prevent injury to cattle.

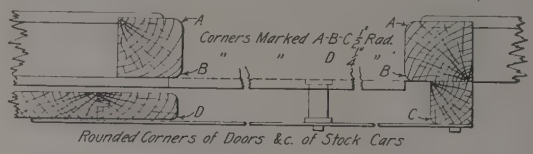


FIG. 657—A. R. A. RECOMMENDED PRACTICE FOR ROUNDED CORNERS OF DOORS, ETC., OF STOCK CARS

End for Hopper Door Operating Shaft

Standard—ADOPTED, 1921.

In 1913 a 2-inch square end for hopper door operating shaft was adopted as Recommended Practice; in 1914 it was advanced to Standard.

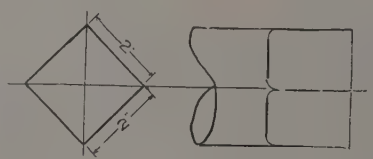


FIG. 658—END FOR HOPPER DOOR OPERATING SHAFT

Passenger Car Doors

The construction of wooden doors for passenger cars has practically been abandoned and the use of pressed steel shapes has become general. The various designs of steel doors for passenger carrying cars as well as for baggage, express and postal cars, together with the fixtures used on them, are illustrated and described in pages following.

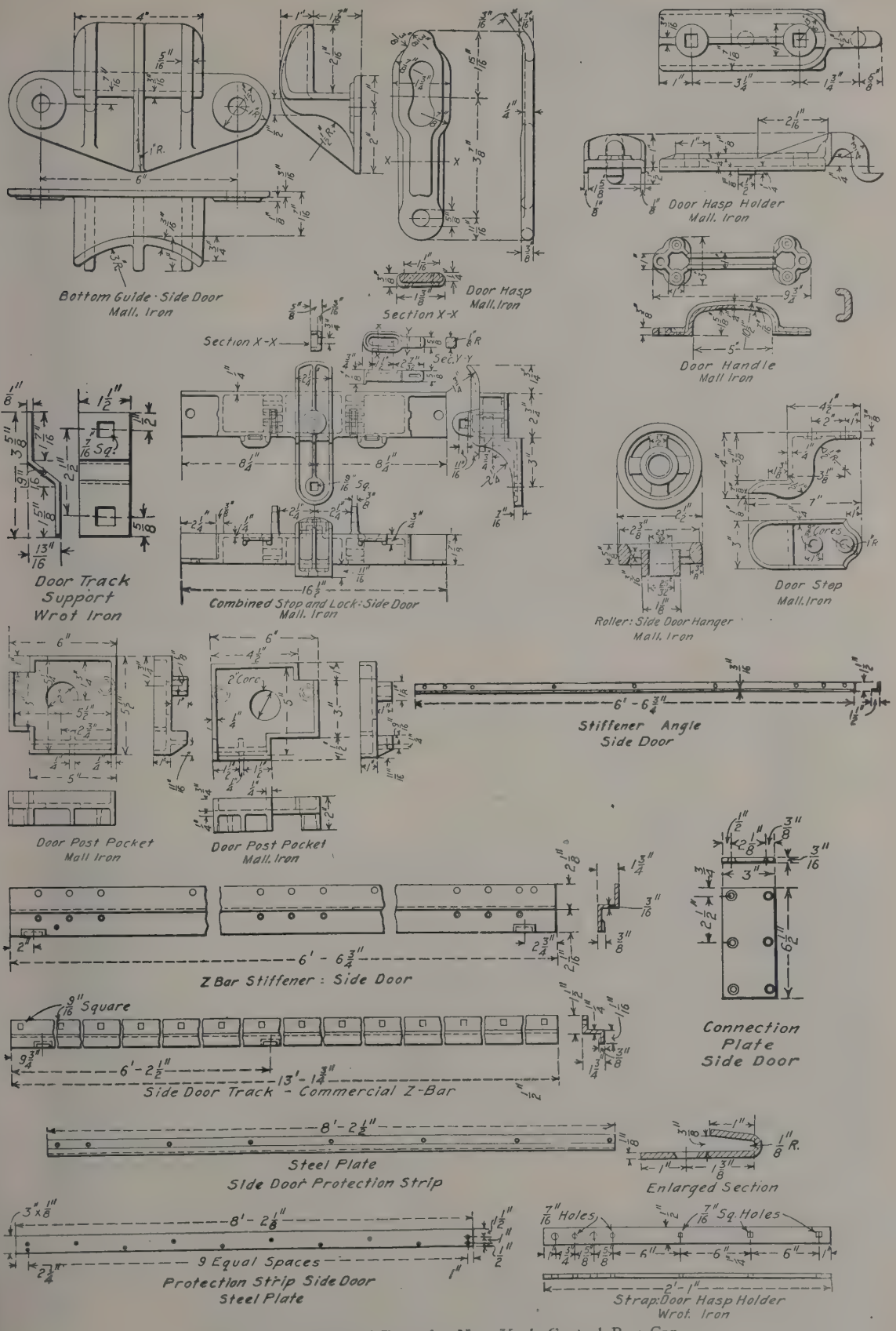


Fig. 659—Details of Door for New York Central Box Car.

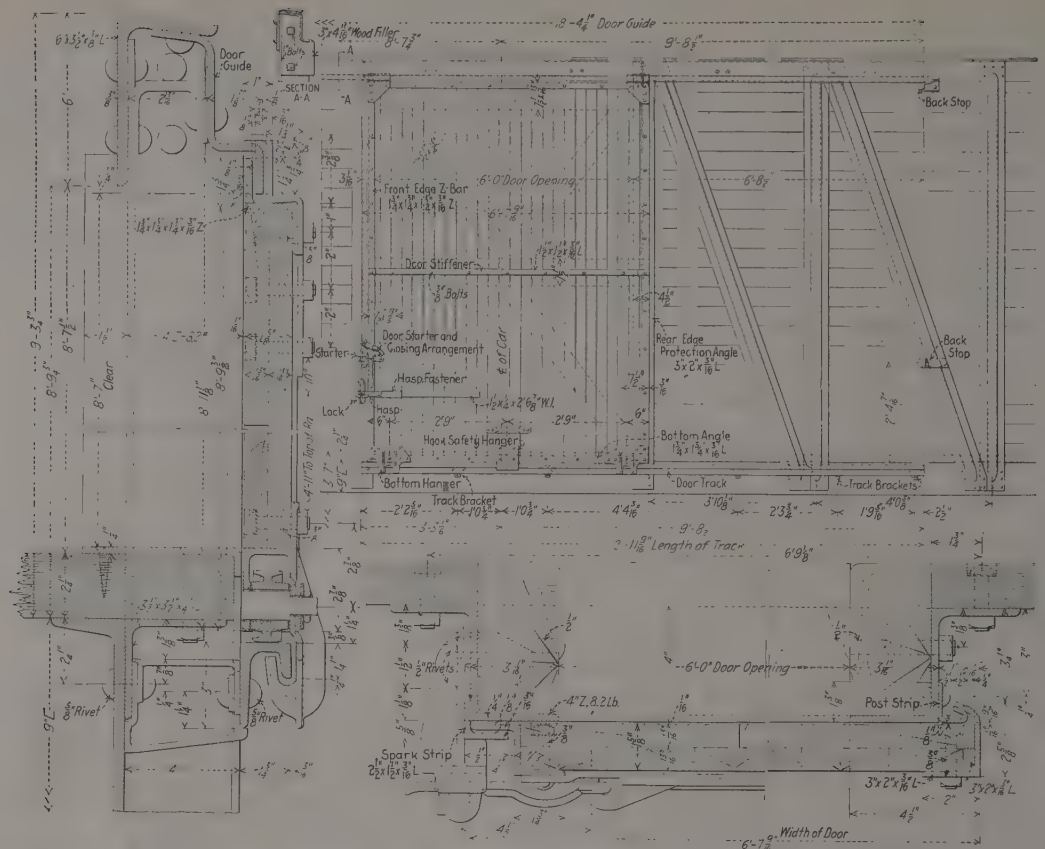


Fig. 660—Camel No. 50 Bottom Supported Car Door for Application to U. S. Government Single Sheathed Box Cars.

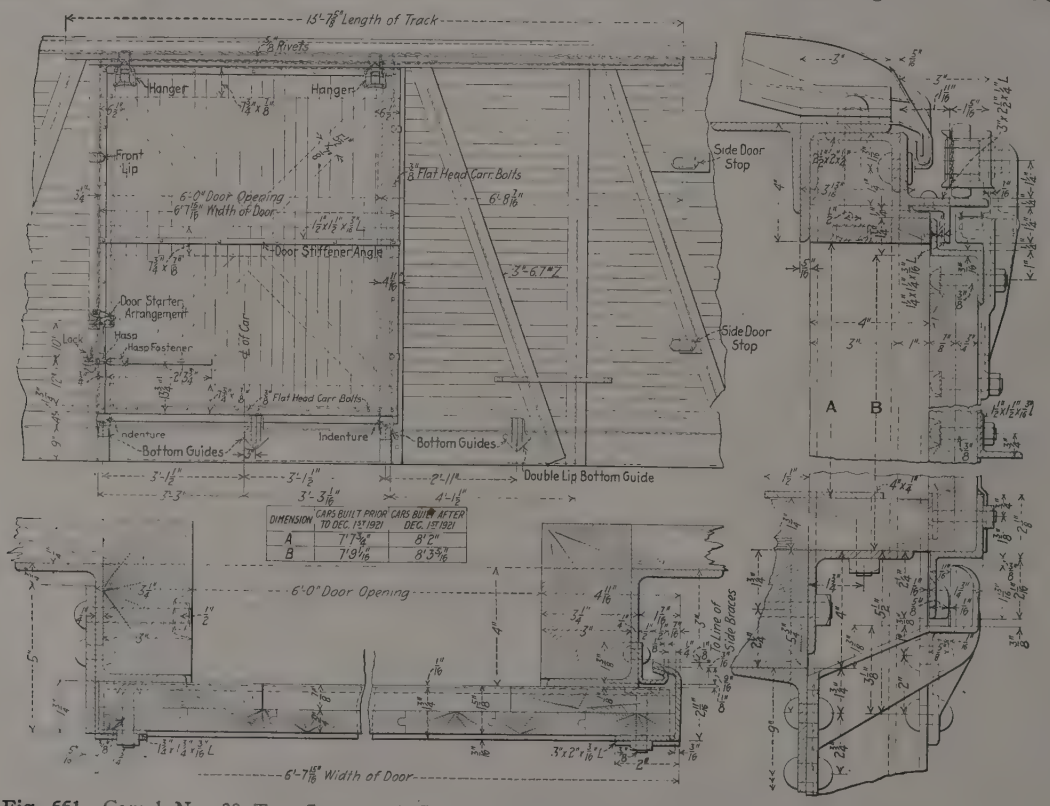


Fig. 661—Camel No. 30 Top Supported Car Door for Steel Superstructure Single Sheathed Box Cars.

Camel Company.

(*See also Page* 401)

Camel Top and Bottom Supported Doors

Freight car doors are required to be spark, weather and burglar-proof, easily opened and closed, and strongly constructed to withstand rough handling in traffic movement and the impact of the car lading. The various types of doors built by the Camel Company have successfully met all of these requirements and thousands of Camel Doors are in use on the railroads in America and abroad.

The Camel Door No. 50 as shown in Fig. 662 is a bottom hung door supported by a continuous channel section door track. This door is full steel bound, gusseted at the corners and is shown as applied to a U. S. R. A. single sheathed box car. It is spark and weather proof and equipped with Camel burglar-proof lock and door starter.

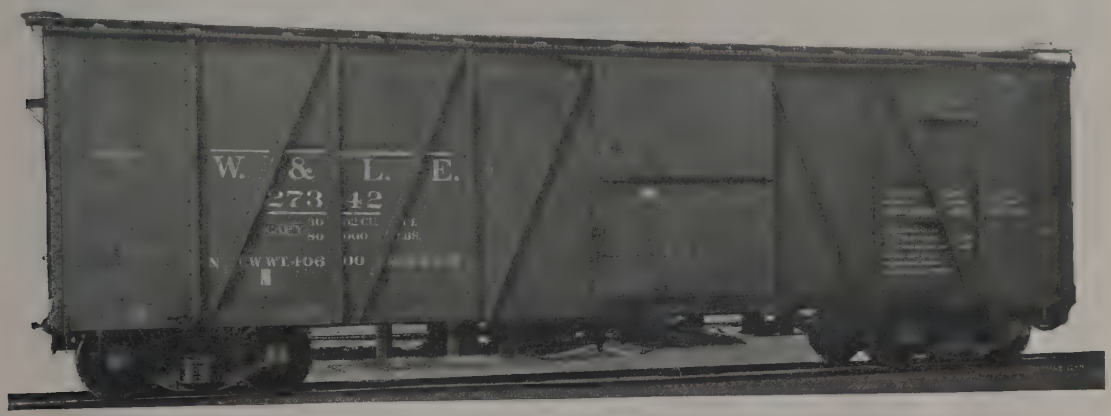


Fig. 662—Camel No. 50 Bottom Supported Door

The Camel Door No. 32 is a top hung door as shown in Fig. 664 supported by rolled steel T-bar track and designed to insure absolute weather protection at the top. The hangers are provided with two rollers insuring free operation. The large roller has a 7/8-in. diameter cold rolled steel axle which is supported by the front and rear walls of the hanger. This door is full steel bound, spark proof and equipped with the Camel burglar proof combination stop and lock, starter and closer and burglar-proof bottom guides. This application complies fully with the latest A. R. A. recommendations.

The Camel Door No. 30 as shown in Fig. 663 is designed for application to steel superstructure single sheathed box cars. This is a top hung door supported by rolled steel track riveted to angle side plate. The door hangers are provided with auxiliary anti-friction rollers to insure free movement. The door is full steel bound and spark and weather proof. It is equipped with Camel burglar-proof lock, door starter and closer, and a double lip guide which prevents the door from striking the side braces.

The application of these Camel Doors is not limited to the types of cars illustrated but designs are already available or can be modified to suit any and all types of car construction. Since the installation does not require extensive alterations in the provisions made for ordinary doors, Camel Doors can be applied without difficulty to cars already in service and thus increase the efficiency of existing equipment.

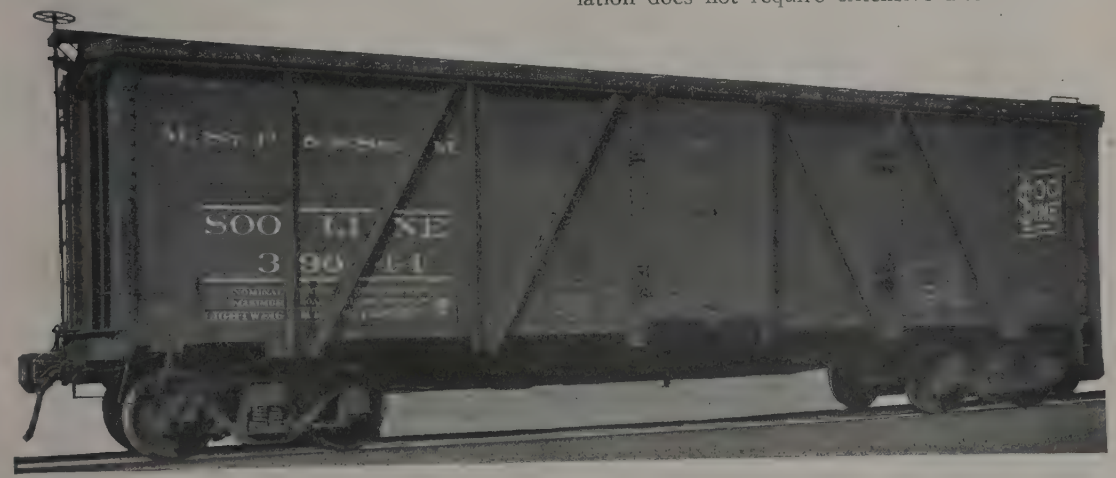


Fig. 663—Camel No. 30 Top Supported Door

For other products and branch offices, see classified and alphabetical indexes.

CAMEL COMPANY, CHICAGO, ILLINOIS

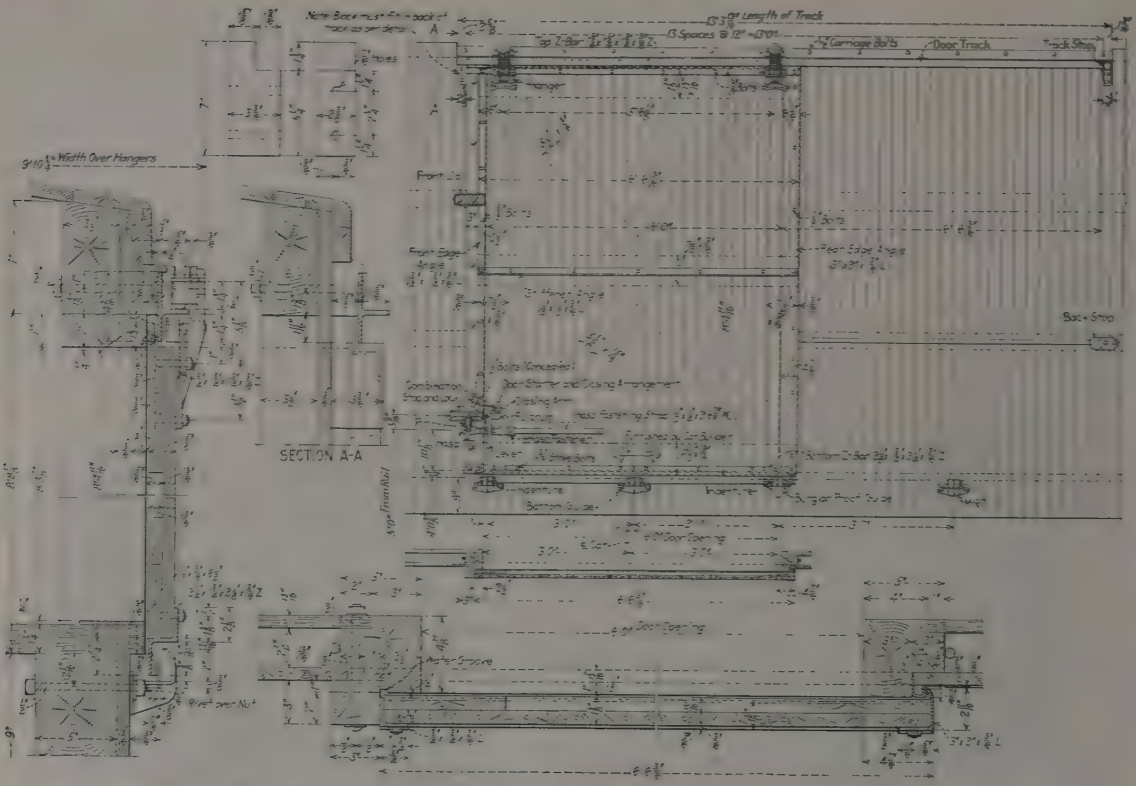


Fig. 664—Camel Car Door No. 32 for Double Sheathed Box Cars.

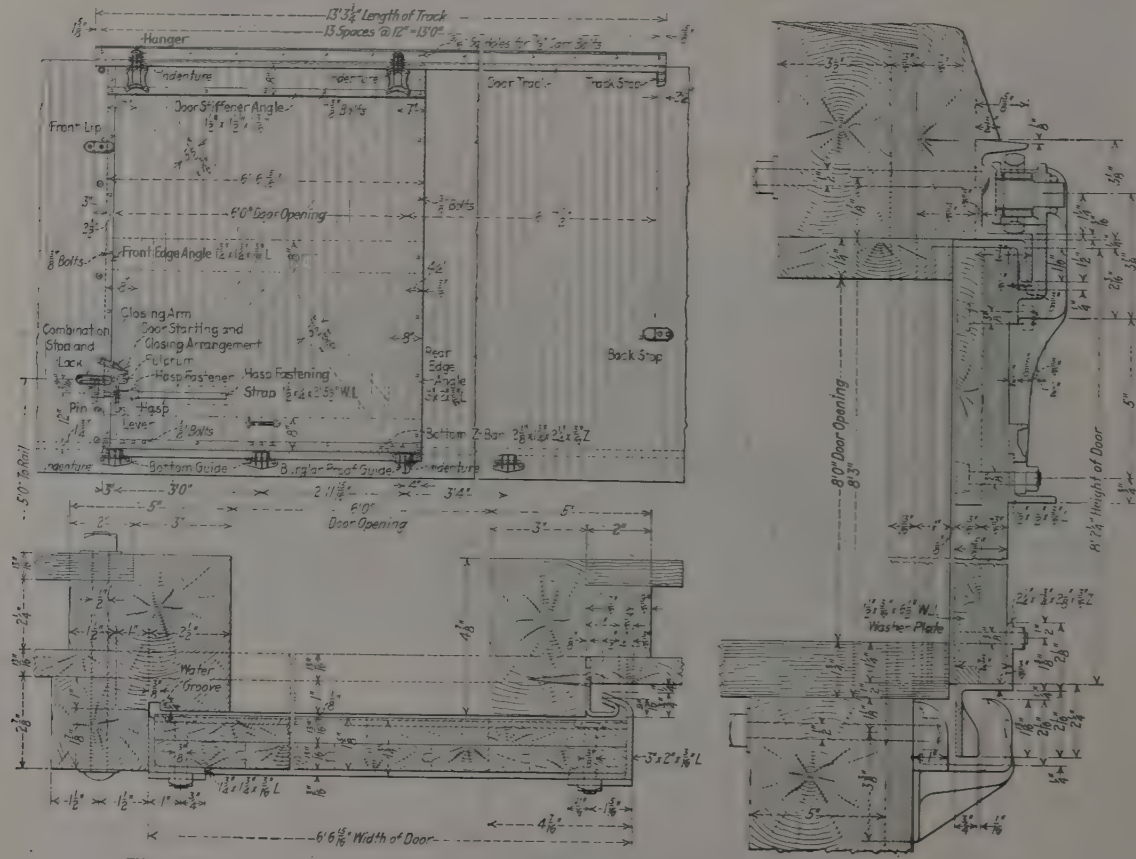


Fig. 665—Camel Top Supported Car Door No. 27 for Wooden Double Sheathed Box Car.

Camel Company.

(*See also Pages* 401, 403, 405)

Camel, Camel-Gilroy, and Jones Peerless

The Camel Door No. 27, a top hung door supported by channel Z-bar track, is shown in Fig. 666 as applied to double sheathed box cars. This full steel-bound door is spark and weatherproof and moves with ease on rollers operating between the flanges of the track. It is equipped with a Camel burglar-proof combination stop, lock, starter and closer and burglar-proof bottom guides. This application complies with A. R. A. recommendations.

The Camel-Gilroy Door shown in Fig. 669 is a bottom hung door supported by a continuous angle track. This when closed is continuously held in place on all four sides and is shown as applied to a double-sheathed box car. It is equipped with a Camel burglar-proof lock, starter and heavy rolled steel Z-bar front stop which interlaps with the front edge protection strip. The door is full steel-bound and weather proof.

The Camel-Gilroy Automobile Car Doors as shown in Fig. 667 are bottom hung doors supported by a continuous angle track. These full steel-bound doors are spark and weather proof and equipped with Camel burglar-proof locks and door starter. When closed the doors are continuously held in place on all four sides. The small door has an auxiliary post bolted to it, which, by means of interlocking castings, when the door is in a closed position becomes a rigid support between the plate and side-sill. This arrangement makes the car suitable for either single or double door loading.

The Jones Peerless Car Door, a top hung door carried on rolled steel channel track as shown in Fig. 672 is shown as applied to a single sheathed car. Freedom of movement is assured as the rollers operate between horizontal flanges of the track. The full steel bound door is held tight when in closed position by a deflector on the track and is always spark and weather proof.

Fig. 666—Camel No. 27 Top Supported Door

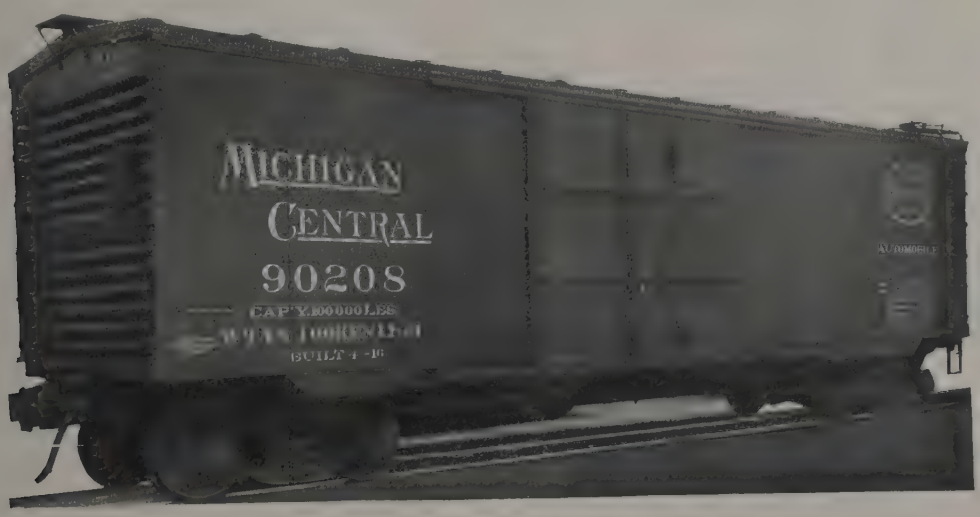


Fig. 667—Camel-Gilroy Automobile Car Door

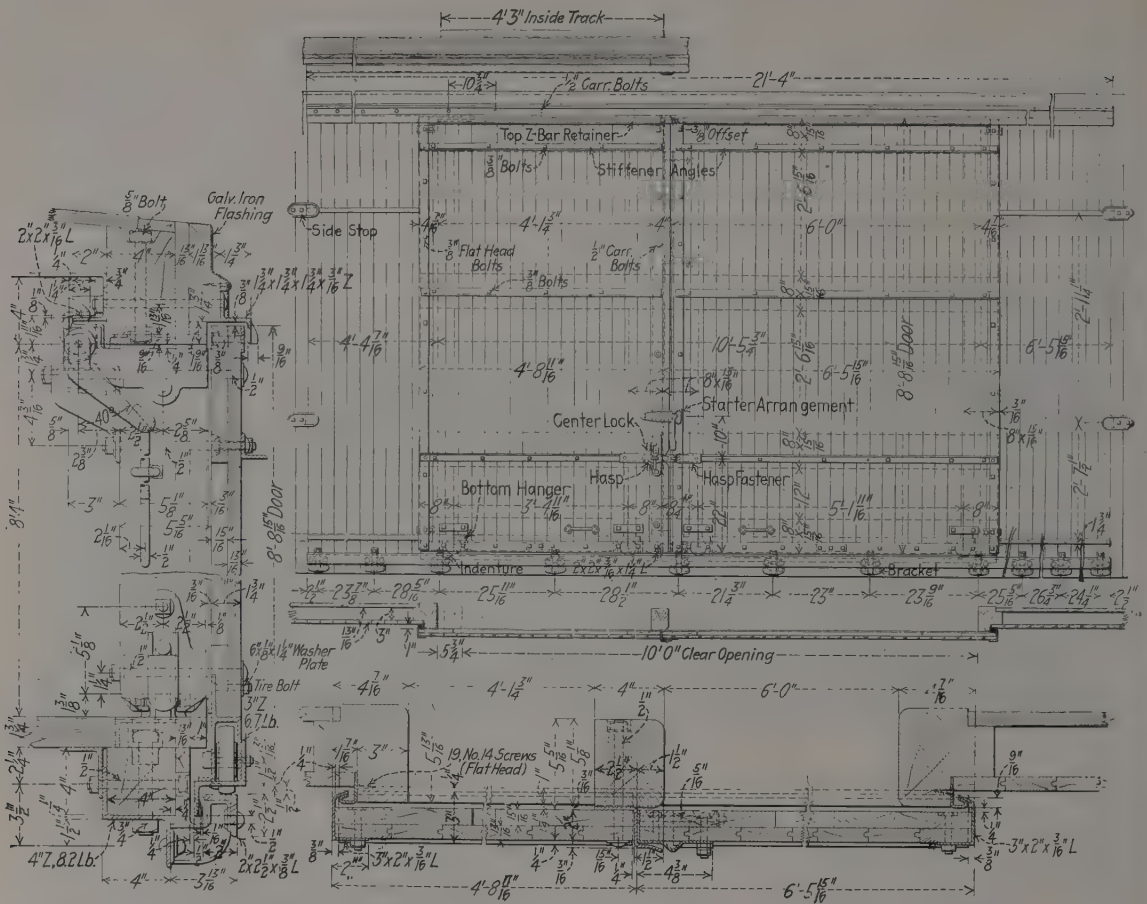


Fig. 668—Camel-Gilroy Bottom Supported Door for Double Sheathed Automobile Car.

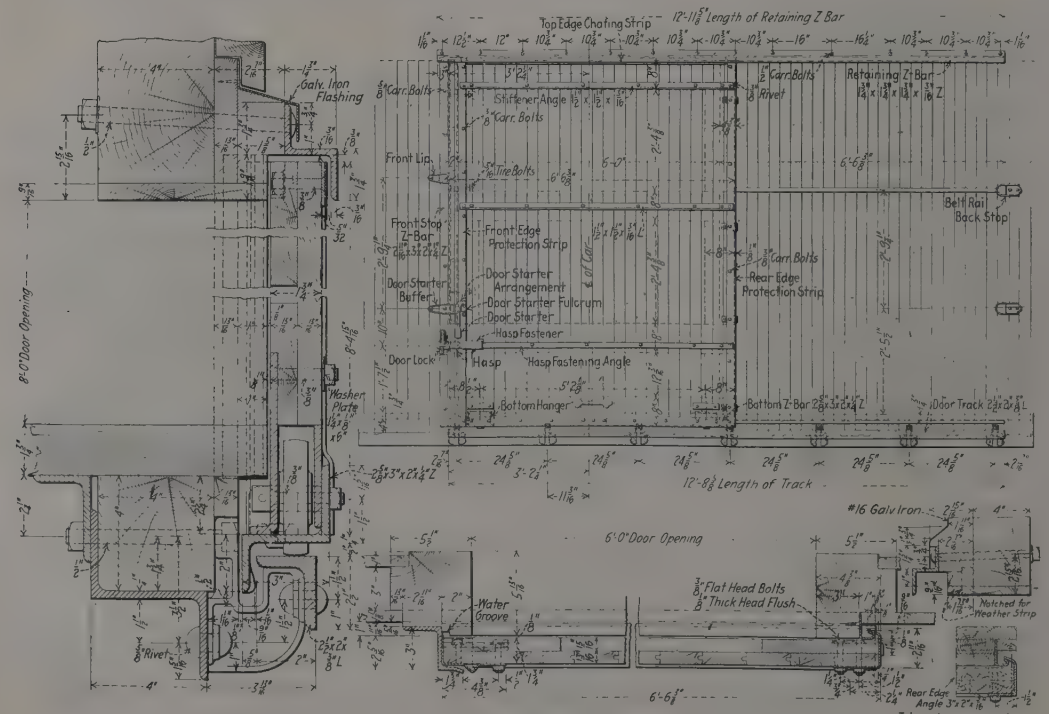


Fig. 669—Camel-Gilroy Car Door for Double Sheathed Box Cars.

Camel Company.

(*See also Page* 403.)

Camel Fixtures and Locks

The committee on car construction of the American Railway Association has, during the last few years, emphasized stronger car door fastenings and reinforcements as one of the most important improvements necessary in box car construction. The complaints of defective door fastenings, guides that can easily be removed and the lack of reforcement of the bottom of box car doors allowing the doors, especially if the wood is decayed, to be opened by forcing them over the guides without breaking the seals, demand decisive action if the proper protection of shipments is to be maintained.

The Camel Company has for years been calling attention to these problems; Camel Car Door Fixtures, Locks and Door Reinforcements conform in every way to the present standard A. R. A. specifications.

The Camel Combination Stop and Lock with Door Starter and Closer and its operation is shown in Fig. 671. This device prevents the splitting of the wood door stop and the front portion of the door. The two bolts which are concealed in the combination stop and lock casting make this application positively burglar-proof. The application of the hasp, hasp fastener, and hasp fastening strap shown in the above illustration, distributes the pulling strain evenly over the front of the door. The use of a door starter and closer which eliminates damage to the door when opening or closing, is especially recommended by the American Railway Association Car Construction Committee.

Fig. 670—Camel No. 27 Top Supported Door

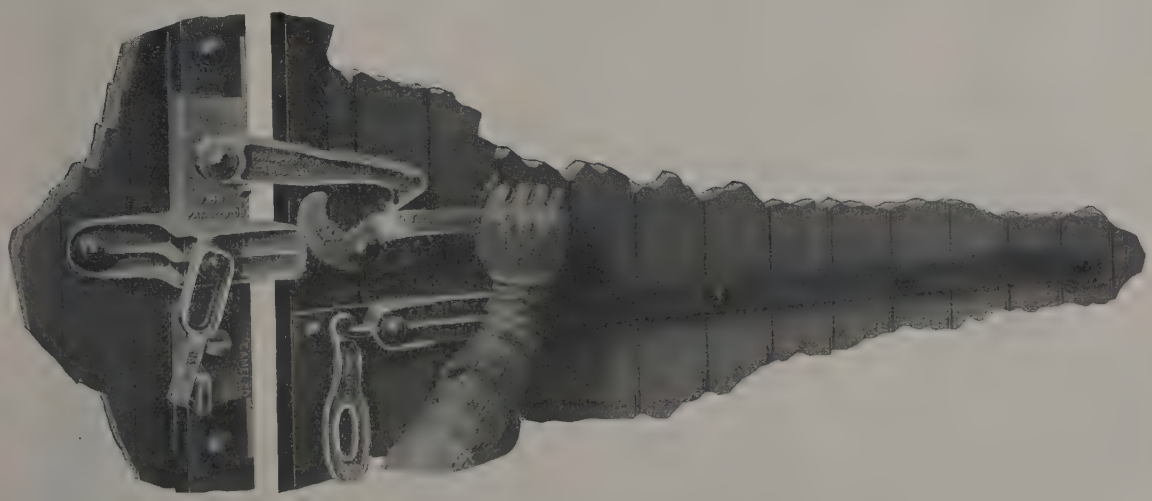


Fig. 671—Camel Combination Stop and Lock

For other products and branch offices, see classified and alphabetical indexes.

CAMEL COMPANY, CHICAGO, ILLINOIS

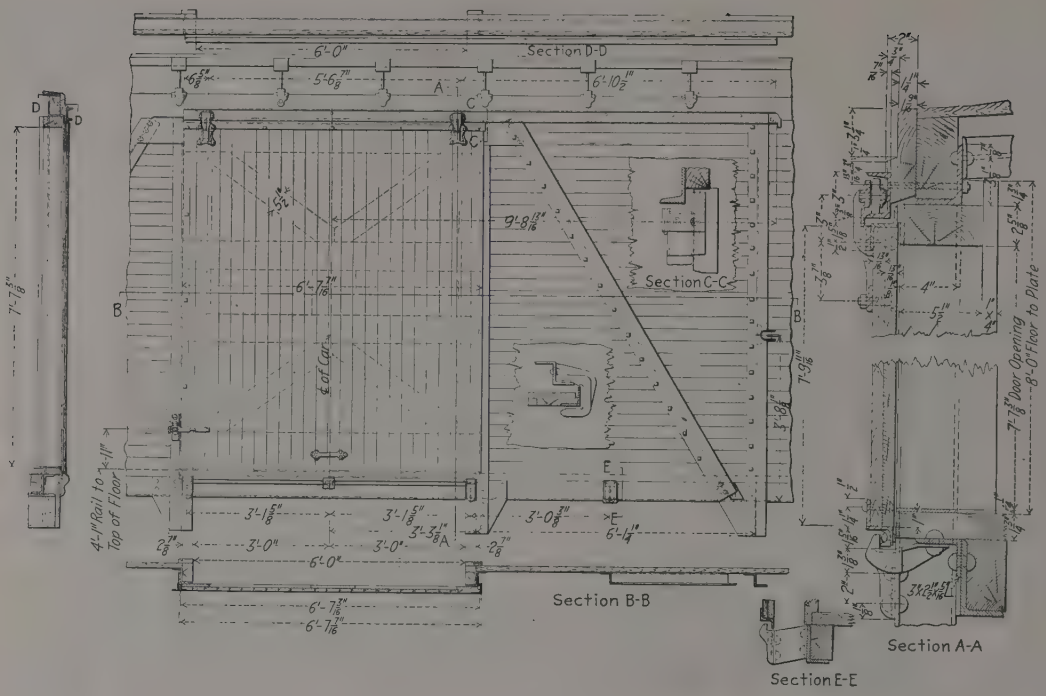


Fig. 672—Jones Peerless Car Door for Box Cars. Jones Car Door Company.

(*See also Page* 403.)

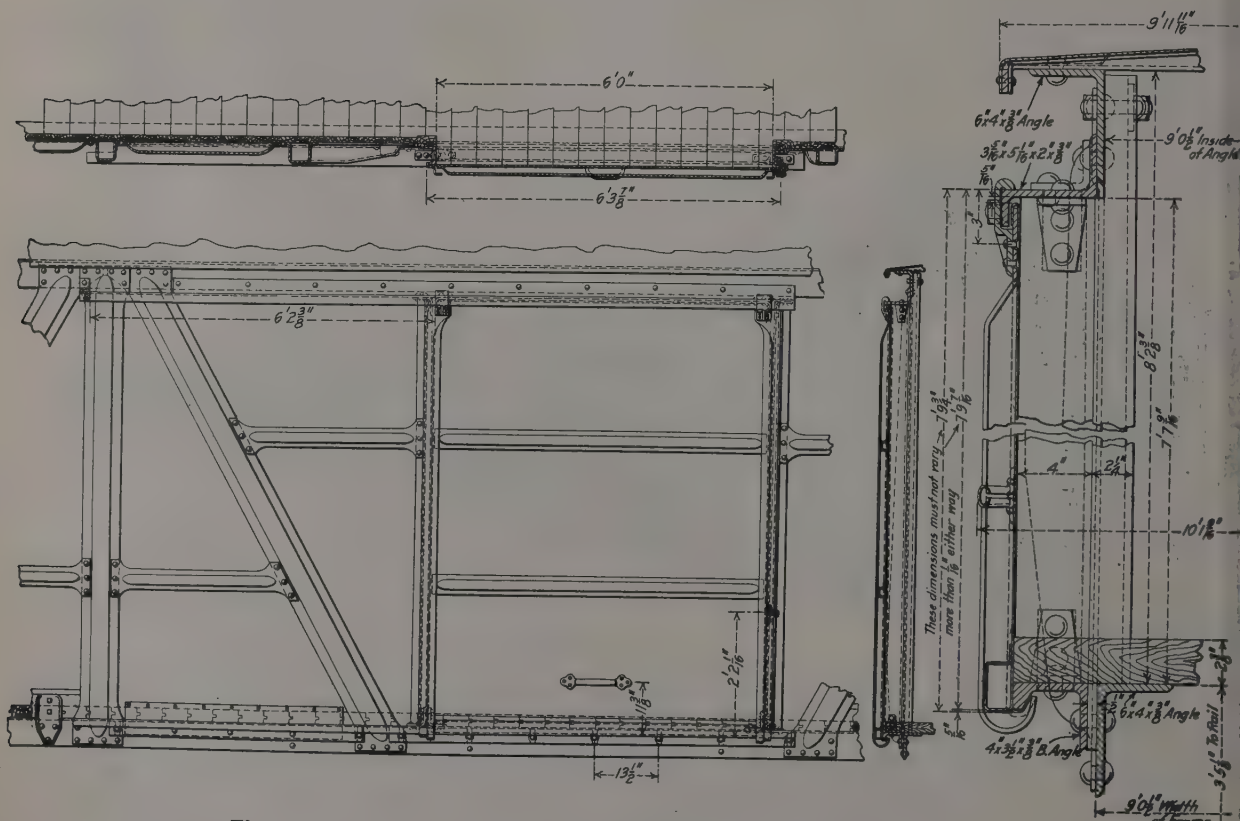


Fig. 673—All-Steel Door Used on Pennsylvania Railroad Steel Frame Box Car.

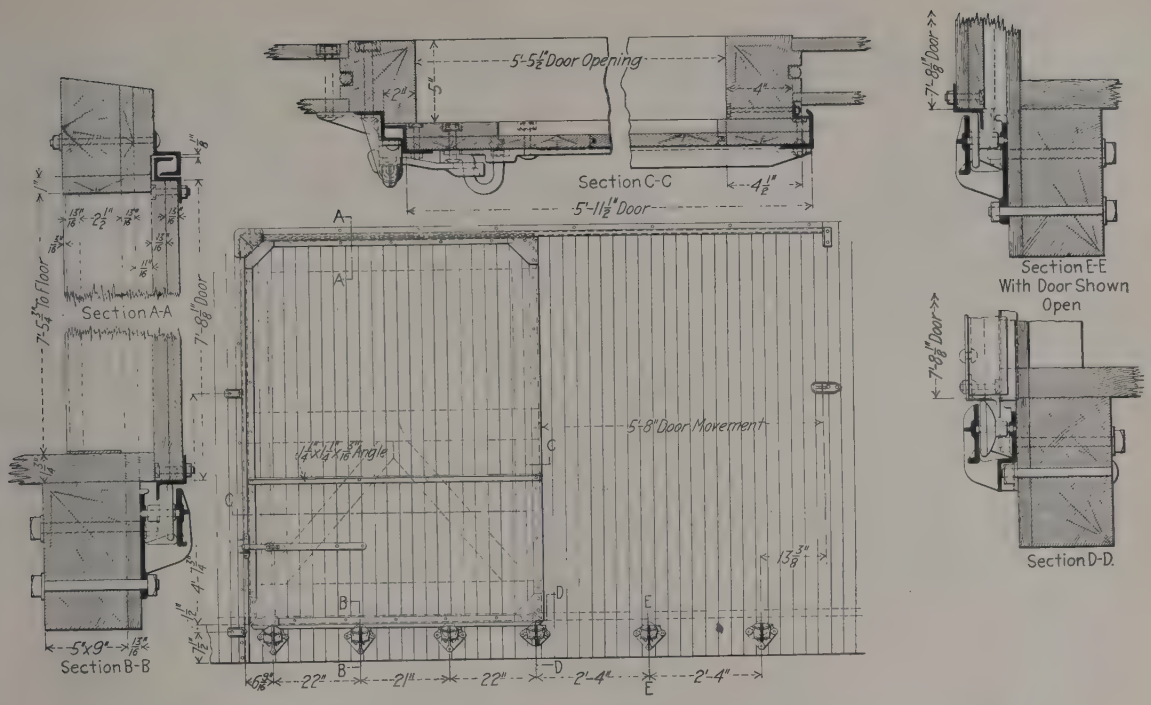


Fig. 674—Arrangement of National Box Car Door. Union Metal Products Company.

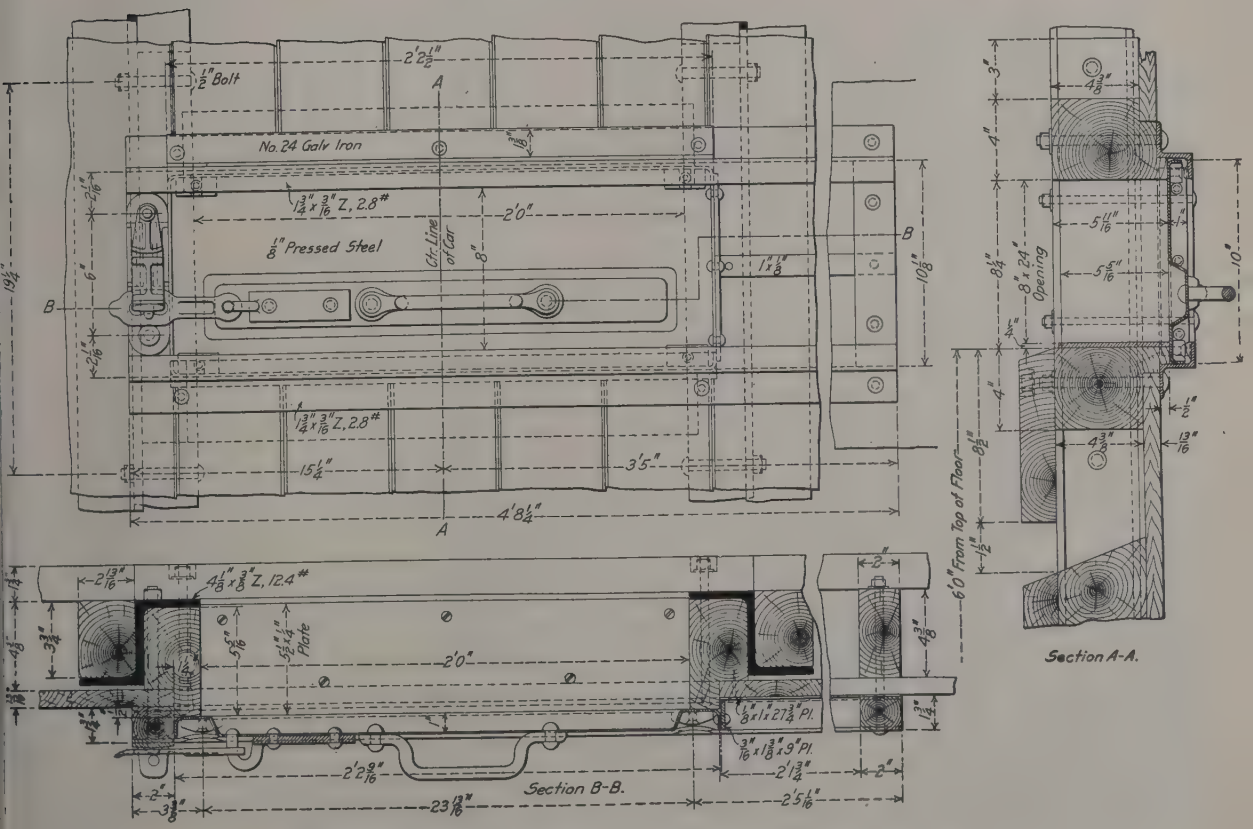


Fig. 675—End Door for Atchison, Topeka & Santa Fe Box Car.

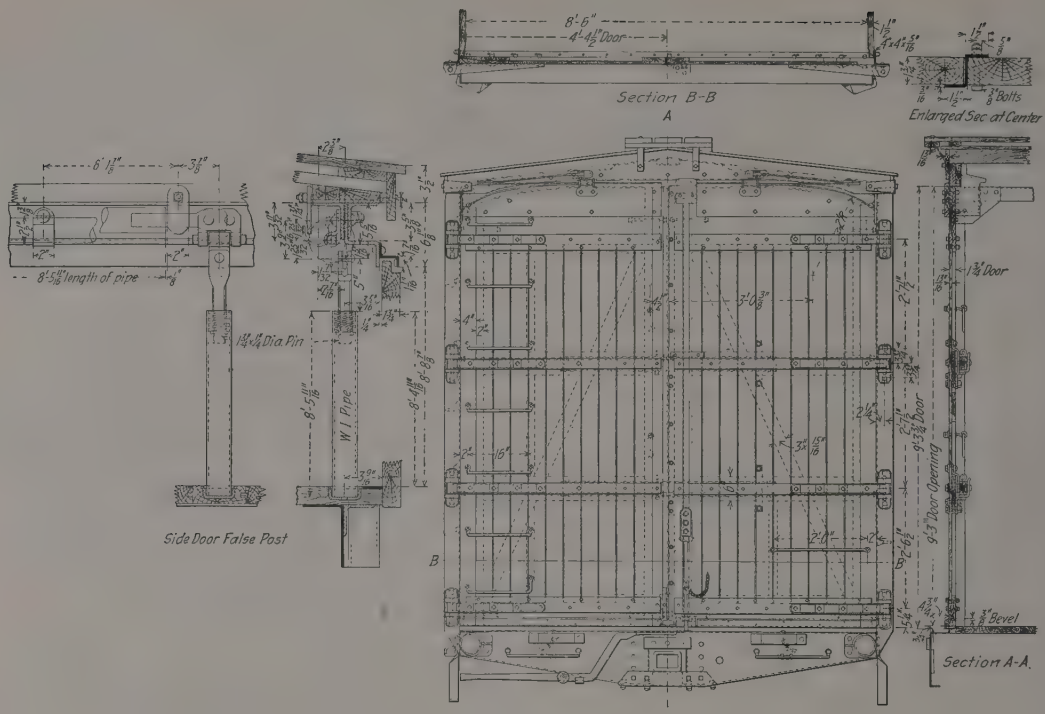


Fig. 676—End Door and False or Movable Post for Side Door of Erie Railroad Automobile Box Car. American Car & Foundry Company.

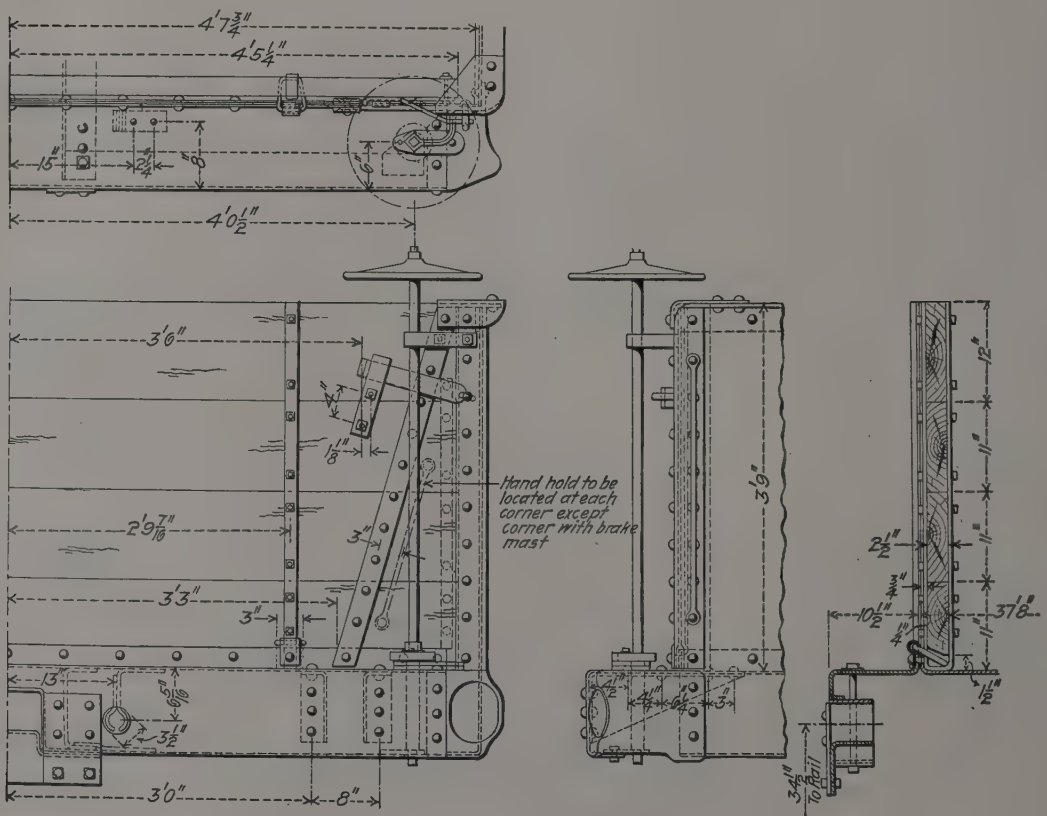


Fig. 677—Drop End Door for Pennsylvania Railroad Gondola Car.

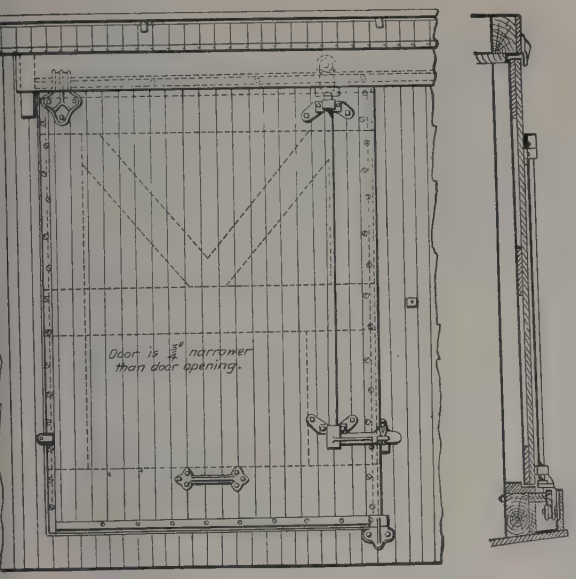


Fig. 678—St. Louis Flush Car Door.

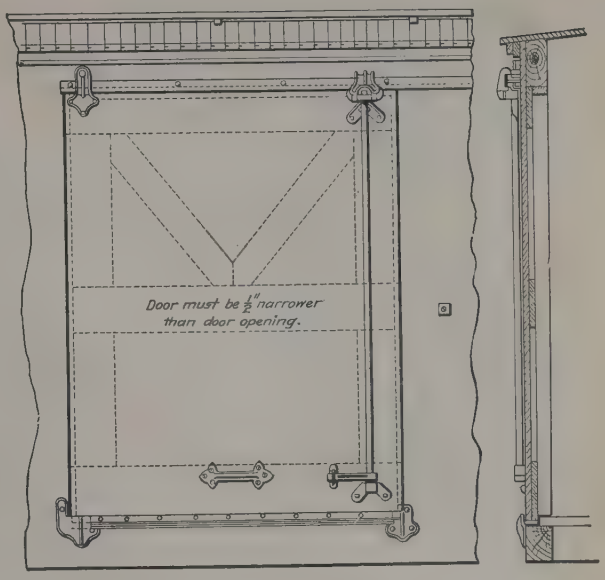


Fig. 679—Western Flush Car Door.
Western Railway Equipment Company.

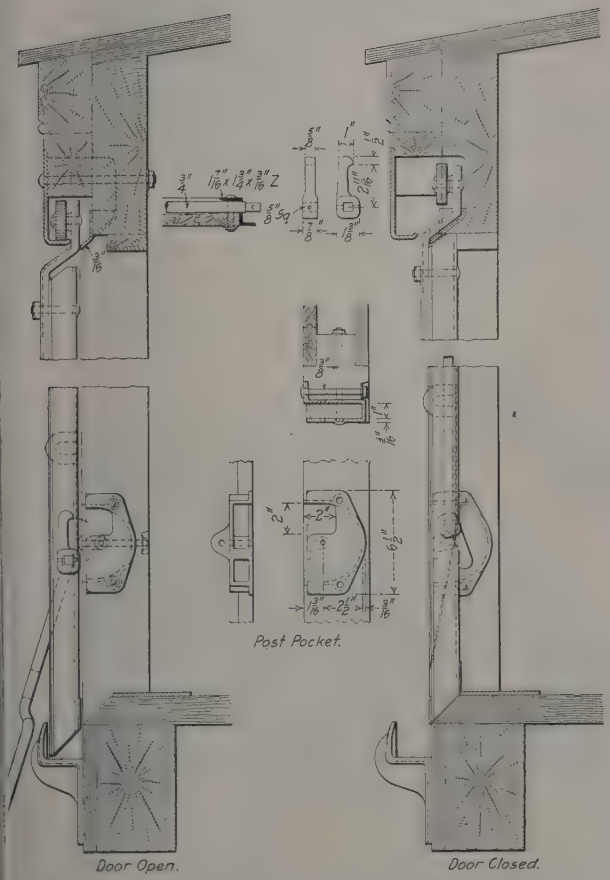


Fig. 680—Ohio Flush Box Car Door. Ralston Steel Car Company.

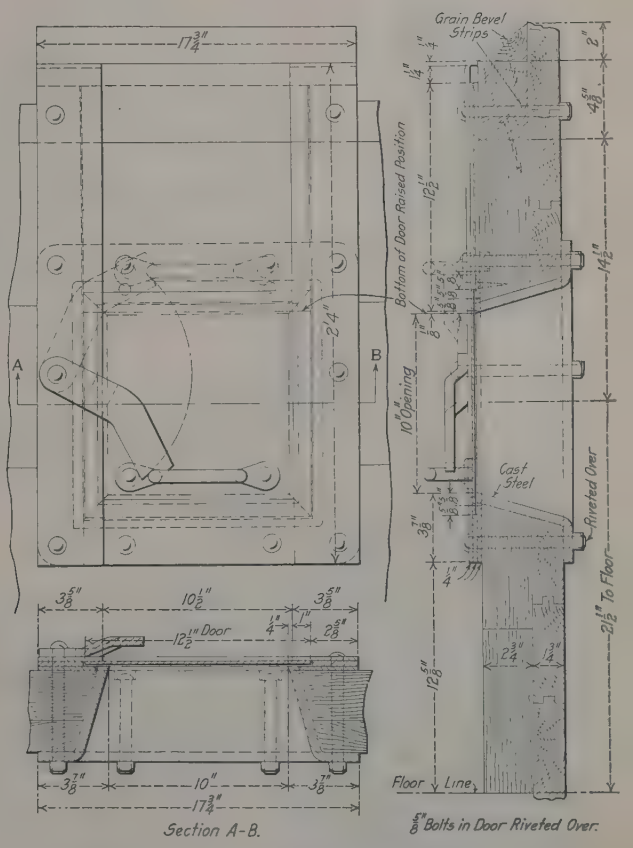


Fig. 681—Lower Rail End Door Used on Canadian Government Railways Box Cars.

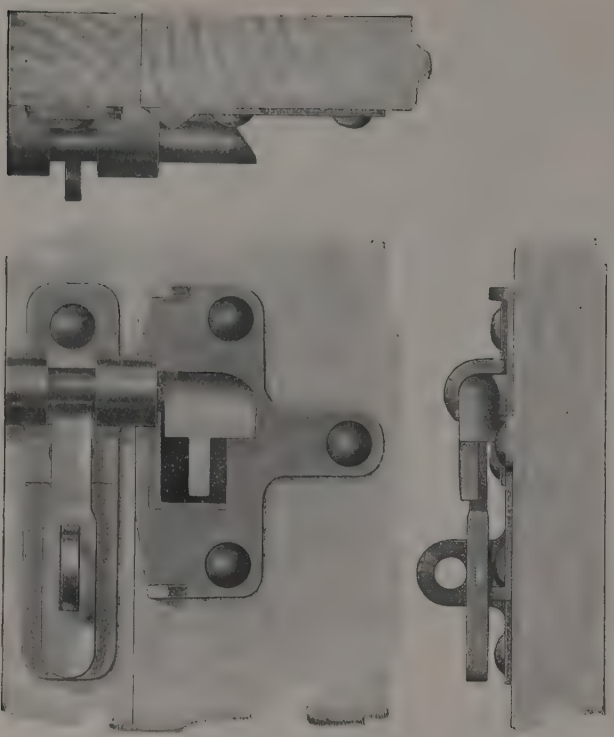


Fig. 682—Automatic Car Door Lock. Railway Utility Company.

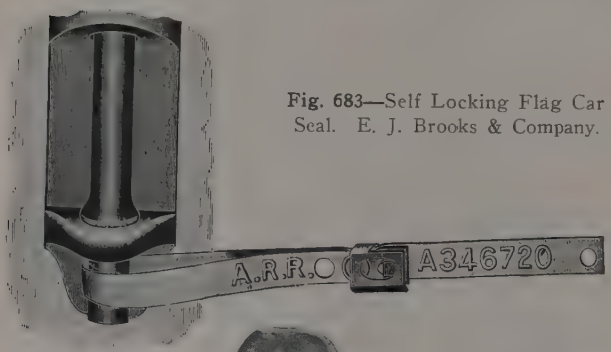


Fig. 683—Self Locking Flag Car Seal. E. J. Brooks & Company.

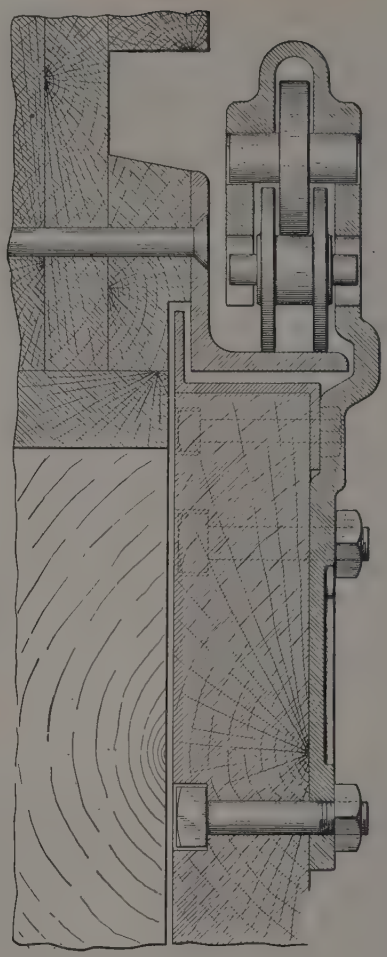


Fig. 684—Cross Section Through Utility Double Roller Car Door Hanger. Railway Utility Company.

Fig. 685—Forged Steel Door Handle. The Damascus Brake Beam Company.

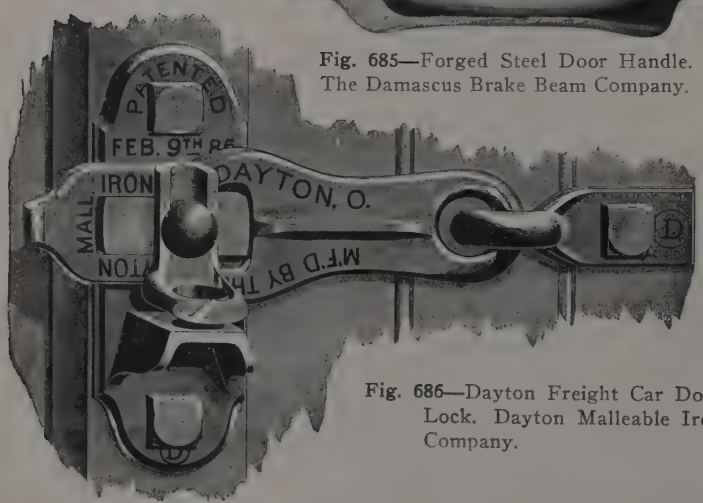


Fig. 686—Dayton Freight Car Door Lock. Dayton Malleable Iron Company.

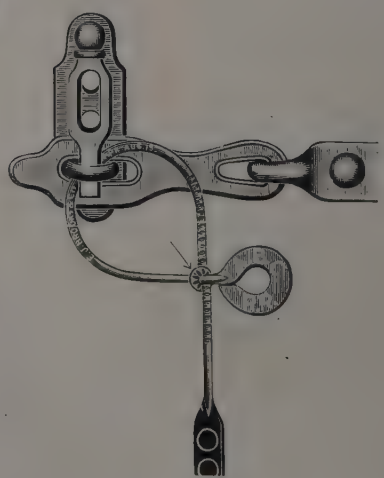


Fig. 687—Twist Lock Car Seal. E. J. Brooks & Company.

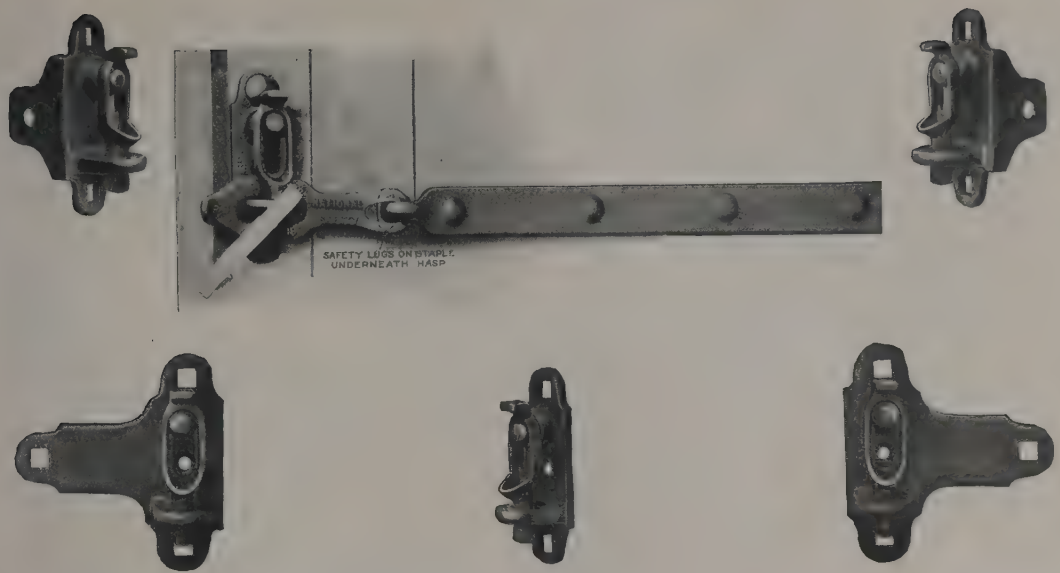


Fig. 688—National Car Door Fasteners—Locks.

Fig. 689
Two Hole Hasp.

Fig. 690—National Car Door Fasteners—Staples.

Fig. 691
One Hole Hasp.

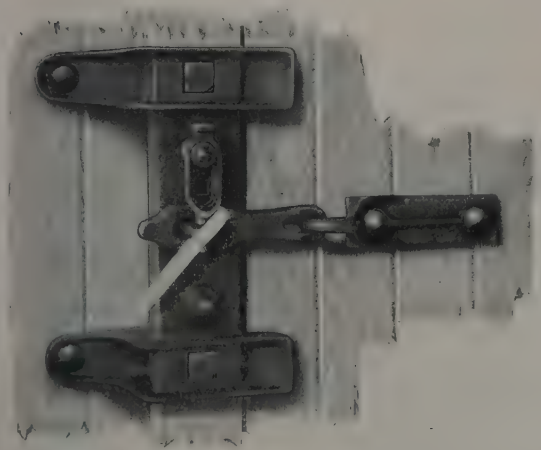


Fig. 692—National Car Door Stop and Lock Combined.

Fig. 693—National Burglar Proof Car Door Bracket.

The National Malleable Castings Company.

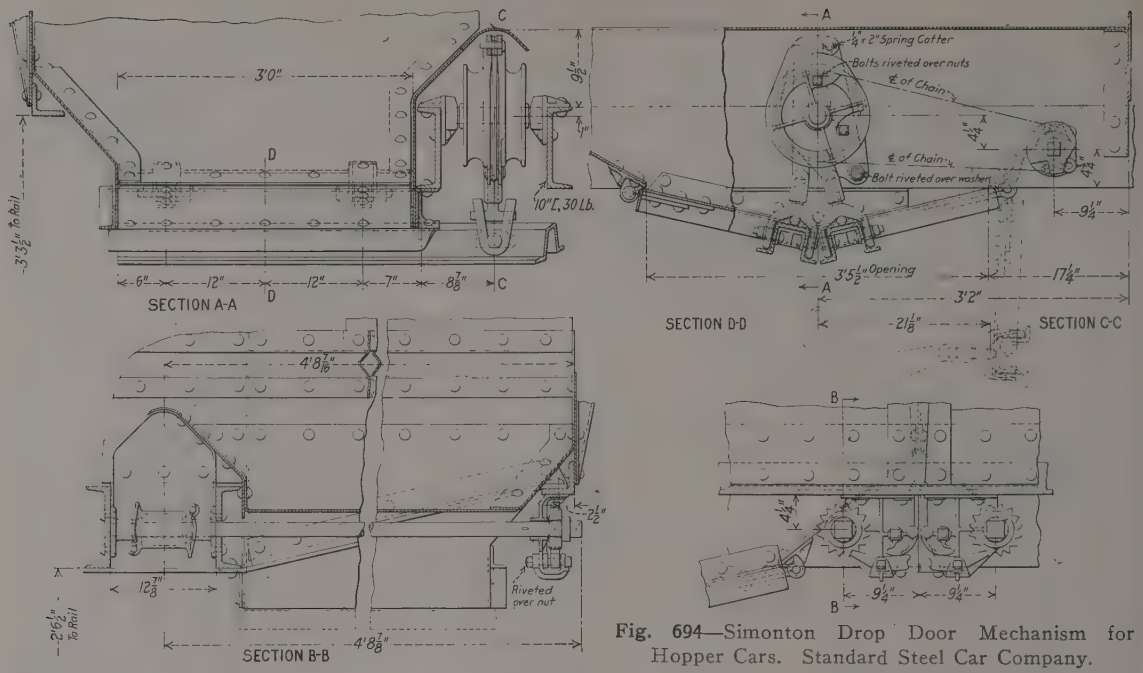


Fig. 694—Simonton Drop Door Mechanism for Hopper Cars. Standard Steel Car Company.

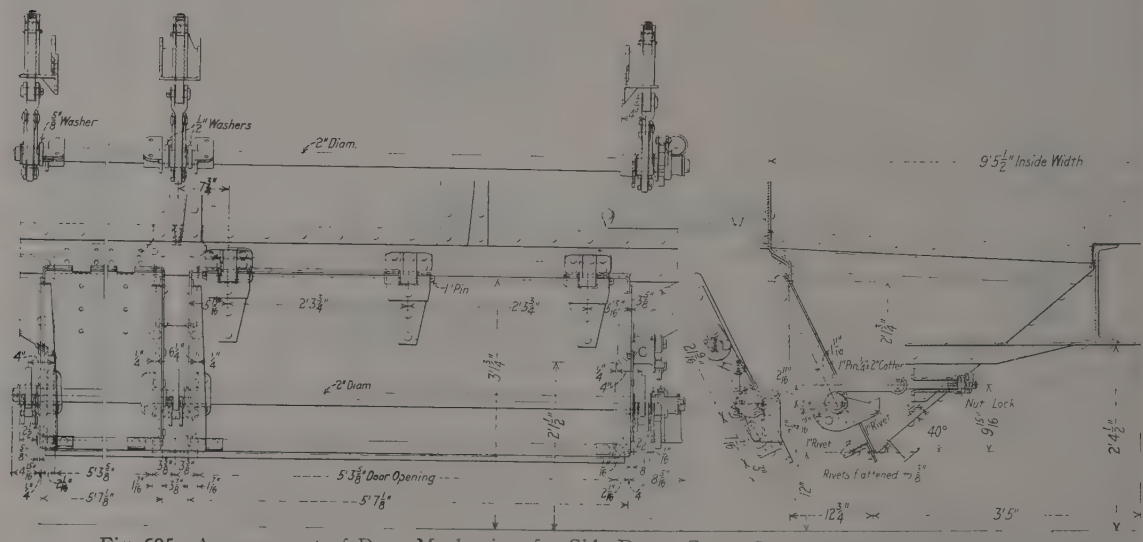


Fig. 695—Arrangement of Door Mechanism for Side Dump Cars. Standard Steel Car Company.

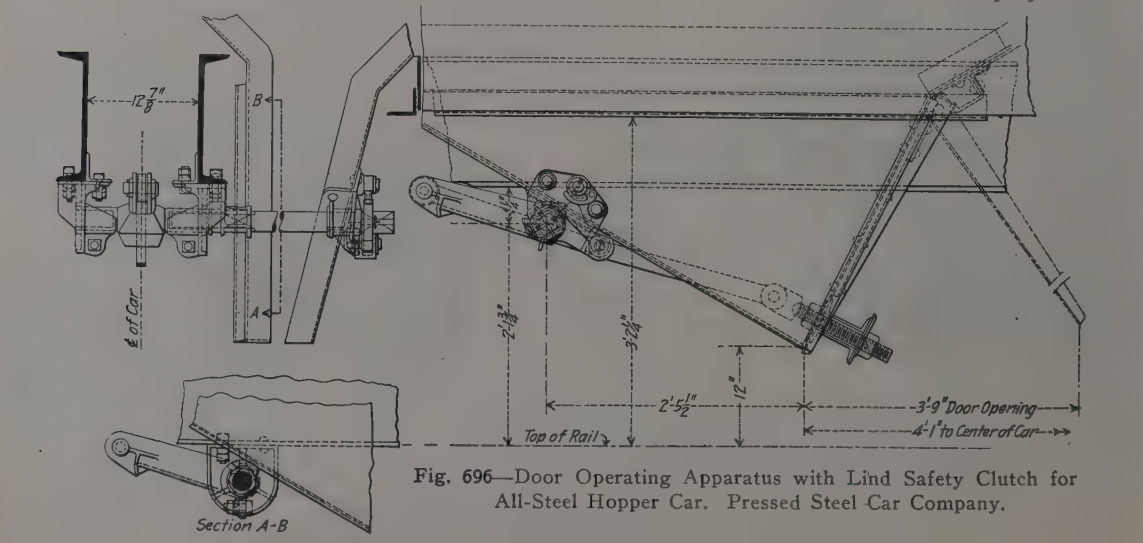


Fig. 696—Door Operating Apparatus with Lind Safety Clutch for All-Steel Hopper Car. Pressed Steel Car Company.

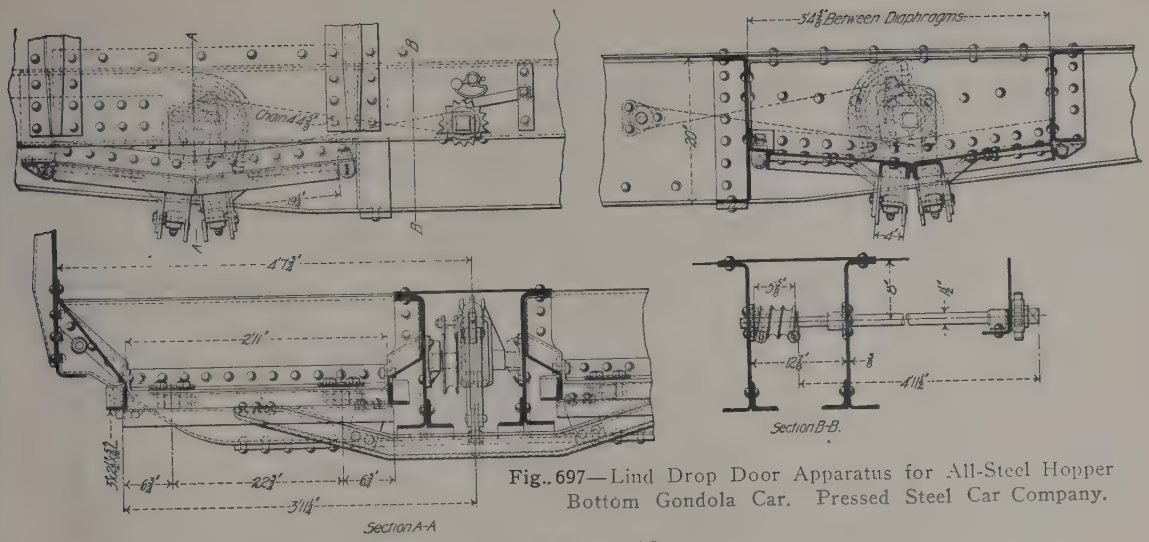


Fig. 697—Lind Drop Door Apparatus for All-Steel Hopper Bottom Gondola Car. Pressed Steel Car Company.

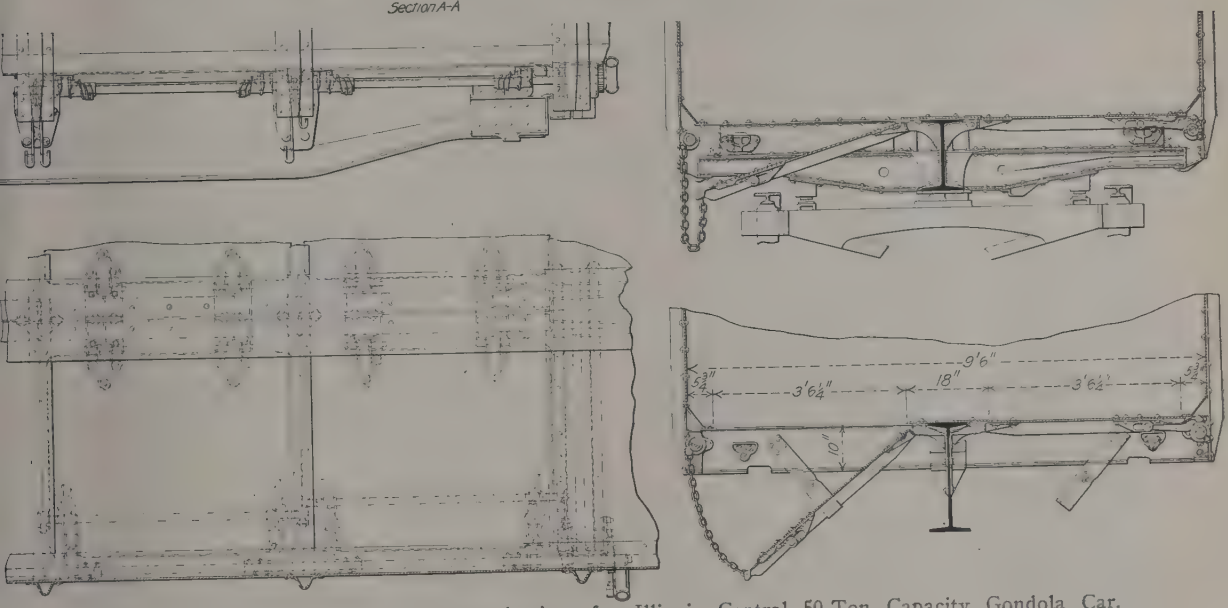


Fig. 698—Bettendorf Drop Door Mechanism for Illinois Central 50-Ton Capacity Gondola Car. The Bettendorf Company.

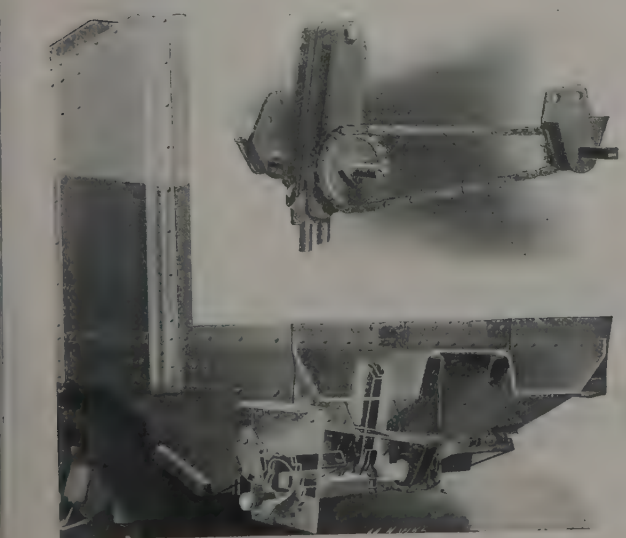


Fig. 699—Dunham Hopper Door Device Applied to All-Steel Hopper Gondola Car. National Railway

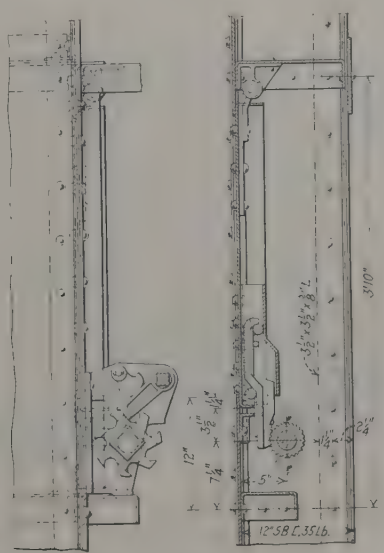


Fig. 700—Drop-Hook Operating Arrangement. Standard Steel Car Company.

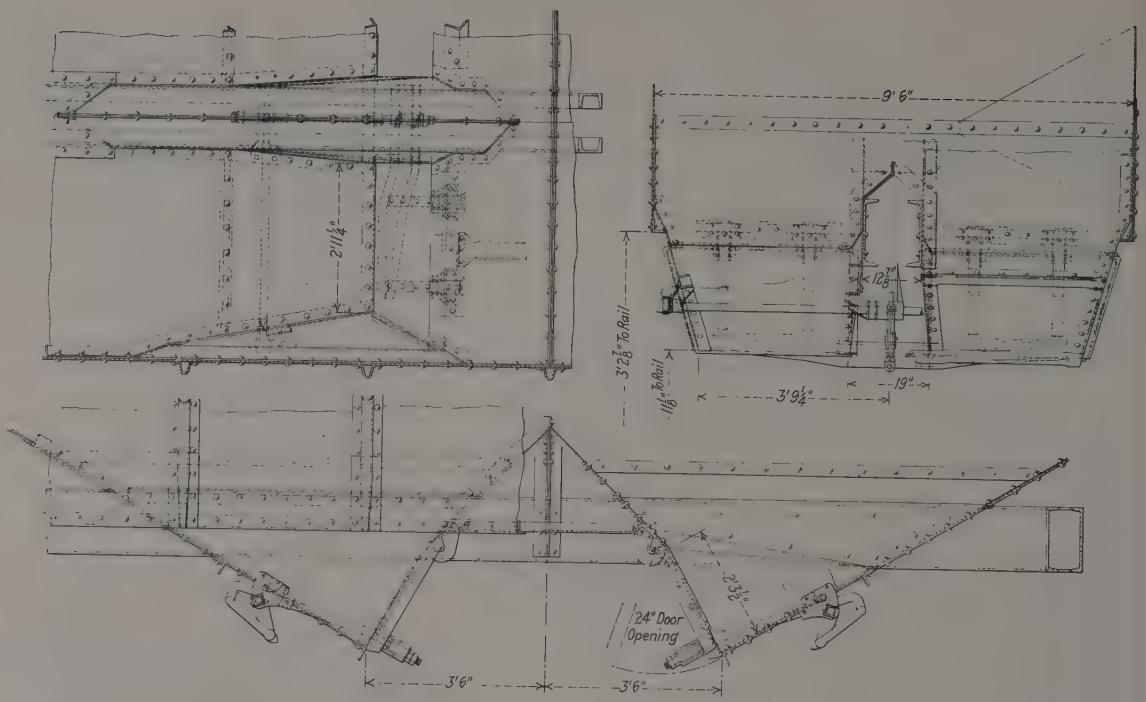


Fig. 701—Simonton Hopper Door Rigging. Standard Steel Car Company.

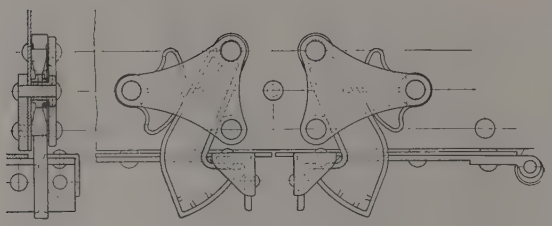


Fig. 702—Wine Door Lock Applied to Flat Bottom Hopper. The Wine Railway Appliance Company.

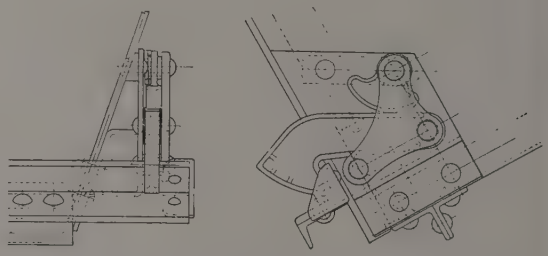


Fig. 703—Wine Door Lock Applied to Twin Hoppers. The Wine Railway Appliance Company.

Fig. 704—Application of Wine Door Lock to Quadruple Hopper Car. The Wine Railway Appliance Company.

(*See also Page* 415.)

Wine Hopper and Side Drop Door Locks

The various ordinary locking and opening appliances for drop doors and hopper doors are more or less intricate, heavy and dangerous to operate. The numerous gears, ratchets, pawls, shafts and chains of the older types are expensive and add considerably to the dead weight of a car. Using a long wrench to force the old style devices open, a procedure often requiring considerable time, is a constant source of danger to the operator.

lightness weight savings of from 500 to 1200 pounds per car are possible. Its low cost and weight make it a very practical device to install on old cars undergoing repair as the application is inexpensive and is easily made. In fact the value of the scrap material of the old style lock often is sufficient to pay the cost of installing the Wine Drop Door Lock.

The use of the Wine Lock on drop bottom cars is increasing daily; a number of roads have adopted this lock as their standard in order to obtain the lowest possible initial costs and maintenance coupled with the highest possible revenue tonnage capacity per locomotive.

Fig. 705—Application of Wine Hopper Door Lock

The Wine Drop Door Lock as shown in Fig. 706 and Fig. 707 is a simple latch and pawl arrangement which engages the end of an angle attached to the bottom of the drop door of the car. A small hammer is the only implement required for its release and it may be positively locked by simply turning the small pawl binding the latch. When latched the weight of the load tends to tighten its grip so that there is no possible way of its dropping while in transit.

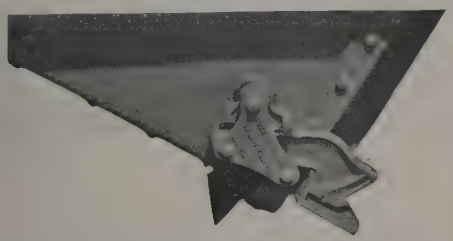


Fig. 706—Wine Hopper Door Lock

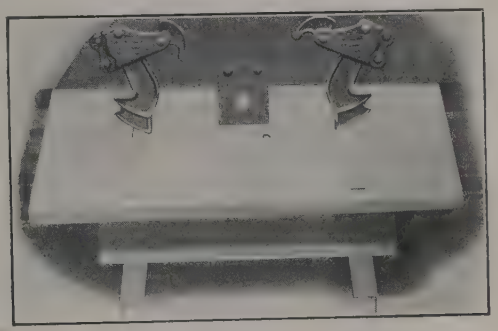


Fig. 707—Wine Side Drop Door Lock

The estimated saving in operation expense due to the reduction of from 1 to 3 per cent in the dead weight of an individual car will vary under local conditions, but the saving in expense of hauling per thousand cars will amount to a considerable sum.

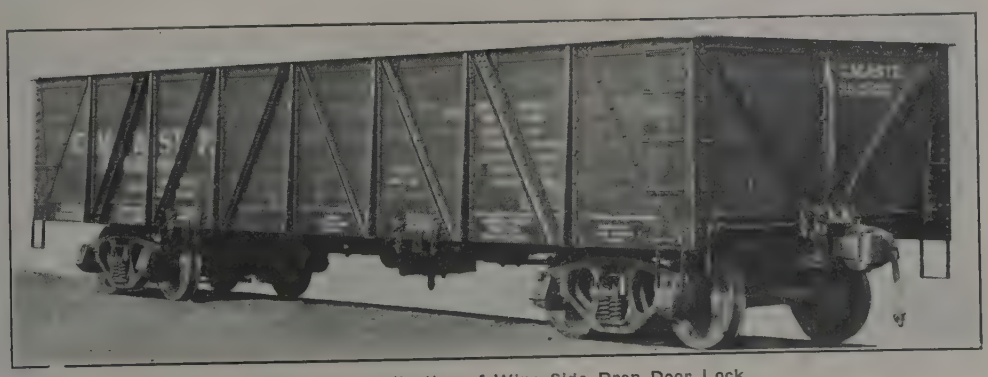


Fig. 708—Application of Wine Side Drop Door Lock

Due to its simplicity its first cost is small and the maintenance cost is negligible. Due to its

For other products and branch offices, see classified and alphabetical indexes.

THE WINE RAILWAY APPLIANCE COMPANY, TOLEDO, OHIO

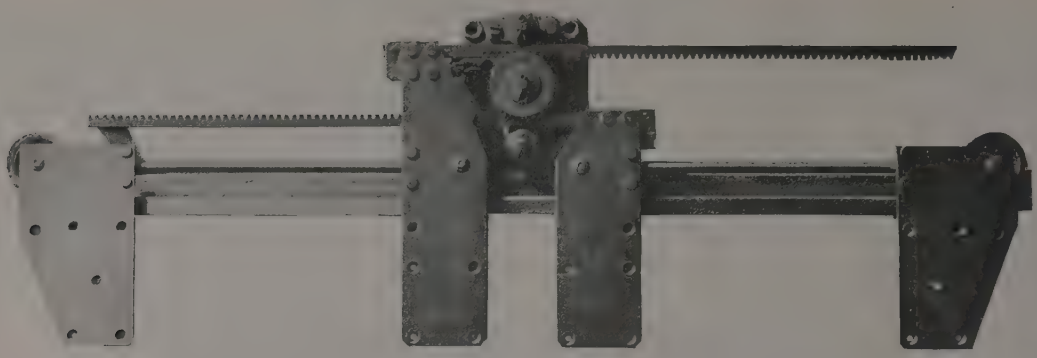


Fig. 709—Double Sliding Door Fixture. James L. Howard & Company.

Fig. 710—Baggage Car Sliding Door Hanger. James L. Howard & Company.

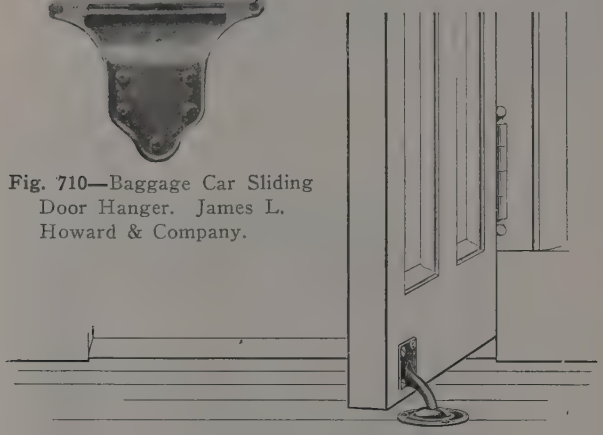


Fig. 711—Sherburne Car Door Holder. Sherburne & Company.

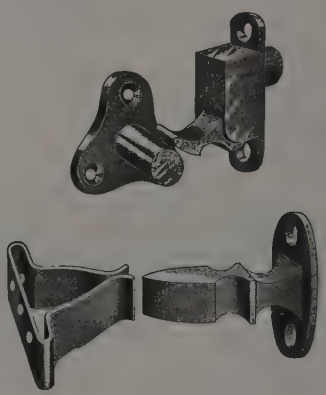


Fig. 712—Door Holders. Adams & Westlake Company.

Fig. 713—Hollow Steel Baggage Car Door. Lawton-Stephens Company, Inc.

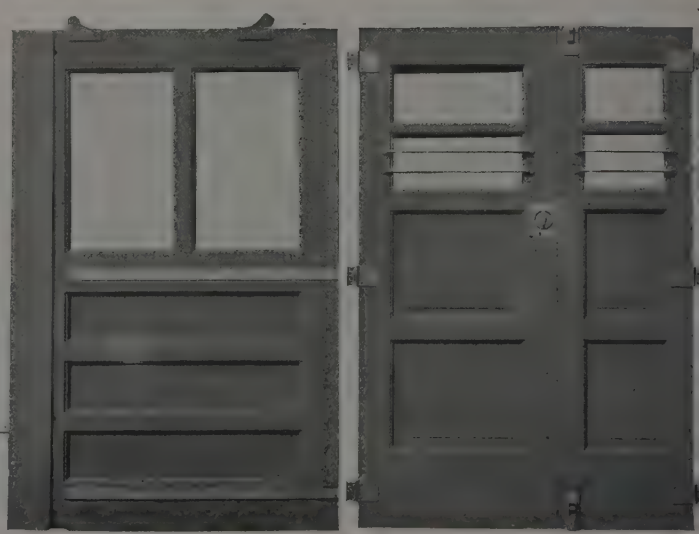


Fig. 714—Hollow Steel Doors for Steel Subway Cars. Lawton-Stephens Company, Inc.

Sliding Doors. End Door.

Fig. 715—Steel Doors for Hudson & Manhattan Tunnel Cars.
Hale & Kilburn Corporation.

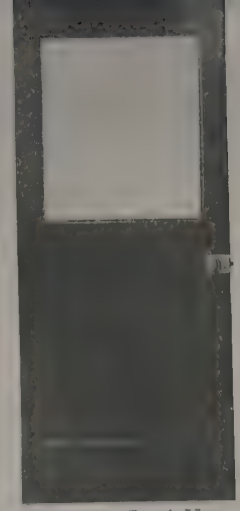


Fig. 716—Steel Vestibule Side Door, with Panel.

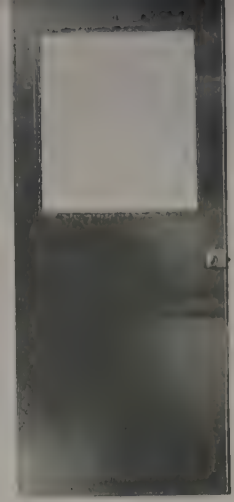


Fig. 717—Steel Vestibule Door without Panel.

Morton Manufacturing Company.

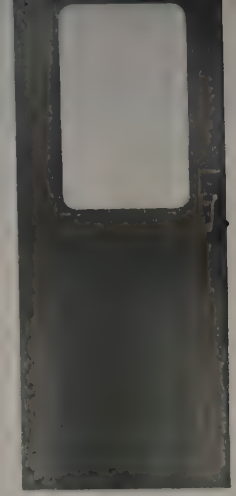


Fig. 718—Steel Body End Panel Door with Round Corners and Glass Beading.

Inside.

Outside.

Fig. 719—Steel Vestibule, End and Saloon Doors for Pennsylvania Railroad Steel Coaches.
Hale & Kilburn Corporation.

Fig. 720—Steel End Door for Steel Coaches.
Hale & Kilburn Corporation.

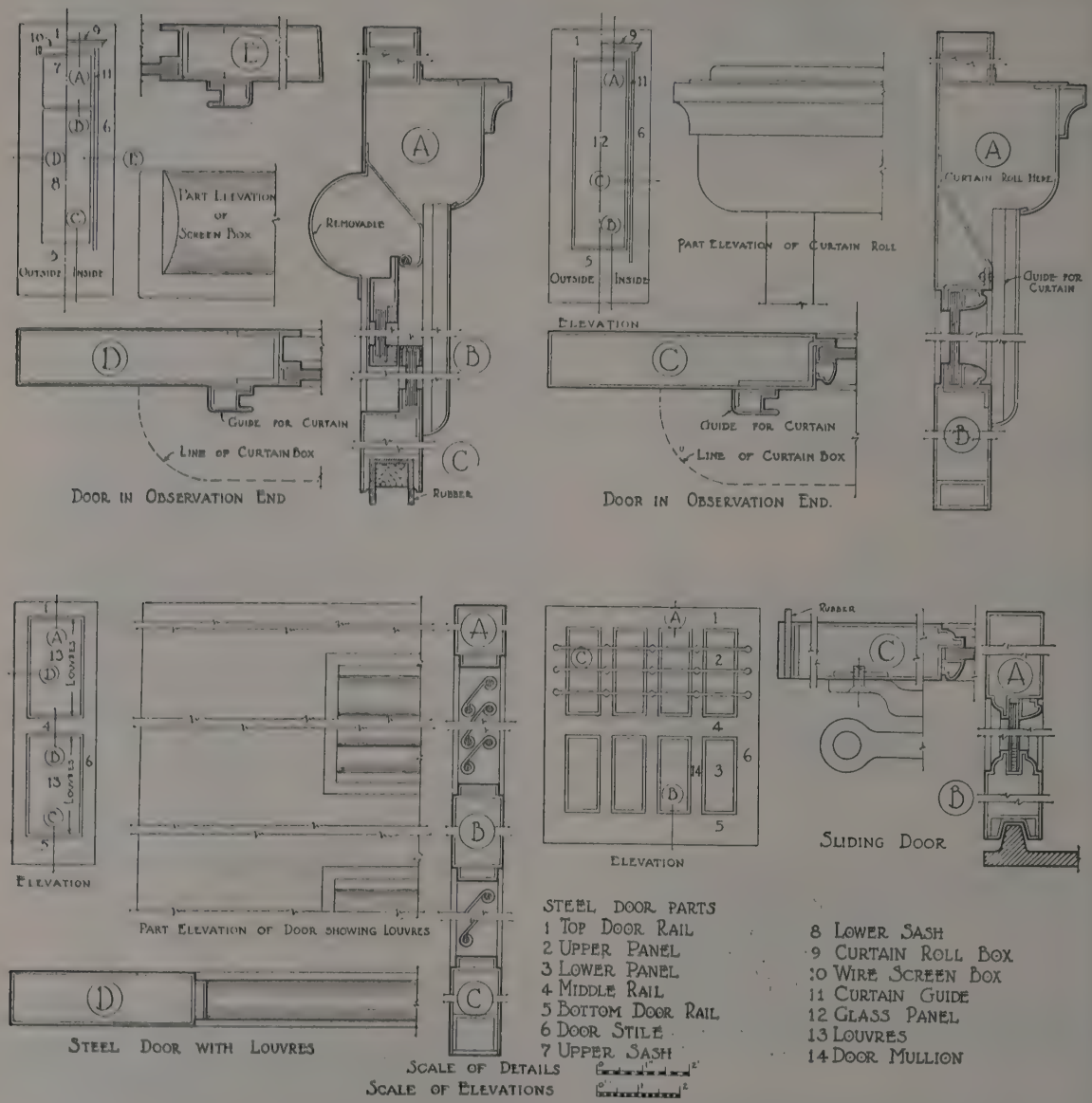


Fig. 721—Steel Doors and Parts for Passenger Train Cars. Dahlstrom Metallic Door Company.

(*See also Page* 419)

Fig. 722—All-Steel Pullman Car Equipped with Dahlstrom Interior Finish, Vestibule, and End Doors.

Dahlstrom Hollow Metal Doors

The strength, durability and fireproof qualities of steel have led to its practically exclusive use in the construction of passenger train cars. The problems of adapting this material to car construction included as one of its phases in which there had been but little preceding experiment, the development of a vestibule end door which would be satisfactory in weight, decorative finish, appearance, and the application of mirrors, sashes and other attachments.

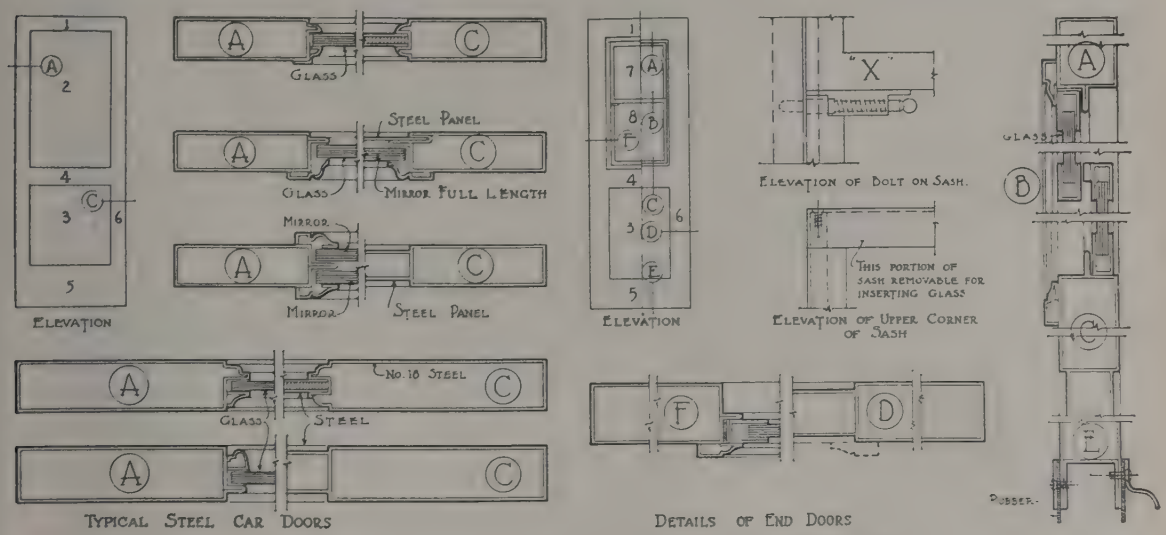


Fig. 723—Sections Showing Dahlstrom Sash and Door Arrangements

When the earliest attempts were being made to build a practical all-steel passenger train car, it was considered that a door made entirely of steel would be too heavy and the effects of temperature changes also would be undesirable. However, the engineers of the Dahlstrom Metallic Door Company studied the cars and their requirements; plans were finally completed and fabrication started.

The first car equipped was the all-steel Pullman car "Jamestown," which was also the first absolutely all-steel car ever built. This car was placed on exhibition at the Jamestown Exposition in 1907.

The present Dahlstrom Hollow Metal Door is designed and constructed to use anywhere and under any conditions where a metal door is desired. It is made from No. 18 gage sheet steel, drawn and pressed to the required shape and size. It can be constructed in a wide variety of styles of paneling and may have a plain glass window, or different mirror arrangements. Provisions are also made for the secure mounting of locks, hinges, sashes, and other fittings.

The construction of the Dahlstrom Door assures rigidity, yet combines with it the requisite lightness and ease of operation; all joints between stiles and rails are autogenously welded and thus all parts are tied together into one homogeneous whole. No opening of joints and unsightly crevices are possible as often found in wood doors. The doors, being all steel, can be finished in any one of a variety of baked-on enamels, or grained to match any desired natural wood finish. Thus these doors are not subject to climatic changes either as to distortion of the door itself or with reference to the finish. The interior of the car may be extremely hot and the vestibule very cold, yet the door is not affected. No allowances need be made for extremes of hot and cold weather nor for varying degrees of humidity.

The cost for repairs will be found to be surprisingly low. Some of these doors have been in service for 16 years and during this period have required but little attention to maintain easy operation or preserve the finish.

The utility is not limited to the vestibule end

Fig. 724—Dahlstrom Hollow Metal Vestibule Door

doors of Pullman cars, as Dahlstrom Steel Doors are suitable for compartment, drawing room, and lavatory entrances. In the construction of day coaches, diners, buffet, baggage and mail cars they are a decided improvement on wooden doors.

For other products and branch offices, see classified and alphabetical indexes.

DAHLSTROM METALLIC DOOR COMPANY, JAMESTOWN, N. Y.

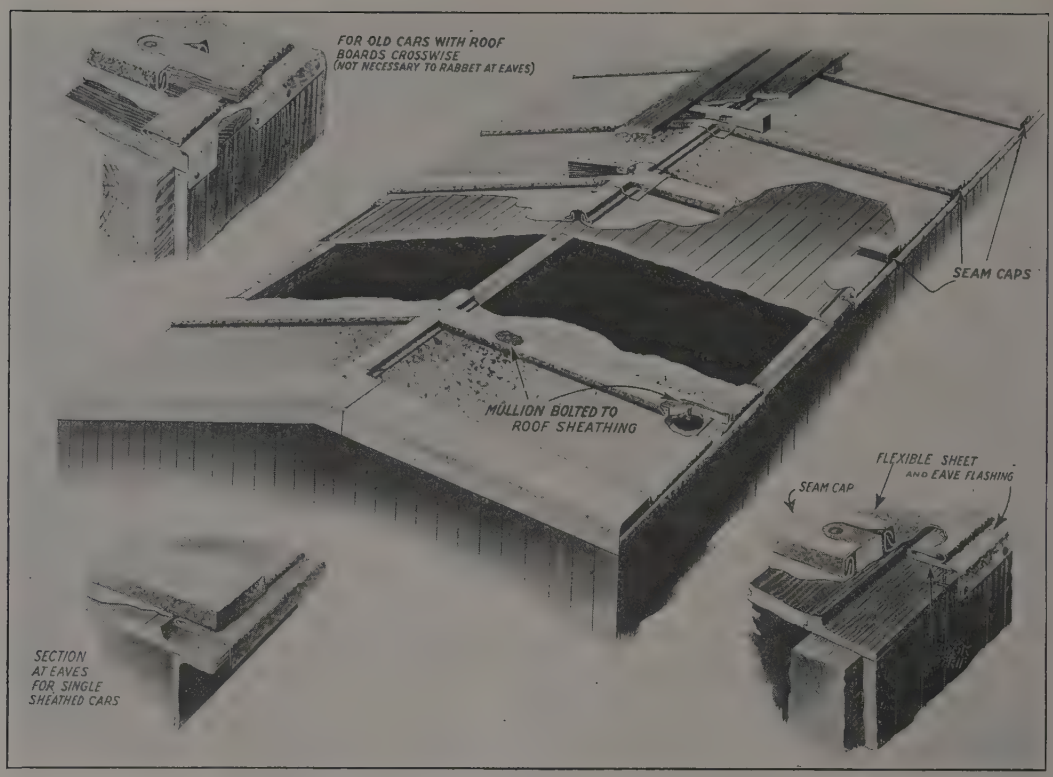

FOR OLD CARS WITH ROOF BOARDS CROSSWISE (NOT NECESSARY TO RABBET AT EAVES)
SEAM CAPS
MULLION BOLTED TO ROOF SHEATHING
FLEXIBLE SHEET AND EAVE FLASHING
SEAM CAP
SECTION AT EAVES FOR SINGLE SHEATHED CARS

Fig. 725—National Flexible Outside Metal Roof for Box Cars.

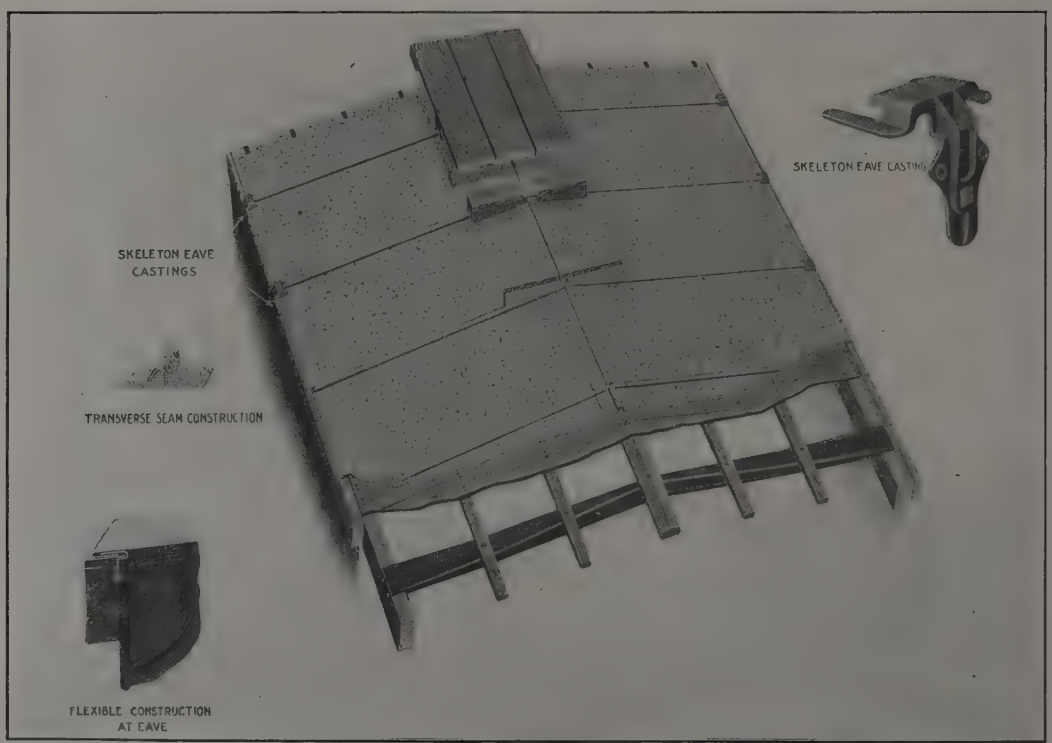


Fig. 726—Chicago Flexible Outside Metal Roof No. 20-A-1 for Box Cars.

Chicago-Cleveland Car Roofing Company.

(*See also Page* 421.)

Inside, Outside and All Steel Metal Roofs

A considerable proportion of freight claims arise from damage caused by leaking of car roofs. The Chicago-Cleveland Car Roofing Company has for years specialized in the manufacture of roofs for freight cars and has solved the problem of producing weatherproof roofs sufficiently flexible to withstand train operation.

The Chicago Improved Winslow Inside Metal Roof, type B, is a double roof consisting of a corrugated sheet metal roof on pressed steel carlines and wooden purlines, covered by a plain wooden roof resting on wooden subcarlines and outside purlines. The combination will last as long as the car, and remain tight during its life. None of the roof sheets are subject to strain, and there is no point where chafing of the galvanizing takes place. The metal roof serves only to shed water, and keep the contents of the car dry.

CHICAGO ROOF LOCKS
SHEET TURNED DOWN OVER INSIDE FACIA.
SUB CARLINE CAP FOLDED OVER END.
OUTSIDE PURLINE AND SUB CARLINE BOLTED THRU SIDE PLATE.
CHICAGO CORRUGATED PRESSED STEEL CARLINE.

Fig. 727—Type B Chicago Improved Winslow Inside Roof

The Improved Superior Flexible Outside Metal Roof—see Fig. 728—is a recent improvement in design. It is thoroughly flexible at the eaves, and also at the ridge where the construction is flattened, to obtain strength and solidity, without interfering with flexibility of the main sheets. The seam caps are closed at ends by seam cap castings which hold down the roof sheets at eaves and so designed as to allow free movement of roof sheets.

The National Flexible Outside Metal Roof is absolutely waterproof and at the same time is sufficiently flexible to absorb strains caused by the twisting motion of the car. The sheets are held at the eaves by hooks which engage the eaves strip, and prevents them from rising. At the sides an extremely flexible joint, in connection with the mullion caps, gives free play to each sheet. A shoulder at the ridge end of the sheet engages a shoulder of the ridge cap and permits free play at this point.

The Chicago Flexible Outside Metal Roof No. 20-A-1—see Fig. 726—has been in service for many years on all types of box cars. This roof has an efficient form of lock seam and weather proof ridge construction, and is flexible at the eaves. The hook strip with which the roof sheets engage is placed behind the fascia and thus eliminates danger of damage to the roof sheets in case of side rakes. The skeleton eave casting prevents accumulations of cinders with their accompanying corrosive action.

The Chicago Commonsense All-Steel Carline Roof No. 100-A—see Fig. 729—has been designed not only to keep the contents of the car dry, but also to be so substantial that it will perform the same functions for the top of the car that the steel underframe does for the bottom. This roof is built on steel carlines and purlines with No. 16 U. S. gauge roof sheets which extend the full width of the car and have no joint or seam at the ridge. The running board is supported by saddle angles on the top of the center of each carline. Important features of this construction include firm braces for the sides of the car, maximum headroom inside of the car; maximum eave clearance; and great strength with a low dead weight and low maintenance cost.

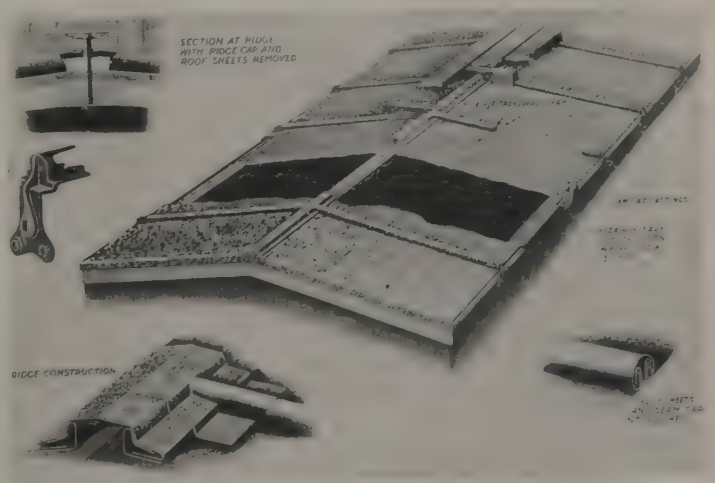


Fig. 728—Improved Superior Flexible Outside Metal Roof

For other products and branch offices, see classified and alphabetical indexes.

CHICAGO-CLEVELAND CAR ROOFING CO., CHICAGO, ILL.

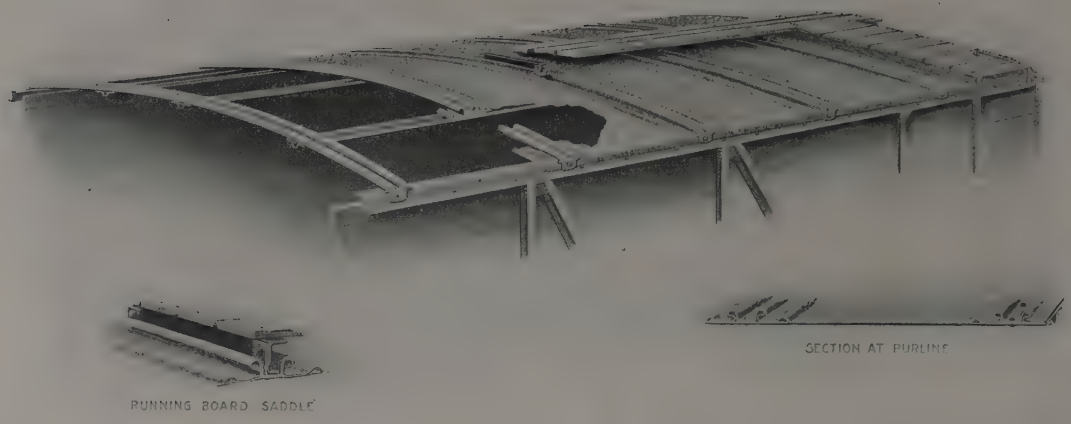


Fig. 729—Chicago Common-Sense, All-Steel Steel Carline Roof No. 100-A

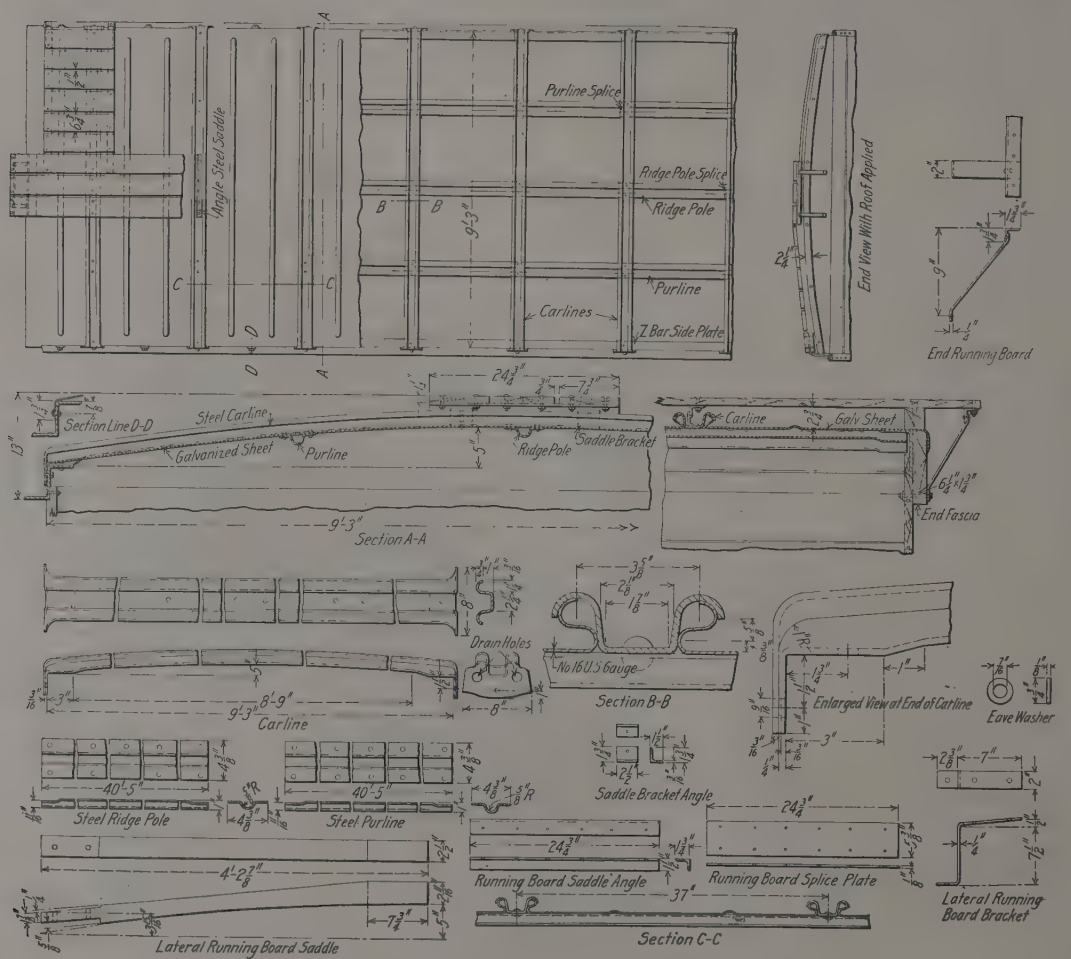


Fig. 730—Chicago Common-Sense All-Steel Steel Carline Roof No. 100

Chicago-Cleveland Car Roofing Company.

(*See also Page* 421.)

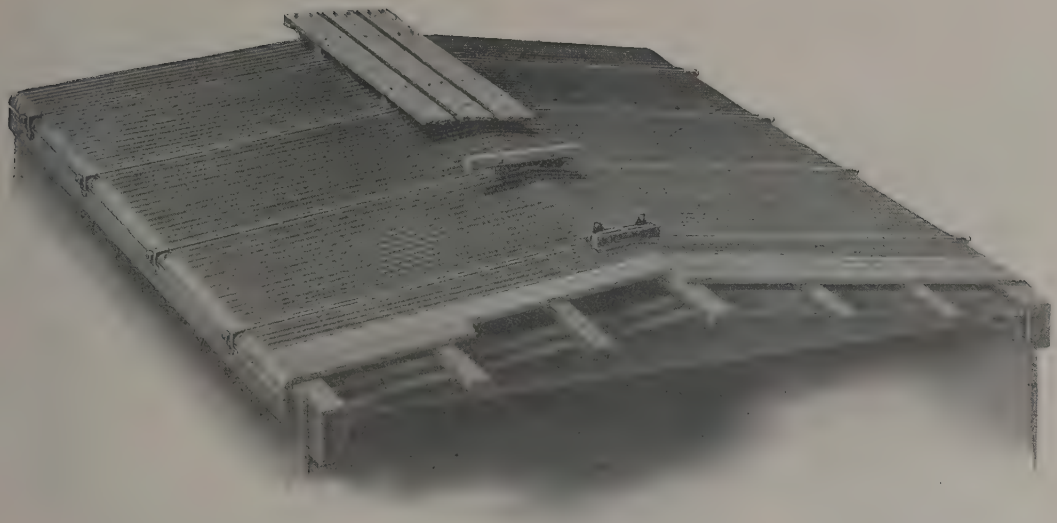


Fig. 731—Ureco Type "A" Flexible Outside Metal Car Roof. Union Railway Equipment Company.

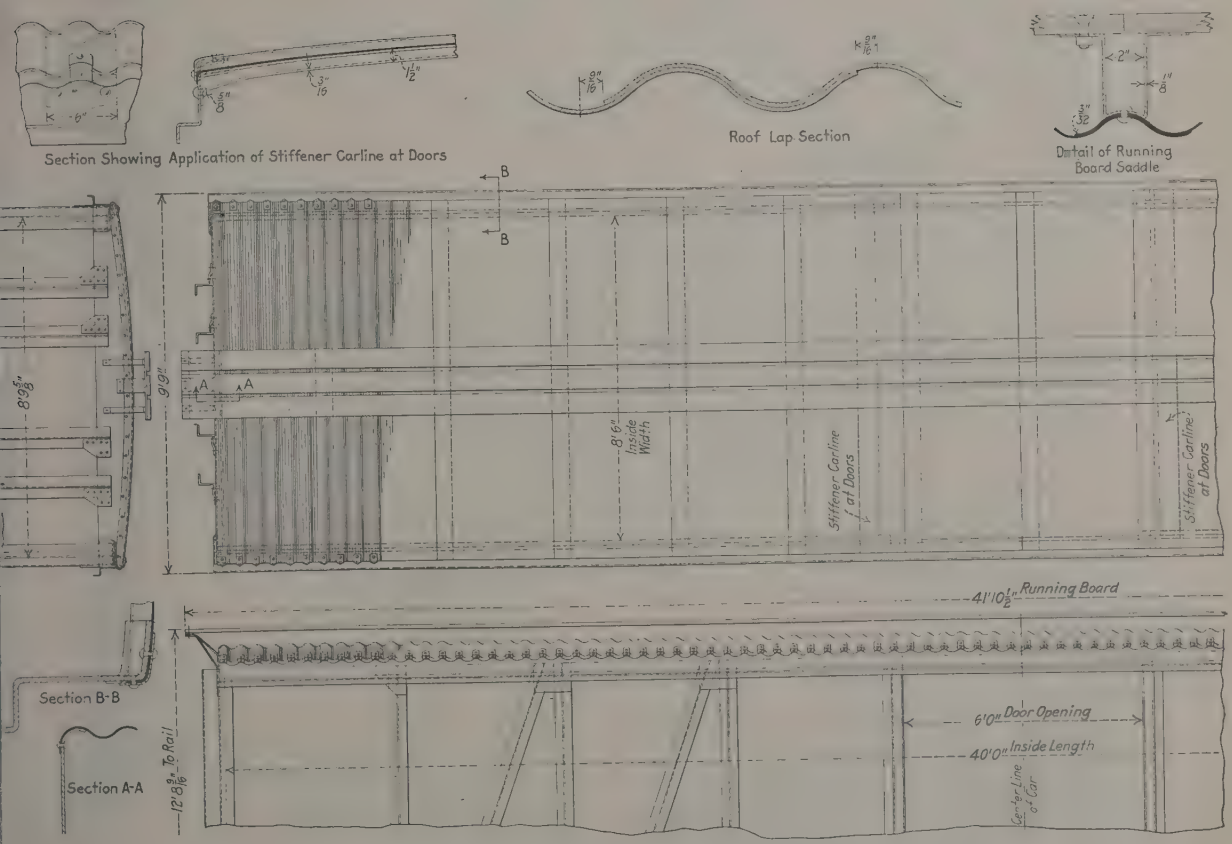


Fig. 732—General Arrangement and Sections of the Sharon Pressed Steel Car Roof. Sharon Pressed Steel Car Company.

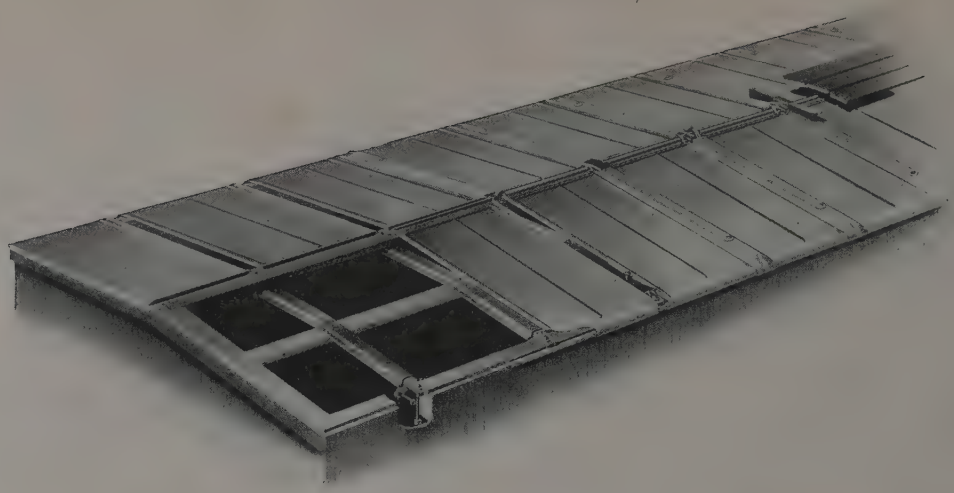


Fig. 733—Hutchins All-Steel Roof Applied to Wooden Car.

Fig. 734—Section Through Ridge Pole.

Fig. 735—Section Through Side Plate as Used in Replacing Inside and Outside Metal Roof.

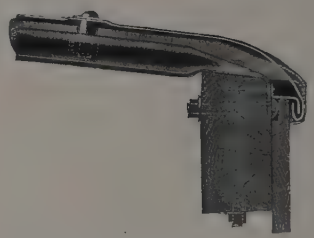


Fig. 736—Section Through Side Plate as Used on Cars with Wooden Frame.

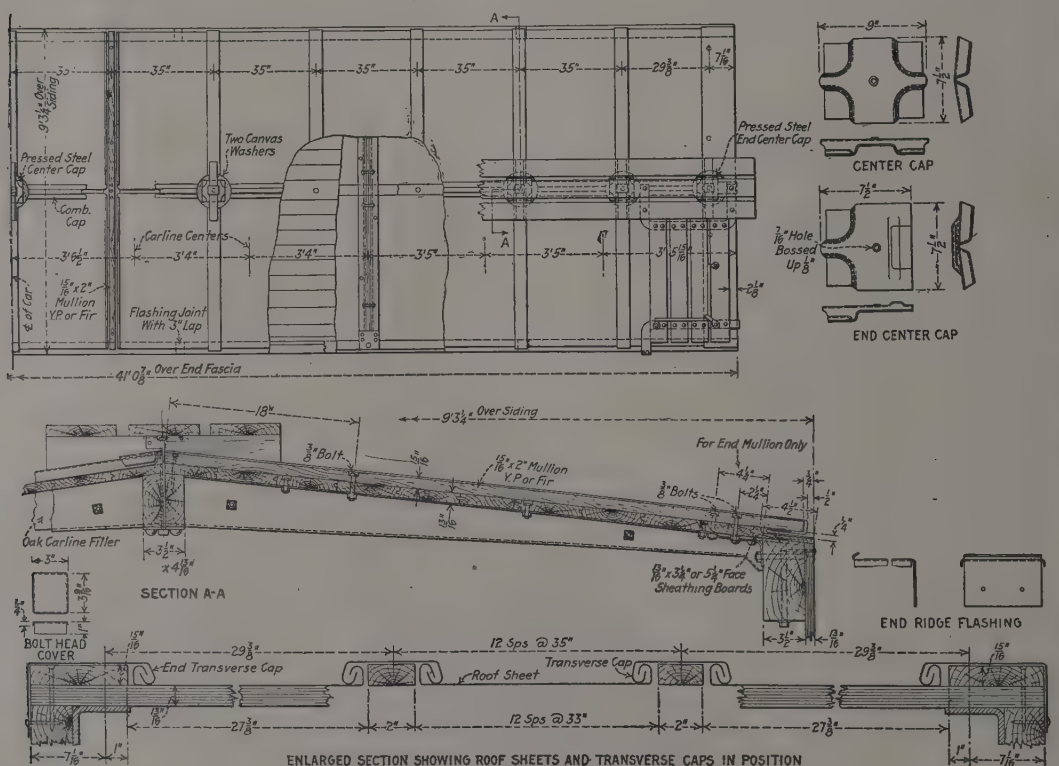


Fig. 737—Hutchins Outside Metal Roof for 40 and 50 Ton U. S. R. A. Double-sheathed Box Cars.

Hutchins Car Roofing Company

(*See also Page* 425.)

Hutchins All-Steel Flexible Roof

This roof has been applied to more than 100,000 freight cars operating on numerous representative American and Canadian Railroads. These installations have been made on old as well as on new equipment.

The All-Steel Flexible Roof for box cars is so named because the weather-proofing and load carrying material are of steel, in one thickness, and the sheets are entirely free of rigid fastening to the frame work of the car, so that when in motion the car frame will not injure the weather-proofing steel. A thick layer of galvanized steel roofing sheets supports the roof loads and turns the weather. These sheets are 1/16 in. thick, yet the total weight is less than the combined weight of ordinary roofing boards and weather-proofing sheets.

Fig. 738—General Appearance of a Hutchins Flexible All-Steel Roof

The sheets are not fastened rigidly to any part of the car framing. This feature of the All-Steel Flexible Roof prevents any stress from being set-up in the weather-proof steel, therefore weaving of the frame cannot tear the sheets, and they are protected from excessive wear on the underside by being supported upon wooden purlines, ridge pole, and side plate. For cars having steel side plates, a wooden strip is placed on top of the side plate to support the roof sheets. To prevent rusting, all parts of the roofing material are made of galvanized steel.

The roof is easily and quickly applied and expert workmen are not required. The eaves strips are fastened into place first; the sheets are hooked into these strips and dropped into place, after which the joint caps are put on, placing the threaded end of the shoulder bolt through the carline, and applying lock and nut underneath. The ridge caps are dropped into position and the running board saddles are put on with the bolt passing through saddle, ridge pole and carline.

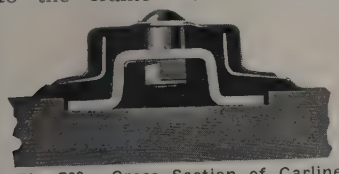


Fig. 739— Cross Section of Carline

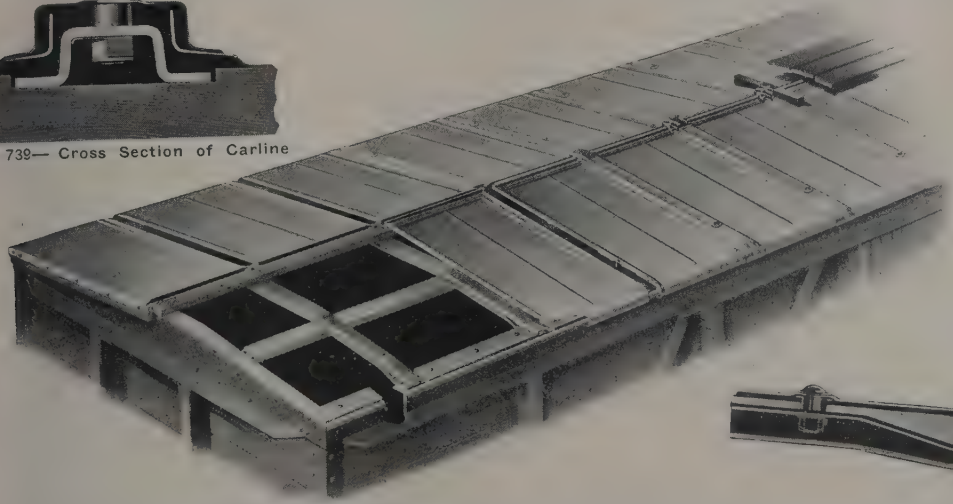


Fig. 740—Illustration Showing Progressively the Roof Complete, then Successively Omitted the Run Board, Saddles and Roof Plate. Note Contact of Shoulder Bolt with the Carline, and the Bearing of the Carline on the Side Plate

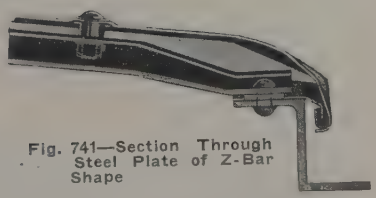


Fig. 741—Section Through Steel Plate of Z-Bar Shape

The "U" shape of the carline, the up-turned flanges of the roof sheets and the carline cap are shown in Fig. 739. The shoulder bolt is in one piece, and is furnished riveted to the carline cap. The method of fastening the end of the carline to

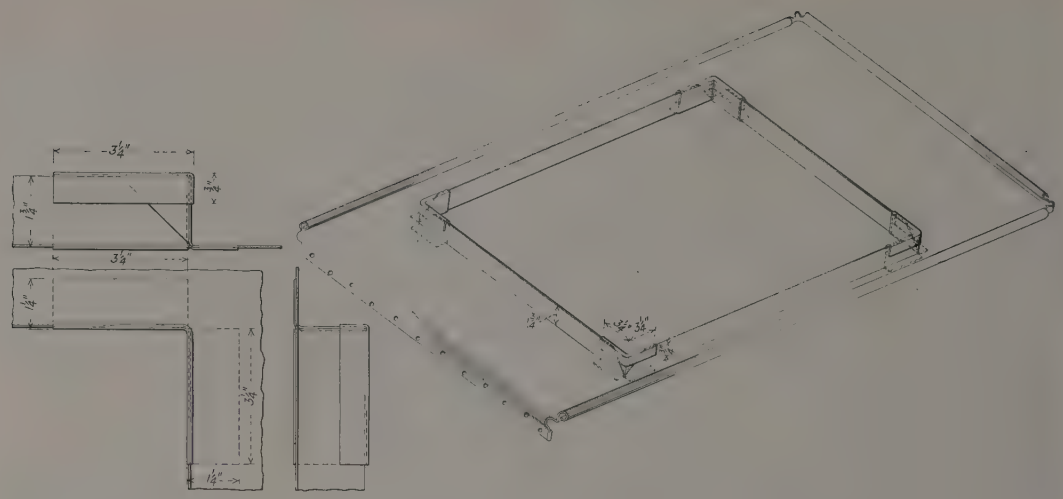


Fig. 742—Hatch Sheet used on Refrigerator Cars with Hutchins "D" Type Outside Metal Roof—Fig. 743 and 744—or Hutchins Outside Metal Roof.

Parts of Hutchins Type D Roof.

- A *Lock Roll Joint*
- B *Torsion Eave Bead*
- C *Galvanized Roofing Sheets*
- E *Galvanized Joint Eave Filler Piece*
- F *Galvanized Center Hood*
- G *Galvanized Saddle Cover*

Fig. 743—Hutchins Type D Outside Metal Roof.

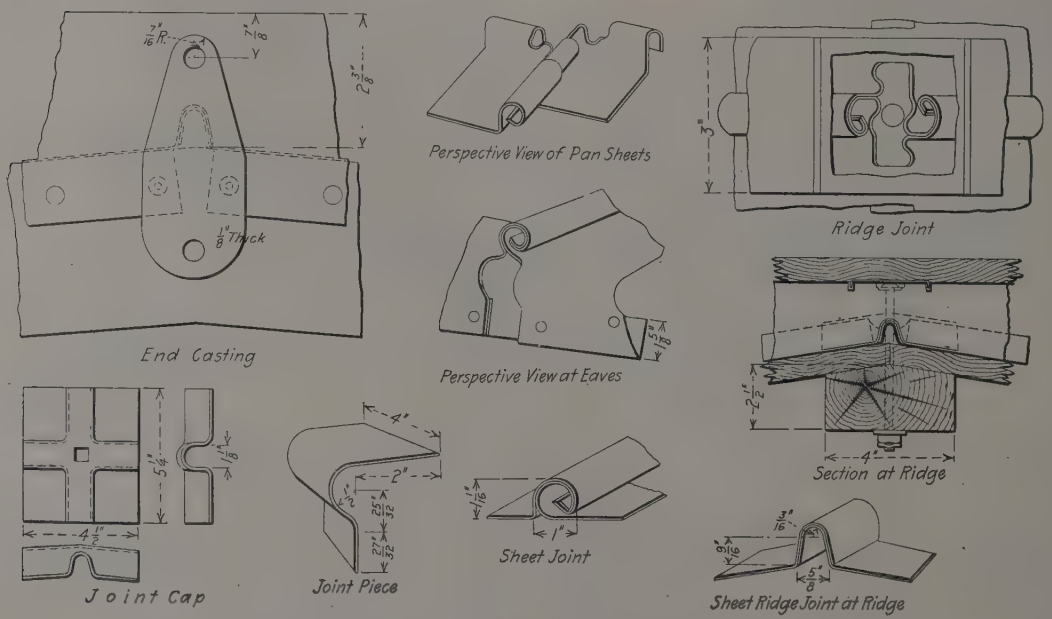


Fig. 744—Details of Hutchins Type D Outside Metal Roof.

Hutchins Car Roofing Company.

(*See also Fig. 743 and Page 427.*)

Hutchins All-Steel Flexible Roof *(Cont'd)*

a metal side plate, the arrangement of the flashing, the manner in which the roofing sheets hook under the flashing, and the shape of the lower end of the carline cap are illustrated in Fig. 741. This shows clearly how simple a process it is to hook the roofing sheets under the flashing and drop them into place.

The arrangement of the carlines on top of the side plates with an upward slope to the top of the purlines, making the section between purlines straight so that the ridge pole is on top of the carlines, is most substantial for a minimum weight of material. The carlines are arched enough to carry the roof loads and at the same time are not so far from being straight as to weaken them in their function of tying the side plates together.

The long life of a Hutchins Roof follows naturally the type of construction. Though the roofing sheets are not fastened rigidly to any part of the framing, they are restrained from sliding off at the eaves by the engagement with the eaves flashing, the turn-down of the carline cap and the engagement at the ridge with the ridge caps. They cannot be blown off because of the over projection of the carline caps from eaves to ridge and the ridge cap and joint caps. Each sheet is held down by four bolts, the two carline cap bolts in adjacent carlines and the two joint cap bolts through saddles, ridge pole, and carlines. Therefore no stress can be set up in the roof sheets to tear them. Hutchins roofs have been known to outlive the service of cars on which they were originally placed.

The clamping effect of the carline caps restrains the sheets from movement lengthwise of the car. In the extreme positions they are absolutely stopped by the carlines.

The fire proof quality of a Hutchins Roof is a valuable feature of the all-metal construction. If warped from excessive heat, the sheets, caps and carlines can be straightened and used again. Although the roofing plates are thick enough to retain their shape under very severe exposure to heat, cases are on record in which cars equipped with Hutchins Roofs have been entirely destroyed by fire, except the roof, which was used again.

The weather-proof character has been thoroughly demonstrated by the fact that in 1920 many of these roofs had been in satisfactory service for ten years in general interchange service throughout the United States, Canada and Mexico.

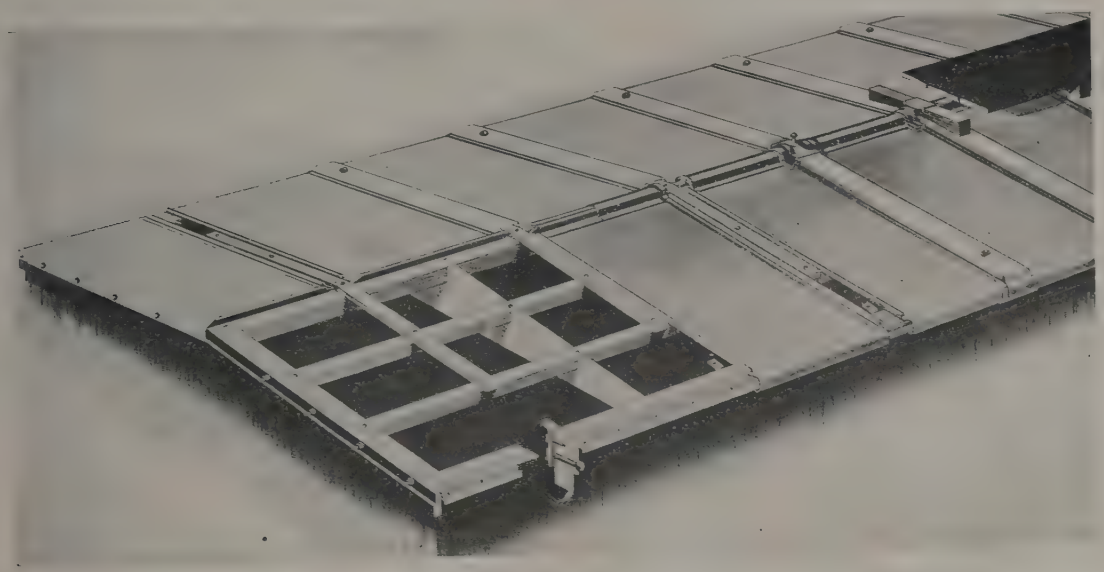


Fig. 745—Hutchins All-Steel Roof to Replace Inside and Outside Metal Roof

Burglar proof construction is accomplished by placing all of the fastenings on the inside. To enter the car through the roof requires the use of such substantial tools as are necessary to cut through steel 1/16 in. thick. As a further precaution, the bolts and rivets are placed in such a manner that no part of the roof can be removed and replaced from the outside without leaving positive evidence of tampering.

The dead weight is low; the weight of a square foot of steel plate 1/16 in. thick is less than the weight of a square foot of 13/16 in. board plus the weight of steel weather-proofing sheets. The use of this roof reduces the total weight of the car 500 to 700 lb.

Maximum cubic capacity is obtained by allowing no part of the roof structure to project below the top of the side plates.

The outside height is low. At the eaves and for some distance up therefrom, the carlines telescope into the carline caps, making the depth of space required for the roof a minimum. This depth is about 2½ in. at the side plates so that the outside height at eaves is less than 2½ in. above the top of side plate.

For other products and branch offices, see classified and alphabetical indexes.

HUTCHINS CAR ROOFING COMPANY, DETROIT, MICH.

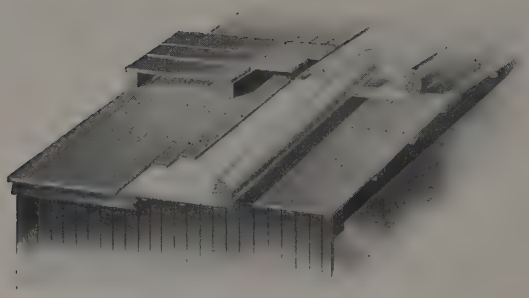


Fig. 746—Hutchins Plastic Car Roof.

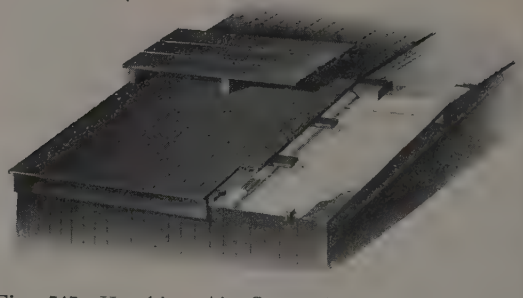


Fig. 747—Hutchins Air Space Sectional Plastic Car Roof.

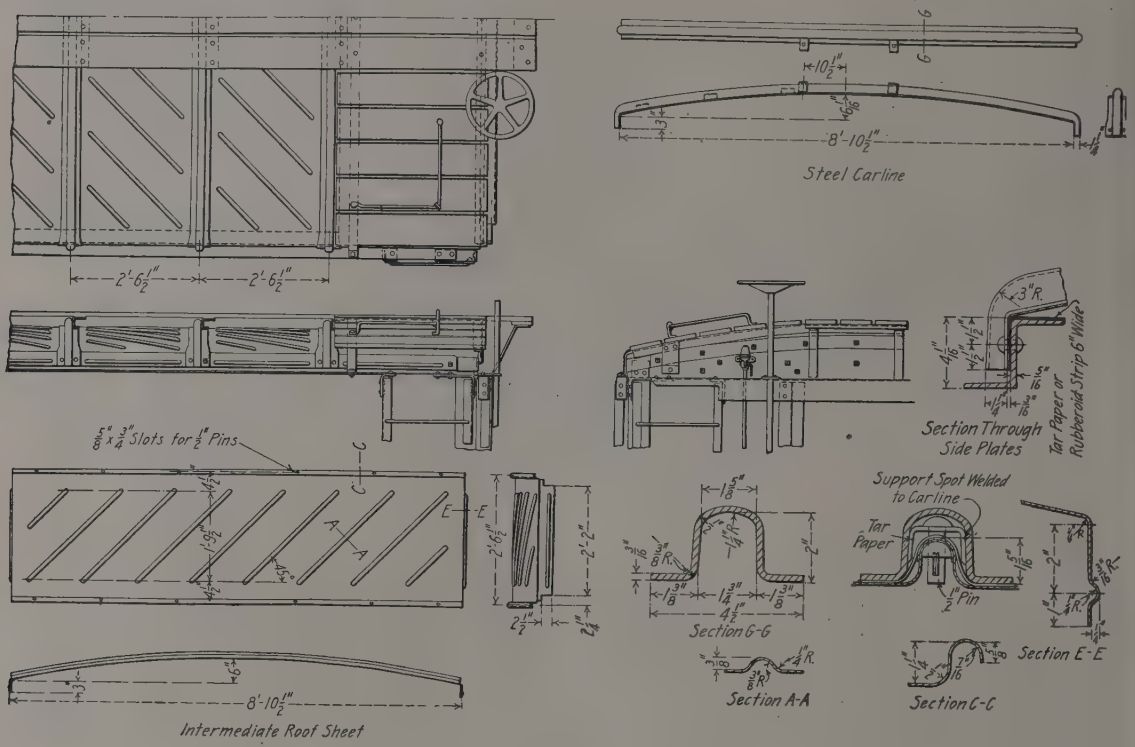


Fig. 748—Hutchins Camber All-Steel Roof.
(See also Page 429.)

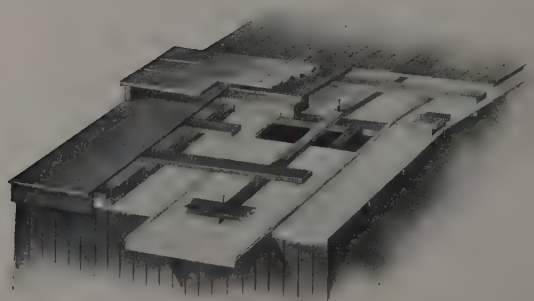


Fig. 749—Hutchins All-Metal Inside Roof.

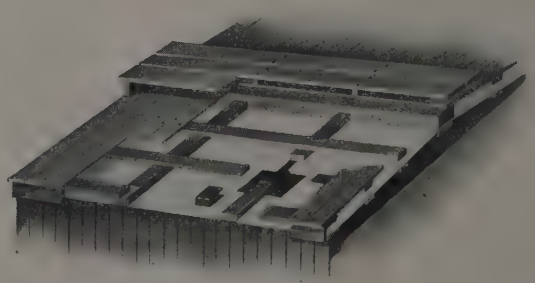


Fig. 750—Hutchins Sectional Metal Inside Roof.

Hutchins All-Steel Flexible Roof *(Cont'd)*

The car frame is strengthened; since the weight suspended at the top of side and end body framing is comparatively small, there is less racking of such framing by this roof. The result is the same as reinforcing the side and end body framing and the superstructure of the car is held together rigidly and firmly by the carlines, purlines and ridge pole.

A low center of gravity results from the low total weight of the roof and the amount of material necessary in the side and end body framing.

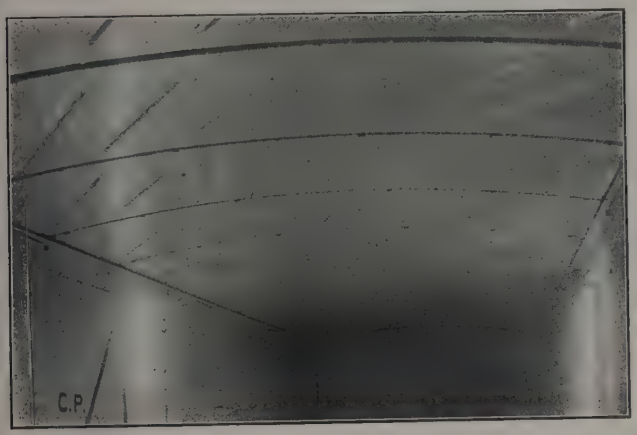


Fig. 751—Interior of Car Equipped with Hutchins Camber All-Steel Roof. Hutchins Car Roofing Company

This is a very desirable feature.

A reduction of damage claims results from the thorough protection afforded the lading. A roof which needs repairs frequently, exposes the lading to weather damage just as frequently and for a considerable period, each time repairing is necessary. The All-Steel Flexible remains weatherproof so long that damage claims are very materially reduced in number when it is used, and the name—"the Dry Lading roof"—by which it is known, is justified.

The ventilation provided by the type of construction embodied in Hutchins Roofs is very important with certain classes of lading as, for example, flour. The circulation of air which these roofs promote, tends to prevent "sweating." In some instances millers have even specified that they be furnished with cars equipped with Hutchins Roofs. Tin plate shipments constitute another class of lading which must be handled with great care. Hutchins Roofs are readily acceptable by this group of shippers.

Ease of inspection, in the case of Hutchins car roofs, prevents many delays and removes the cause of many claims for damages. The roof, consisting as it does, of a single ply allows the immediate and sure detection of roof leaks.

The possible labor saving is important. The cost of the first application of the roof to new or old cars is relatively low and because there are no repairs due to fair wear and tear until the remainder of the car is in bad condition generally, the labor charge for maintenance is a minimum.

To replace inside and outside metal roofs on repaired cars with an All-Steel roof, the design shown in Fig. 0008 is adaptable. Roofing boards are not used; it is only necessary to rip off the old roof and roofing boards and lay the All-Steel Flexible Roof directly on top of the old ridge, the steel or wood carlines, and purlines. This roof is made from No. 16, No. 18 or No. 20 U. S. standard gage galvanized steel. In Fig. E007 and Fig. E009 is shown the manner in which these roofs are secured to the side plates and also to the carlines.

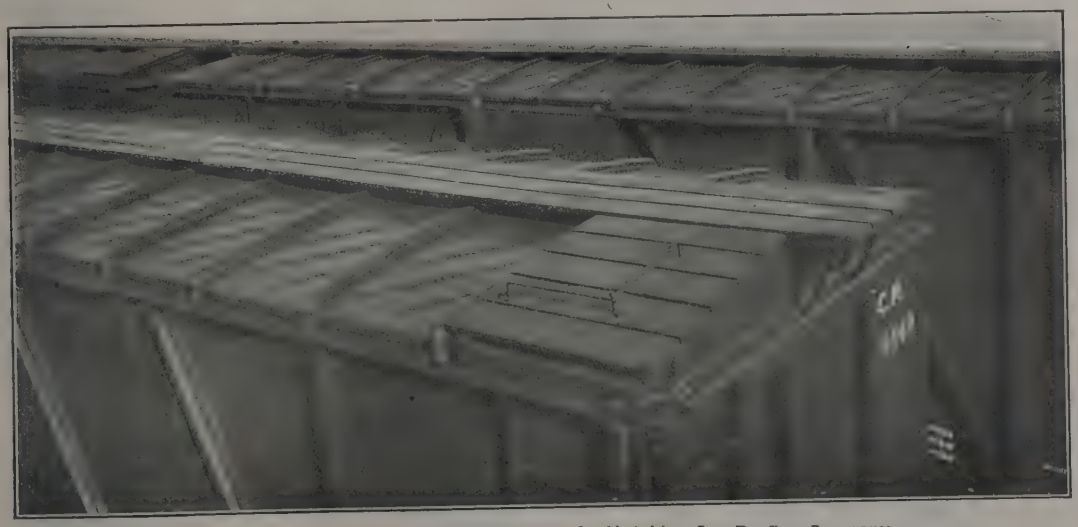


Fig. 752—Hutchins Camber All-Steel Roof. Hutchins Car Roofing Company

The Hutchins All-Steel Flexible Camber Type of roof—Figs. 748, 751 and 752—differs from the other types described, in that the roof plates extend from eave to eave of car instead of to the ridge.

For other products and branch offices, see classified and alphabetical indexes.

HUTCHINS CAR ROOFING COMPANY, DETROIT, MICH.

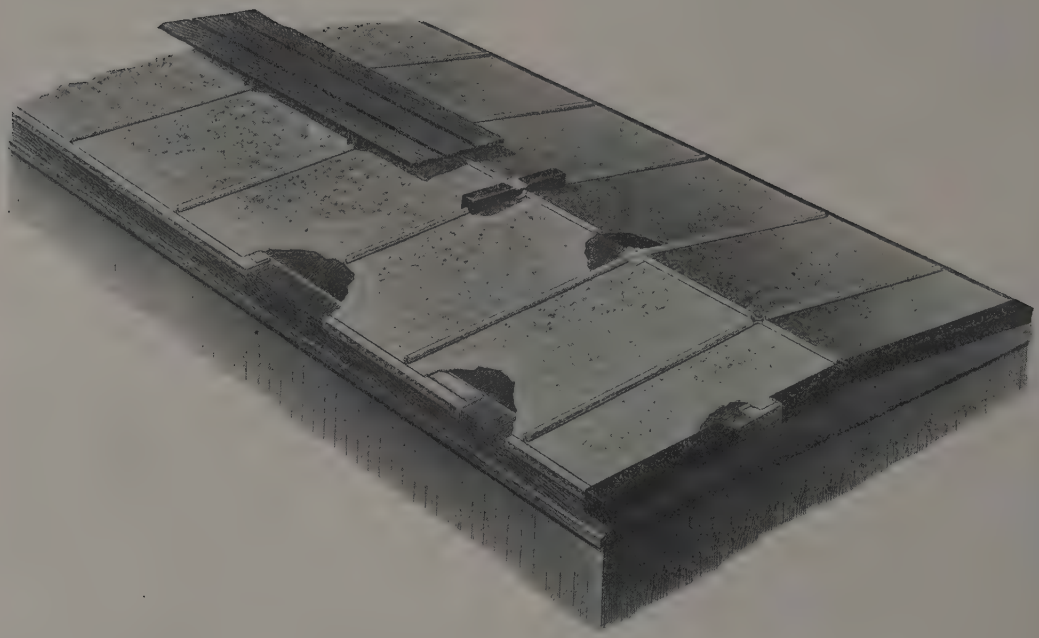


Fig. 753—Improved XLA Flexible Steel Roof for Box Cars

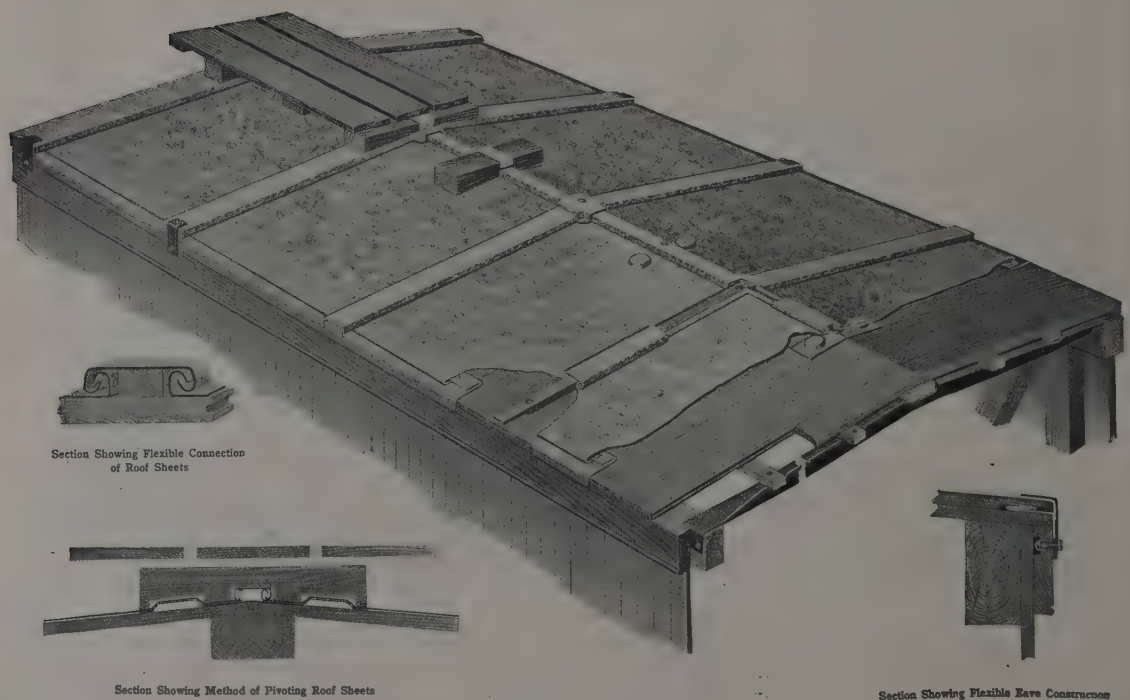

Section Showing Flexible Connection of Roof Sheets
Section Showing Method of Pivoting Roof Sheets
Section Showing Flexible Eave Construction

Fig. 754—XLA Flexible Steel Roof for Box Cars

The Standard Railway Equipment Company.

(*See also Page* 431.)

Murphy Solidsteel Roofs

The Murphy "Solidsteel" Roof has been designed with the object of producing a light, serviceable box car covering, which will serve as a durable and substantial roof and at the same time be an efficient brace for the entire superstructure of the car.

In the construction of modern steel or semi-steel box cars, every effort is made to secure a thoroughly rigid structure. Braces, posts, gussets and all parts of the frame are solidly united by means of riveted connections, intended to form permanent joints and to make certain that the various members will act as a unit in resisting the stresses imposed under service conditions.

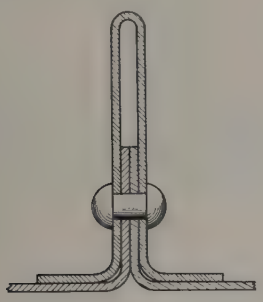


Fig. 755—Section Through Carline

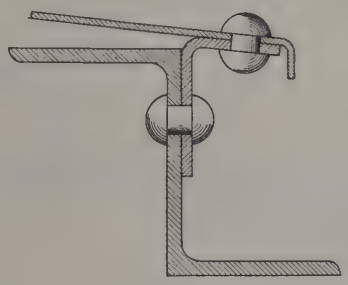


Fig. 756—Section Through Side Plate

One of the most important advantages of the Murphy "Solidsteel" Roof is due to the fact that it is designed to co-operate with other parts of the car framing, in such a manner as to produce a thoroughly braced structure of the utmost strength and rigidity. It ties the superstructure together at the top as firmly as it is held at the bottom, and unless a car body is built in this manner, the various fastenings will eventually work loose, causing roof leaks and a general rapid deterioration.

Murphy "Solidsteel" Roofs are made of 1/8 in., 7/64 in. and 3/32 in. black or galvanized rolled steel plates. The method of making the transverse roof sheet connections is shown in Fig. 755. This type of fastening is made by butting together the flanged roof sheet edges and after capping them with a sturdy U-shaped piece, the entire assembly is riveted solidly together, to form a reliable and rigid water-tight joint. The flanged U-shaped piece placed over the flanged roof sheet edges, forms a strong, efficient carline. The design avoids all inside projections, rivets are outside the car body so that they may be easily inspected, and are arranged to resist in direct shear any weaving tendency of the car superstructure.

The smooth interior obtained by this method of roof sheet connection, is of great importance in providing the largest possible stowing space with no downward projecting parts to catch and injure the lading.

A sectional view through the side plate roof connection is shown in Fig. 756. This fastening is arranged with a row of rivets under the eaves, well protected by the roof overhang and, as the rivets are driven horizontally, there is no possibility of a leak developing in case one of them should become loose.

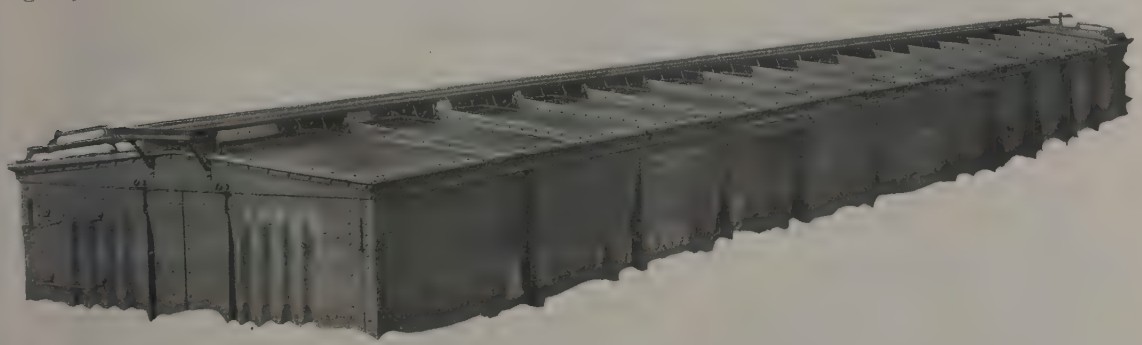


Fig. 757—The Murphy "Solidsteel" Roof—Outside View

The Murphy "Solidsteel" Roof is a light, efficient and very serviceable design, for all seteel or single-sheath cars. It is particularly adapted to the automobile car, with its wide unsupported door opening; "Solidsteel" roof construction can be depended upon to resist all buckling stresses that tend to develop at this point and which cause serious trouble where roofs of suitable design have not been provided.

For other products and branch offices, see classified and alphabetical indexes.

Fig. 758—Camel Angle Carline. Camel Company.

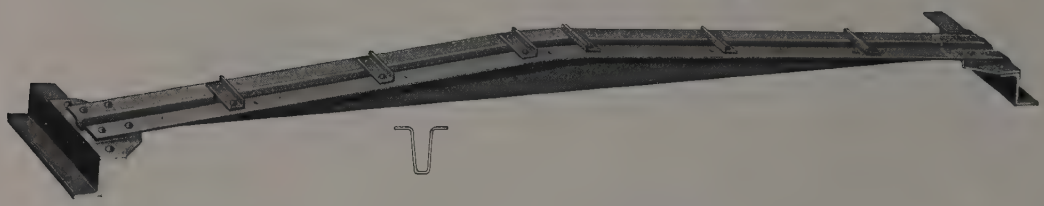


Fig. 759—Pressed Steel Carline Type U-2. The Standard Railway Equipment Company.

Fig. 760—Forged Steel Carline. The Standard Railway Equipment Company.

Fig. 761—Ideal Carline. The Standard Railway Equipment Company.

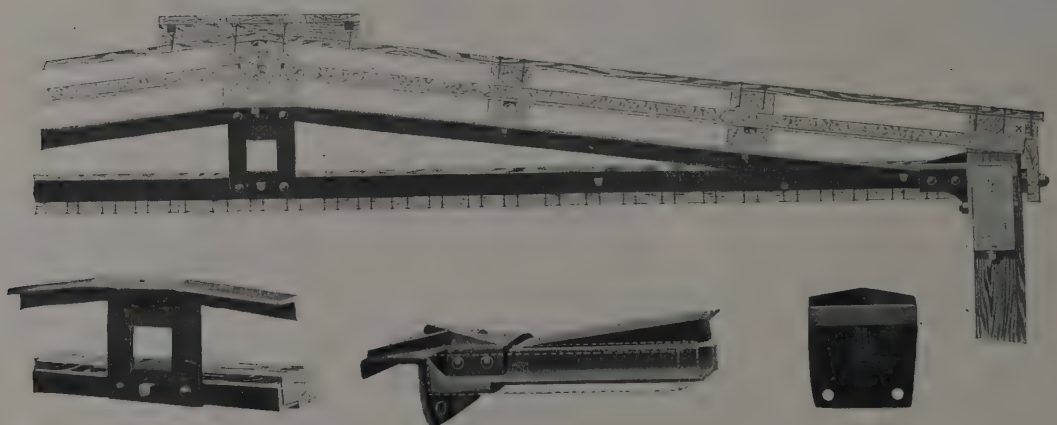


Fig. 762—General Arrangement of Chicago Trussed Steel Carline No. 21 for Box and Refrigerator Cars. Chicago-Cleveland Car Roofing Company.

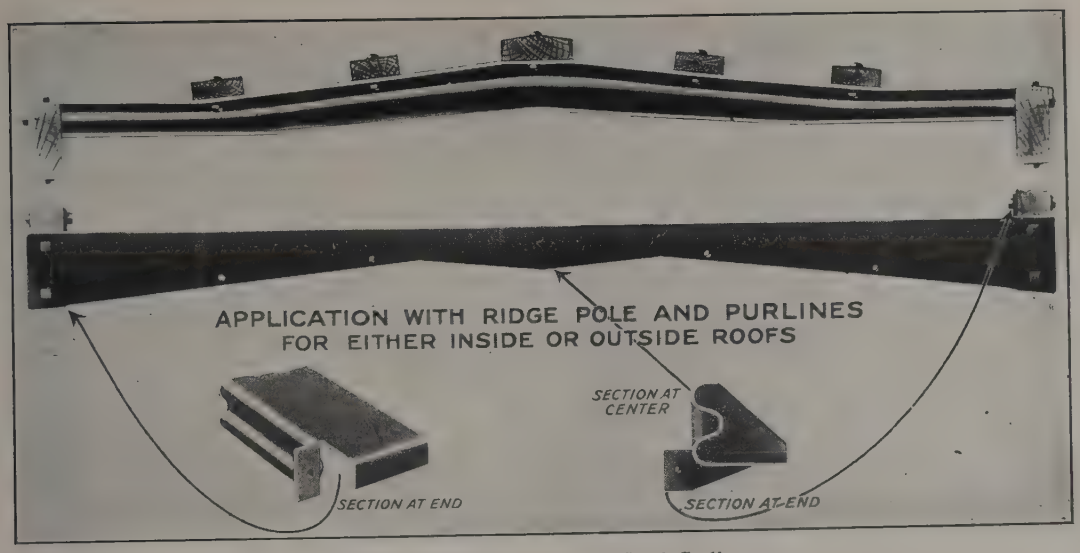

APPLICATION WITH RIDGE POLE AND PURLINES
FOR EITHER INSIDE OR OUTSIDE ROOFS
SECTION AT CENTER
SECTION AT END
SECTION AT END

Fig. 763—Corrugated Pressed Steel Carline.

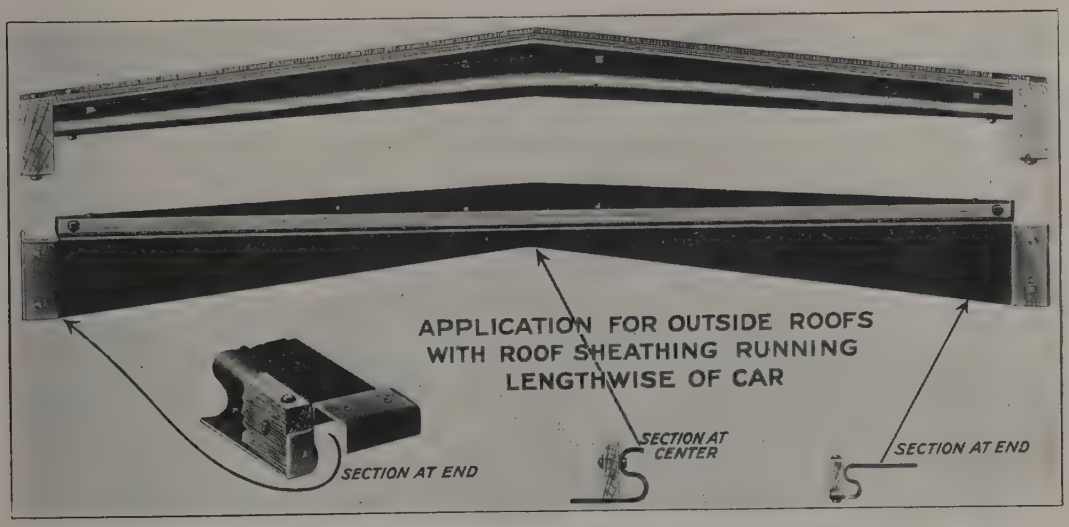


Fig. 764—Corrugated Pressed Steel Carline.

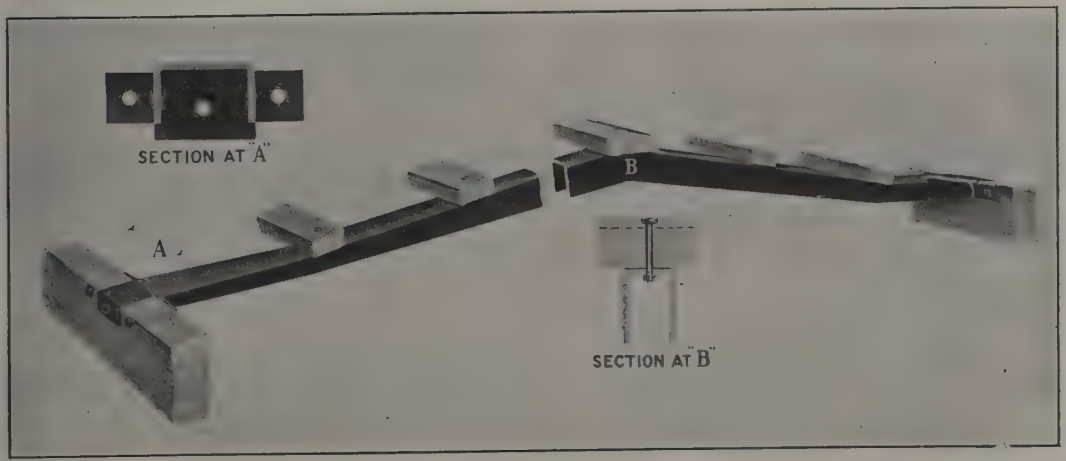


Fig. 765—Pressed Steel Carline.

Chicago-Cleveland Car Roofing Company.

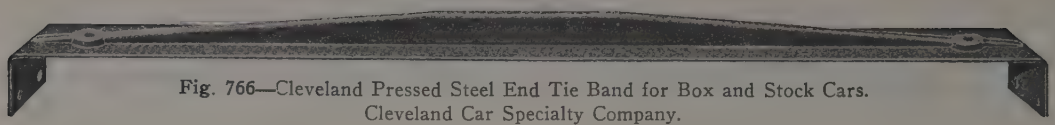


Fig. 766—Cleveland Pressed Steel End Tie Band for Box and Stock Cars.
Cleveland Car Specialty Company.

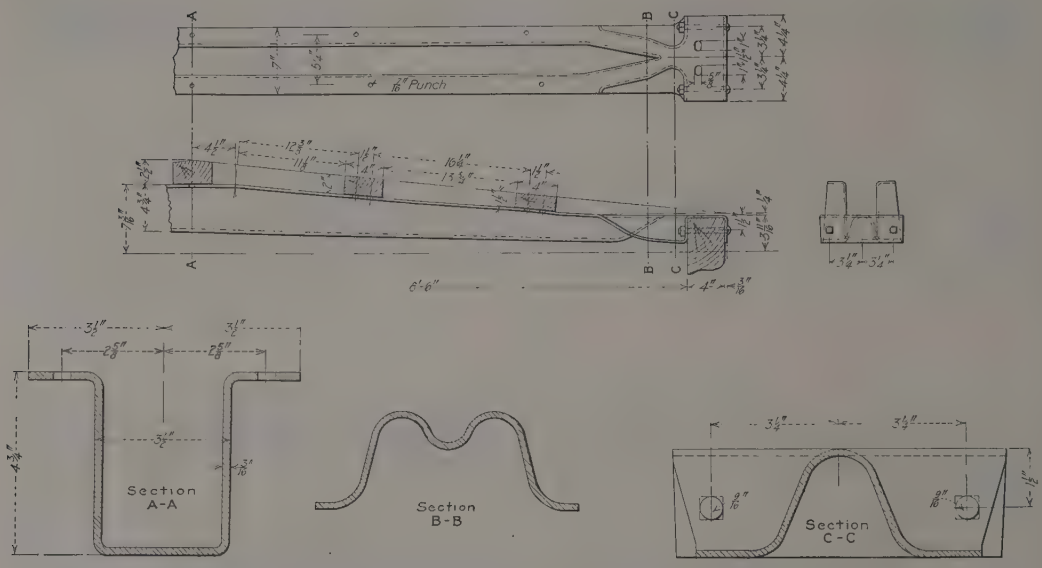


Fig. 767—Pressed Steel Carline Type M. Cleveland Car Specialty Company.

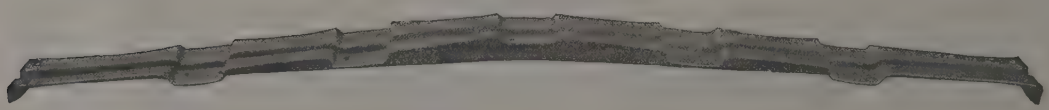


Fig. 768—Cleveland Pressed Steel Carline. Cleveland Car Specialty Company.

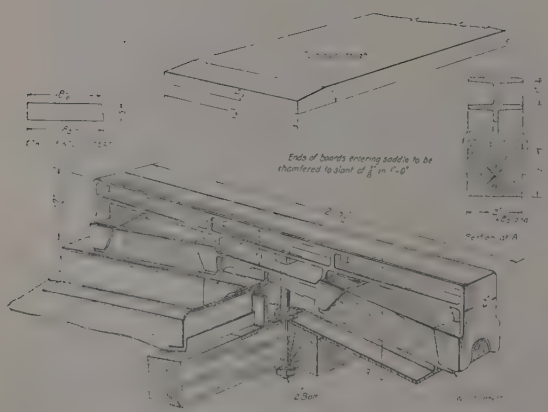


Fig. 769—Application of Miner Metallic Running Board Saddle. W. H. Miner.

Fig. 770—Miner Metallic Running Board Saddles. W. H. Miner

Tuco Roofing for Steel or Wooden Passenger Cars

Tuco National Standard Roofing for passenger cars—a cotton fabric woven from specially spun yarn impregnated with several courses of chemical treatments making it water-proof, mildewproof and fire-resisting—is a Tuco product that has been in service over 20 years and has adequately met its requirements. Long a standard material for wooden passenger equipment it has become much in favor on steel equipment.

In the maintenance of the roofs on steel passenger equipment, considerable difficulty has been experienced where steel has been used throughout in the construction. Owing to the action of cinders along the top of the cars, there is a considerable problem in keeping the steel properly covered with a protective coat of paint. As soon as the paint covering becomes broken or cracked, deterioration of the steel plates begins and proceeds rapidly, especially where the joints in the roof plates project above the smooth surface of the roof, due to the formation of sulphuric acid from the action of water on the cinders. It is also a fact that no matter how rigid the construction of a car may be, there is liable to be some weaving of the roof, which is evidenced by the condition of the joints in the sheets after they have been in service for some time. The use of Tuco National Standard Roofing eliminates this trouble.

grooved wood sheathing is applied directly to furring strips bolted to the steel car lines and projecting slightly above their upper surfaces. Intermediate wood carlines are placed between the steel carlines to provide additional nailing

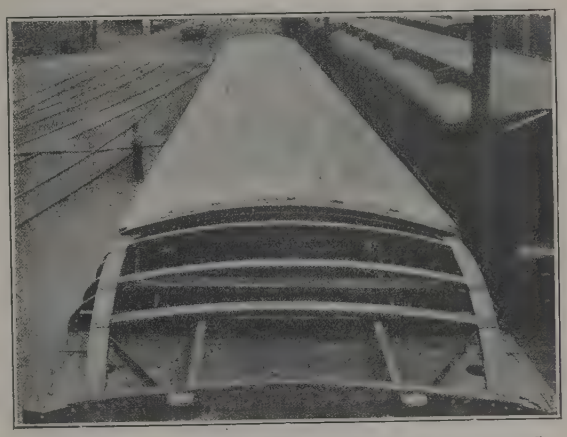


Fig. 771—Steel Passenger Car Roof Arranged for Tuco Roofing

strips for the sheathing. The Tuco Standard Car Roofing is then applied to the sheathing in the usual manner. This construction provides its own insulation, a considerable saving in itself, and also eliminates the troubles with the joints of the metal roof, due to the weaving action and the rapid deterioration of the projecting surfaces

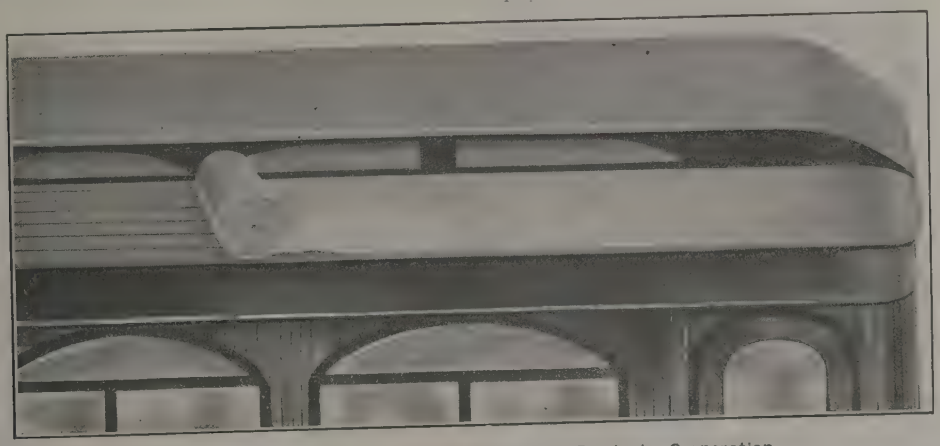


Fig. 772—National Standard Roofing—Tuco Products Corporation

In the application of Tuco Roofing the use of white lead is unnecessary, thereby effecting a saving of labor and material. Otherwise the same practice is followed as with any other canvas roofing, the special advantage being that should the protecting film of paint become cracked, thereby permitting moisture to come directly in contact with the material, it does not deteriorate from mildew.

Within the past few years a number of railways have adopted a semi-wood roof construction for steel equipment in order to secure the advantages of this type of roof covering, which has demonstrated its advantage through many years of service on wooden equipment. Tongued and caused by the impinging action of the cinders and corrosion. There are now a large number of steel passenger cars on which this or a similar type of roof construction and Tuco Standard Car Roofing has been used.

The treated canvas roofing when properly applied and well sanded is fireproof, and serves all the purposes of the steel roof. In addition its life is much greater than that of the steel. Cars having roofs covered with this material are now in use with the roofs still in good condition after ten years of service. The material is furnished in three weights, designated as "CC," "AA" and "FF," which corresponds to No. 4, No. 6, and No. 8, duck, respectively.

For other products and branch offices, see classified and alphabetical indexes.

TUCO PRODUCTS CORPORATION, 30 CHURCH ST., NEW YORK, N. Y.

Parts of Buhoup Wide Vestibule. See Figs. 773-776.

4	*Foot Plate*
6	*Spanner Bar, Lower*
8	*Curtain Plate, Front*
9	*Curtain Plate, Rear*
10	*Curtain Roller*
11	*Curtain*
12NP	*Post Plate, L and R*
20	*Curtain Bearing, Lower*
20A	*Curtain Bearing, Lower, Used with Standard Steel Platform*
21	*Curtain Bearing, Upper*
23	*Curtain Socket*
40	*Patent Plate*
44	*Curtain Spring, L and R*
45	*Curtain Roller Plug*
46	*Arch Plate and Buffer Spring*
49	*Arch Plate Band*
50	*Shield*
52	*Curtain Spring Plug, Large*
53	*Curtain Spring Plug, Small*
54	*Piston Stem*
79	*Buffer Plate for Standard Steel Platform*
80	*Foot Plate for Standard Steel Platform*
81	*Buffer Plate Spring*
91	*Arch Plate*
94	*Spanner Bar, Upper*
95	*Angle Connection, Top, R*
96	*Angle Connection, Top, L*
100	*Foot Plate Housing*
101	*Bulb Angle*
111	*Spanner Bar Bolt*
115	*Angle Connection, Bottom, R*
116	*Angle Connection, Bottom, L*
119	*Piston Stem Bracket*
120	*Piston Stem Guide*
123	*Accordion Hood Band*
124	*Accordion Hood*
125	*Hood Brace Bracket, Front, R*
126	*Hood Brace Bracket, Front, L*
127	*Hood Brace Bracket, Rear, R*
128	*Hood Brace Bracket, Rear, L*
129	*Hood Brace*
130	*Buffer Plate*
134	*Foot Plate Bolt*
154	*Piston Stem Spring*
155	*Piston Stem Washer*
156	*Piston Stem Ferrule*
628	*Buffer Plate Pin*

Fig. 773—Buhoup Wide Vestibule.

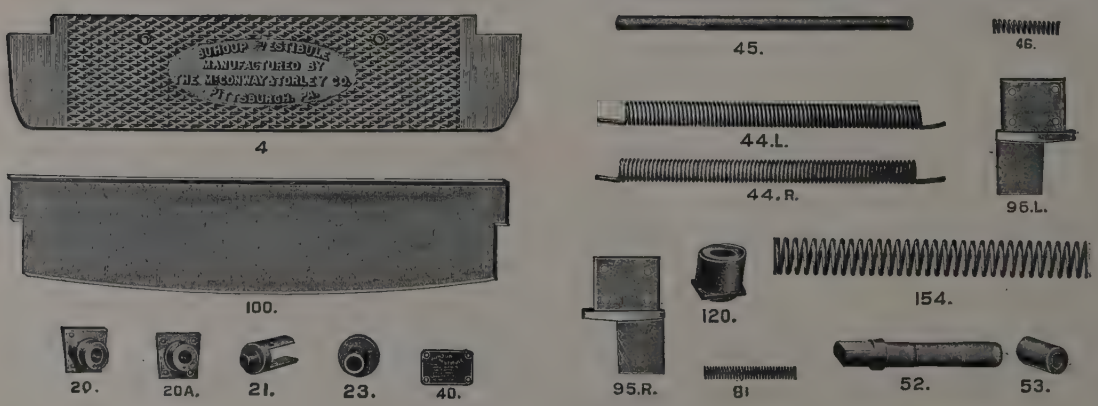


Fig. 774—Details of Buhoup Wide Vestibule. See also Figs. 773, 775 and 776 and Names of Parts on this Page.

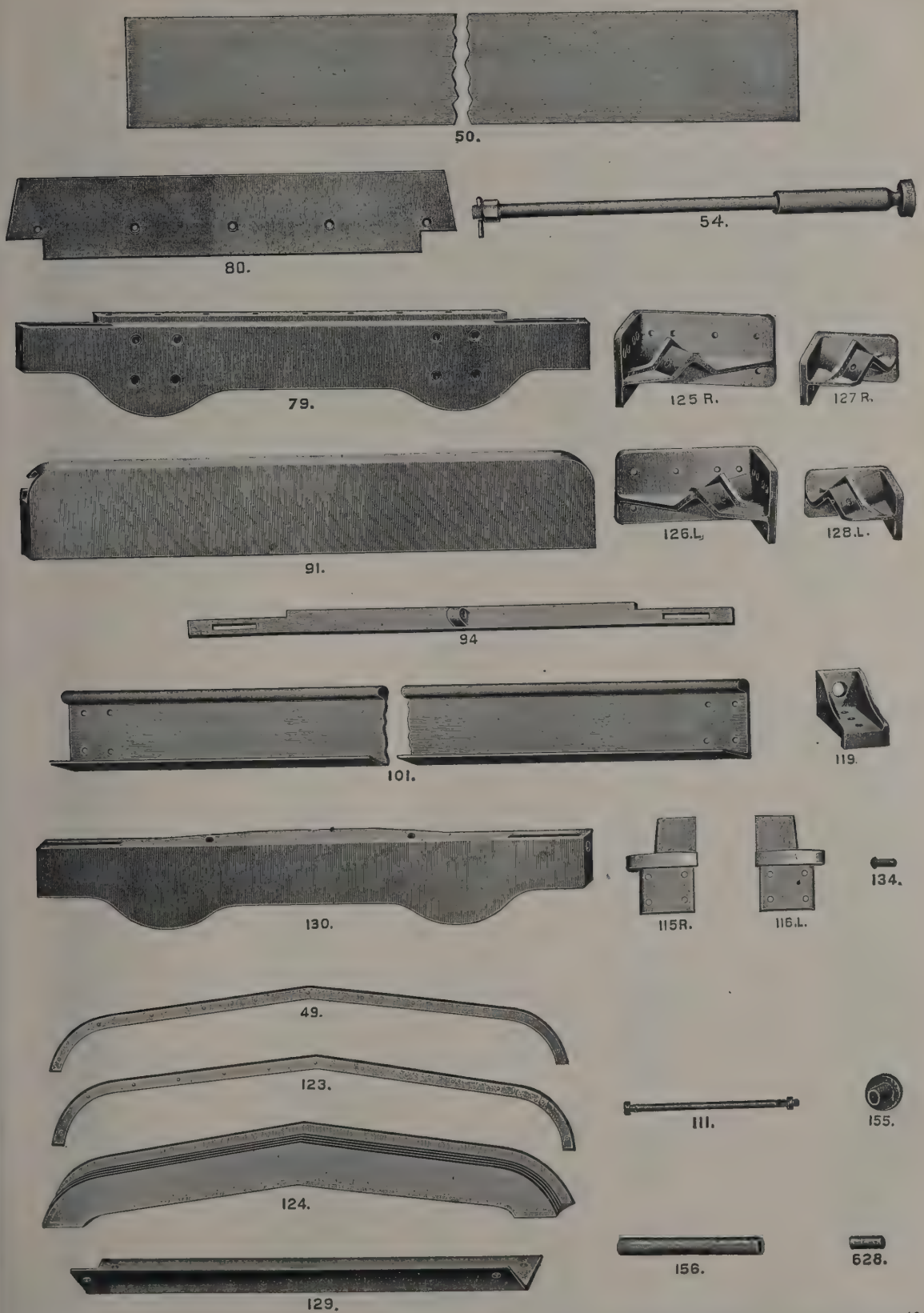


Fig. 775—Details of Buhoup Wide Vestibule. See also Figs. 773, 774 and 776 and Names of Parts on Page 436.

The McConway & Torley Company

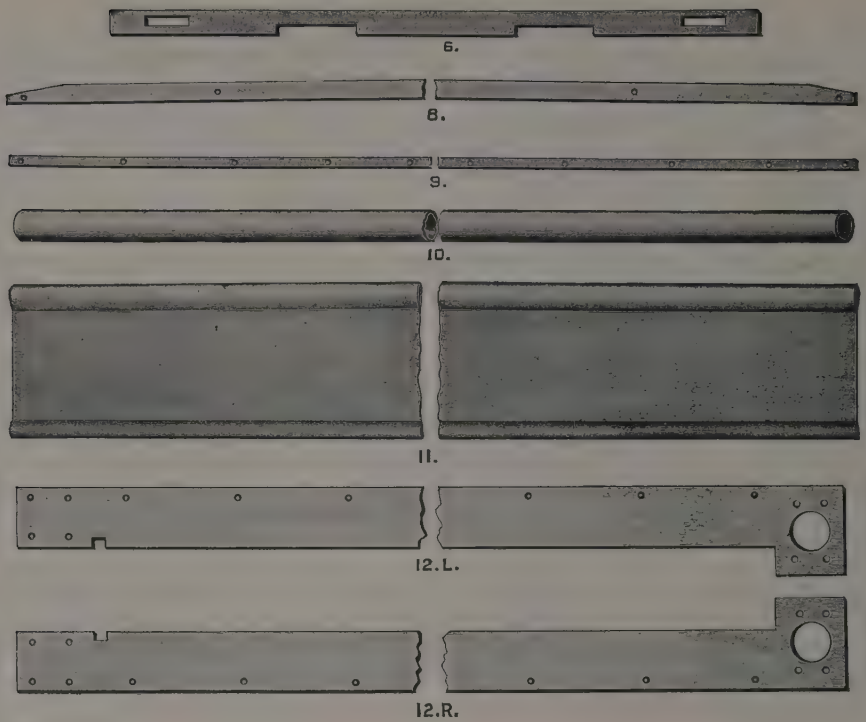


Fig. 776—Details of Buhoup Wide Vestibule. See also Figs. 773-775 and Names of Parts on Page 436.

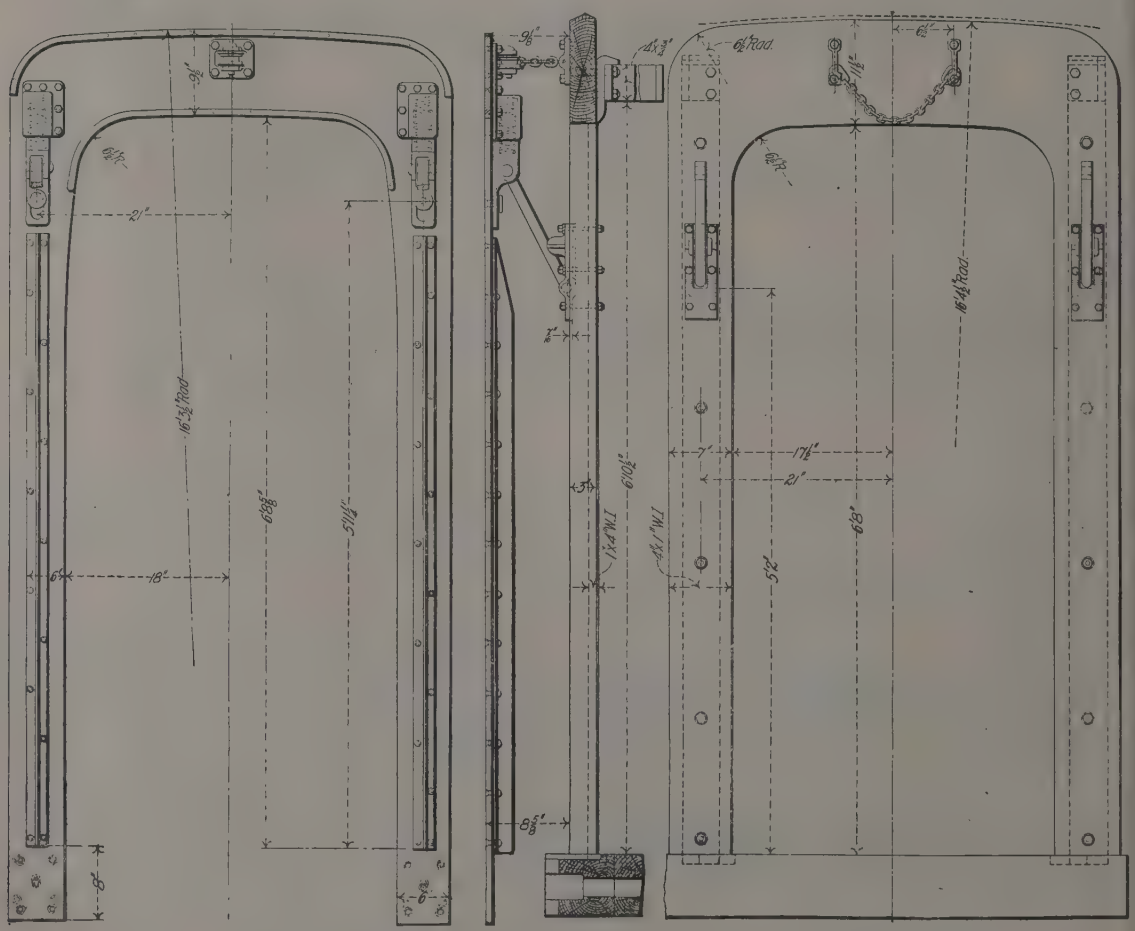


Fig. 777—Gould Vestibule Face Plate. Gould Coupler Company.

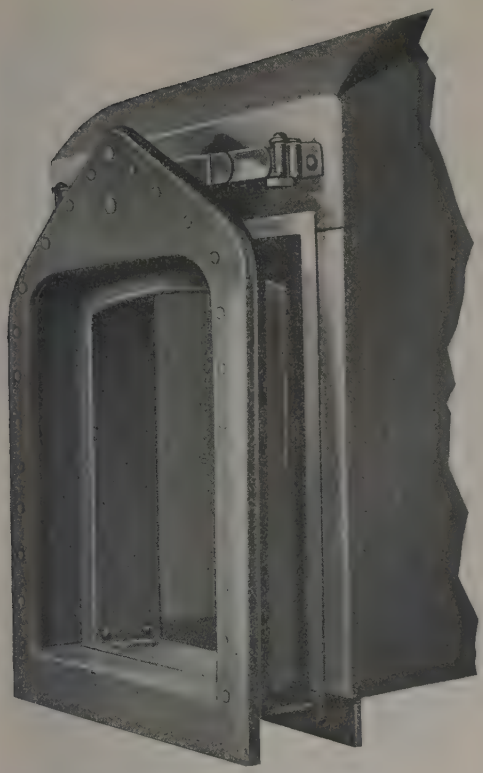


Fig. 778—Rex Steel Vestibule Diaphragm and Rex Upper Buffer Spring. Curtain Supply Company.

Fig. 779—CSCO Standard Six Plait Vestibule Diaphragm, Fire and Waterproofed.

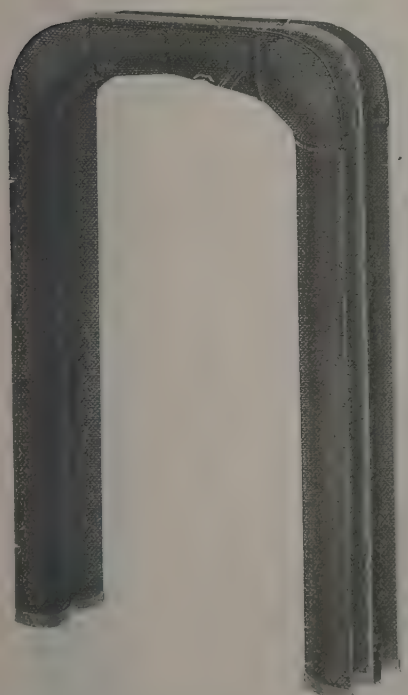


Fig. 780—Rex U-Shape Sloping Top Vestibule Diaphragm, Fire and Waterproofed.

Fig. 781—Rex U-Shape Diaphragms with Open Plait to Swing Out with Face Plates.

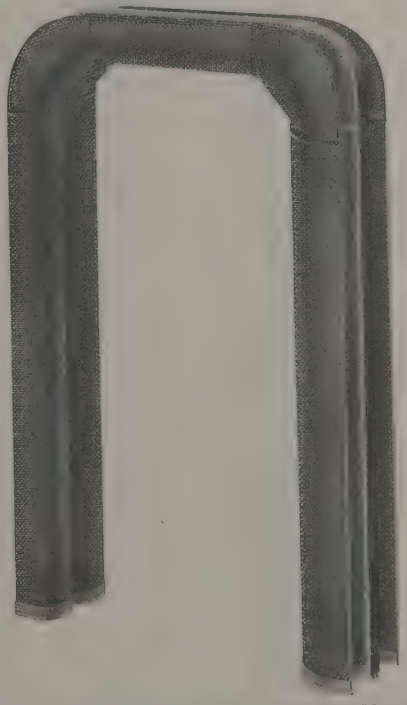


Fig. 782—Rex U-Shape Flat Top Vestibule Diaphragm, Fire and Waterproofed.

The Curtain Supply Company.

Fig. 783—Acme Two Fold "U" Shape Diaphragm with Channel Iron Reinforcement.

Fig. 784—Flexible Joint of Acme Diaphragm Attachment.

Fig. 785—Six Plait "V" Shaper Diaphragm.

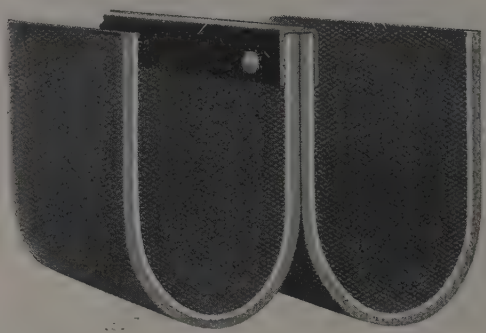


Fig. 786—Section Through Top of Acme Two Fold "U" Shape Diaphragm Showing Channel Iron Reinforcement.

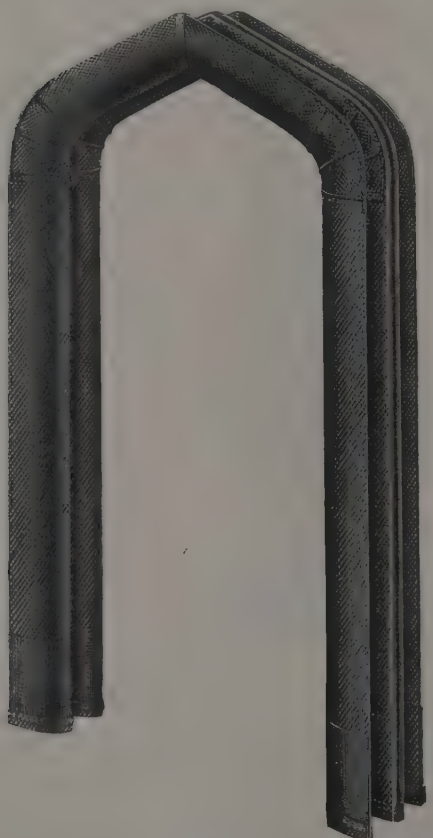


Fig. 787—Acme Two Fold "U" Shape Diaphragm with Apex Top and "T" Iron Reinforcement.

Fig. 788—Acme Reverse Unifold Diaphragm with Sloping Top.

(*See also Page* 441.)

Diaphragms for Passenger Car Vestibules

The ACME U-shape canvas diaphragms for the vestibule openings of passenger cars are made in two forms—one with two folds and another with three folds according to the requirements to be met. The diaphragm is made of heavy 3-ply cotton canvas belting formed into U-shape folds and securely fastened, with steel rivets spaced 4-in. apart, to a continuous channel iron stiffener, which extends completely around the diaphragm and thoroughly protects the edges of the canvas.

The top section of these diaphragms is made of one piece of canvas belting, rendered fireproof and waterproof, which is corrugated to form the corners and with a heavy overlap, is securely stitched to the legs or side sections. The legs have an adjustable foot of transverse weave to provide greater durability at this point in the diaphragm and a 3-in. overlap is provided for height adjustment. The canvas in the sides is treated only to render it waterproof. These diaphragms are built to withstand the severe conditions of fast passenger service.

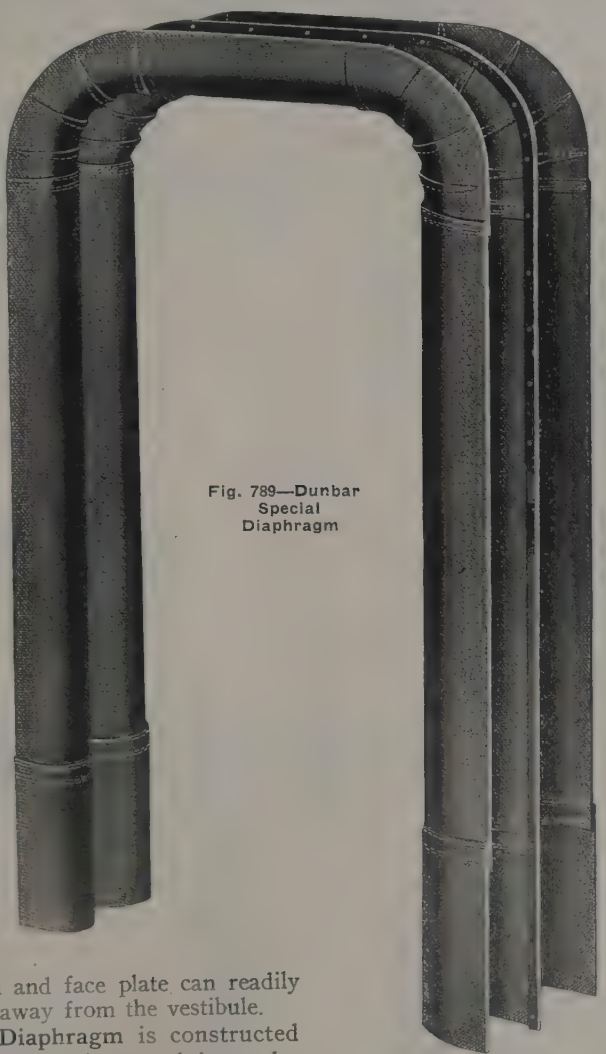


Fig. 789—Dunbar Special Diaphragm

The ACME diaphragm attachment with its flexible joint is designed for the purpose of rendering the legs of the diaphragm flexible. This feature facilitates the application and removal of the diaphragms and also will be found convenient when making repairs to draft rigging. The device is simplicity itself as will be seen from Fig. 784. By removing the lower cotter keys the diaphragm and face plate can readily be swung outward and away from the vestibule.

The Russum Steel Diaphragm is constructed of pressed steel shapes throughout and is so designed that it is weatherproof, and substantial, thereby insuring long service. The sides are made up of steel pockets applied to the end posts of the car into which fit the hinged sides attached to the face plate. Where moving parts come in contact with each other silencer wearing strips are applied, allowing the diaphragm to operate freely and at the same time without undue noise.

The top, which overlaps the side legs, works in a weatherproofed pocket formed by the ceiling of the car and a stationary top which is fastened to the end post pockets and which is made weatherproof by canvas belting applied to heading of car.

Various other diaphragms of the Morton Manufacturing Company are shown in Figs. 783, 784, 785, 786, 787 and 788.

The ACME Vestibule Curtain and fixtures also are products of the Morton Manufacturing Company. The complete outfit includes—besides the curtain proper which can be made of any desired material—a pull rod with either the solid or Ajax release handle, an all-steel curtain roller—with or without the snap button release—a steel revolving shield and pressed steel curtain casing, together with all necessary brackets and hooks for application to cars of either wood or steel construction.

There are two methods of releasing the vestibule curtain in case of emergency in order to prevent the curtain from being torn when cars are uncoupled and trainmen have neglected to unhook it. One method involves the use of a release handle, and the other requires snap buttons by which the curtain is fastened to the roller. The ACME vestibule curtain products are shown in Figs. 790 to 795.

The ACME Buffing Mechanism for the top of the vestibule diaphragm face plate has been designed with a view to reducing wear to a minimum and overcoming breakages. The diaphragm face plates of adjoining cars when coupled together move in all directions, due to the swinging and swaying of the cars when rounding curves, passing over rail joints, switches, crossings, etc., and this device is so constructed that it compensates this action on the face plate.

All parts excepting the coil springs are made of either malleable castings or drop forgings, which are strong and durable and capable of withstanding the hard and continuous service to which buffing mechanisms are subjected. This appliance is light in weight and readily accessible.

For other products and branch offices, see classified and alphabetical indexes.

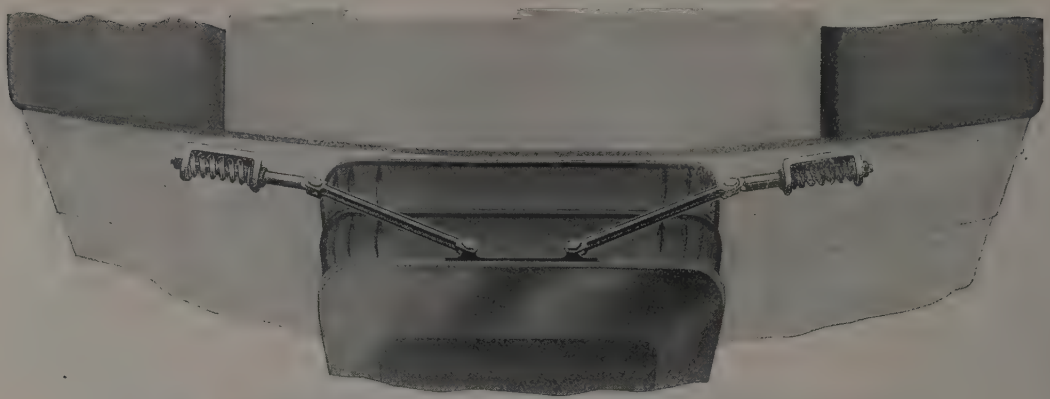


Fig. 790—Acme Buffing Mechanism for Top of Vestibule Diaphragm Face Plates.

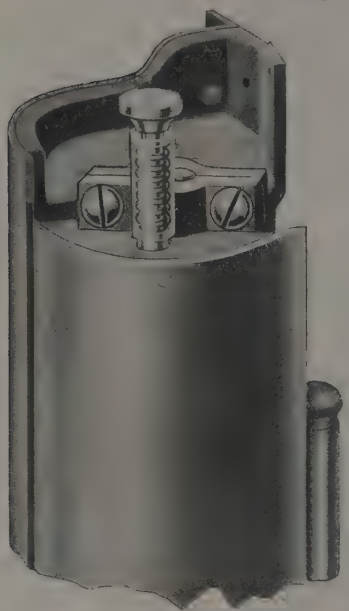


Fig. 791—Acme Revolving Vestibule Curtain Shield; Top View of Casing with Revolving Shield Closed.

Fig. 792—Ajax Vestibule Curtain Release Handle, Open.

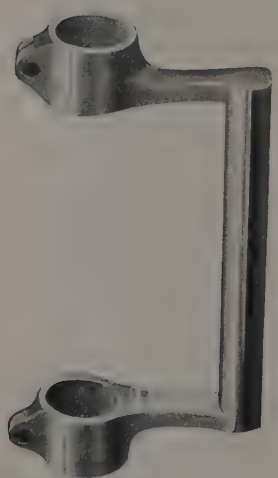


Fig. 793—Acme Vestibule Type A Curtain Handle.

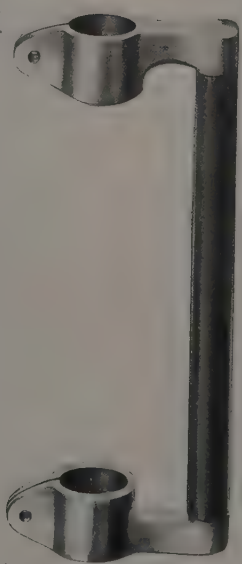


Fig. 794—Acme Vestibule Type B Curtain Handle.

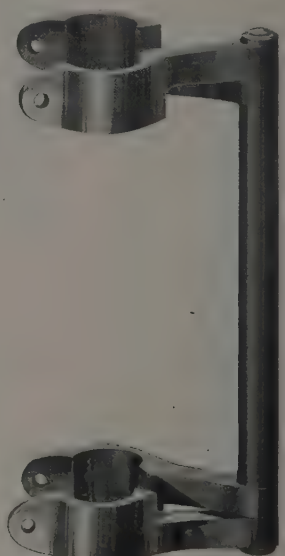


Fig. 795—Acme Vestibule Type C Curtain Handle with Swinging Clamps.

Morton Manufacturing Company.

(*See also Figs.* 783-788 *and Page* 441.)

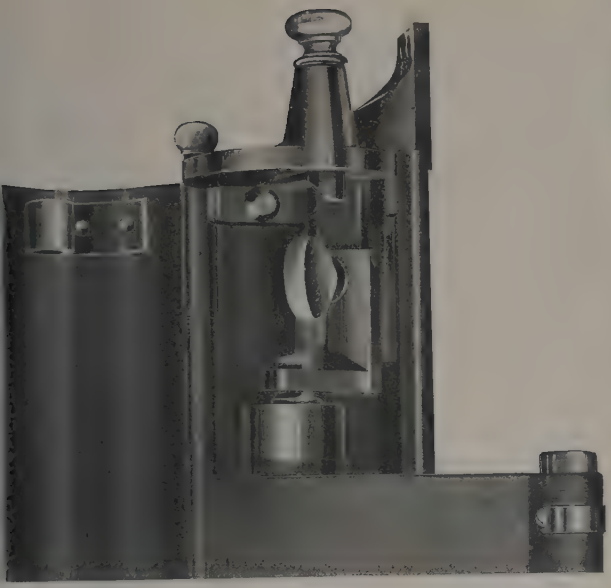


Fig. 796—Rex Opening Shield for Vestibule Curtains with Adjustable Roller Brackets. Curtain Supply Company.

Fig. 797 — Rex Opening Shield for Vestibule Curtains. Curtain Supply Company.

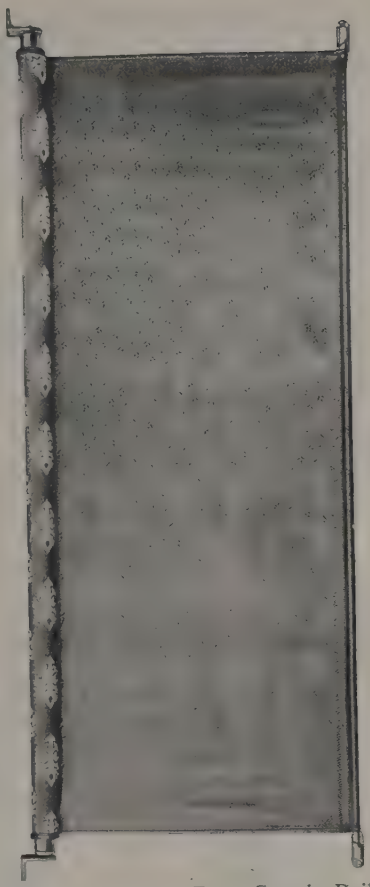


Fig. 798—Sliding Door Curtain Railway Supply & Curtain Company.

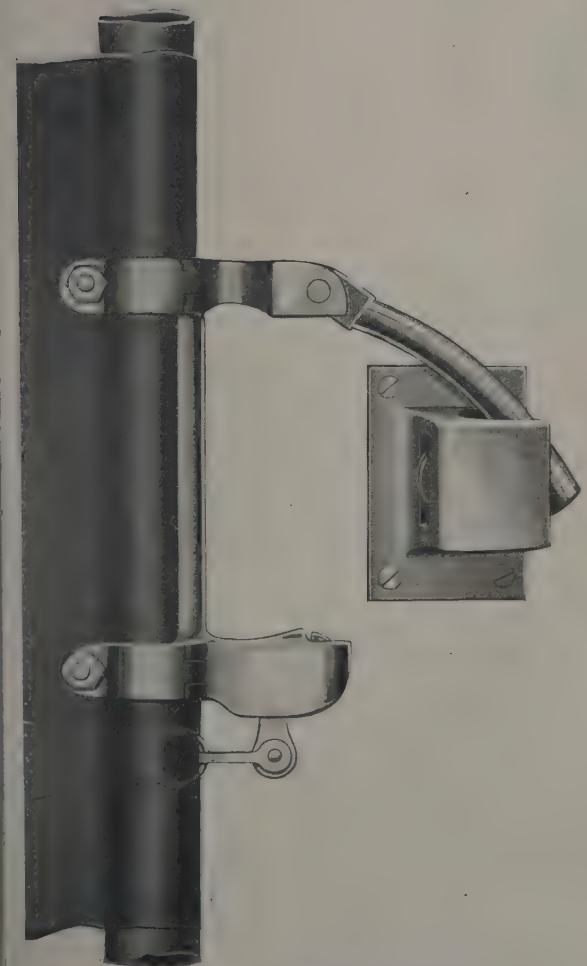


Fig. 799—Rex Automatic Release Handle for Vestibule Curtains. Curtain Supply Company.

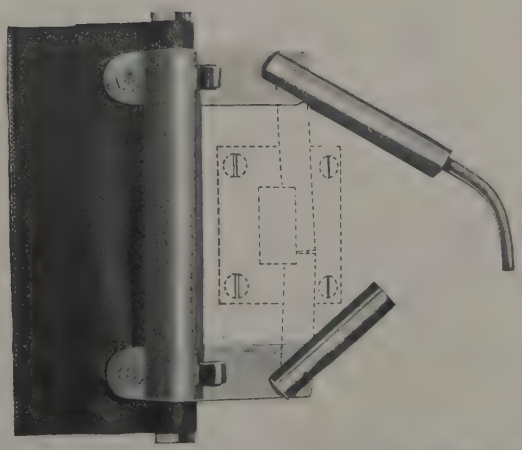


Fig. 800—Rycco Vestibule Curtain Release Handle, Open. Railway Supply & Curtain Company.

Fig. 801—Inside Hand Rail. Fig. 636—Uncoupling Rod Guide. Adams & Westlake Company.

Fig. 802—Trainman's Grab Handle. Adams & Westlake Company.

Fig. 803—Swinging Guard Rail. James L. Howard & Company.

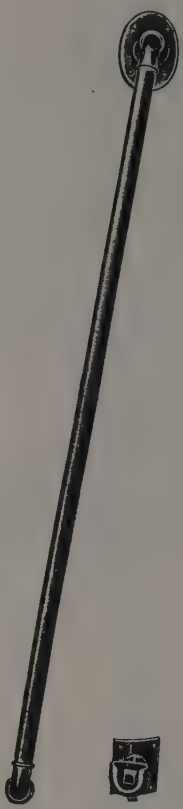


Fig. 804—Vestibule Guard Rail and Fittings. Adams & Westlake Company.

Fig. 805—Trap Door Latch Operating Rod. Dayton Manufacturing Company.

Fig. 806—Corner Post Grab Handle. Adams & Westlake Company.

Fig. 807—Trap Door Holders.

Fig. 808—Trap Door Bumper.

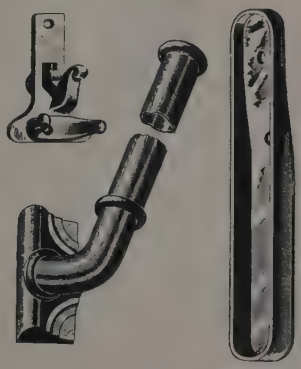


Fig. 809—Door Guard Drop Rod Catch and Pocket. Dayton Manufacturing Company.

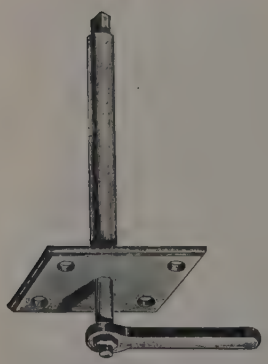


Fig. 810—Rod for Operating Trap Door Latch from Below Platform. Dayton Manufacturing Company.

Fig. 811.—Vestibule Curtain Hook for Steel Posts. The Curtain Supply Company.

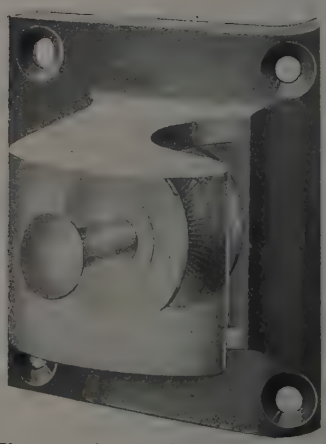


Fig. 812—Vestibule Curtain Hook for Wood Posts. The Curtain Supply Company.

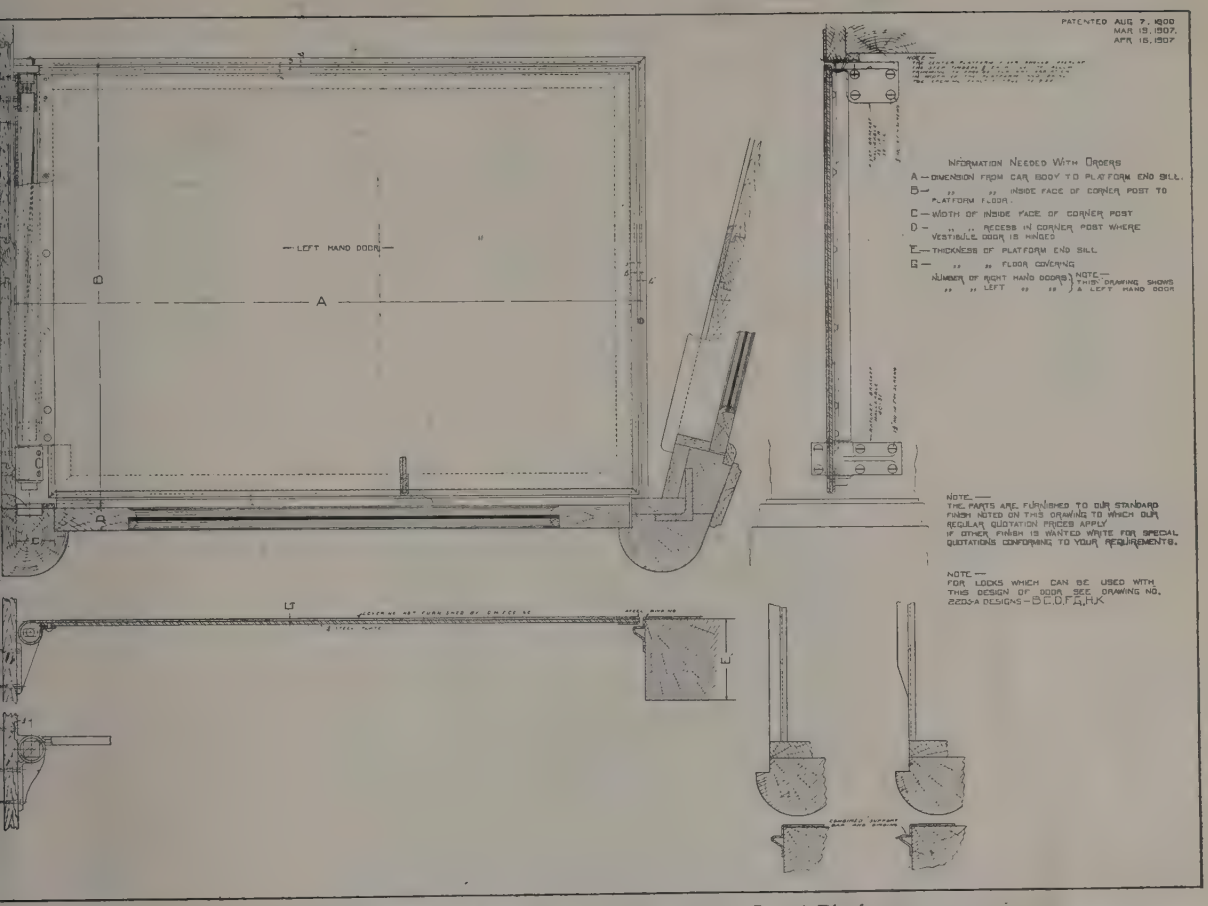
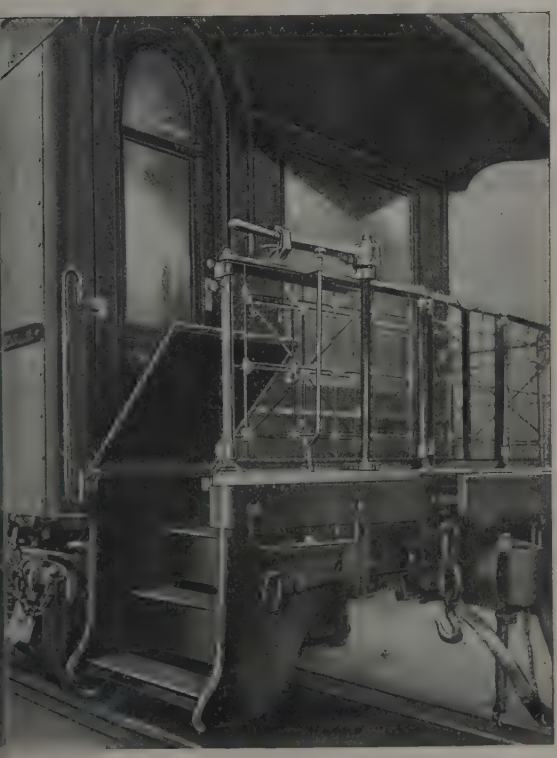

PATENTED AUG 7, 1900
MAR 19, 1907.
APR 16, 1907
INFORMATION NEEDED WITH ORDERS
A — DIMENSION FROM CAR BODY TO PLATFORM END SILL.
B — " " INSIDE FACE OF CORNER POST TO PLATFORM FLOOR.
C — WIDTH OF INSIDE FACE OF CORNER POST
D — " " RECESS IN CORNER POST WHERE VESTIBULE DOOR IS HINGED
E — THICKNESS OF PLATFORM END SILL
G — " " " FLOOR COVERING
NUMBER OF RIGHT HAND DOORS } NOTE — THIS DRAWING SHOWS
" " LEFT " " } A LEFT HAND DOOR
— LEFT HAND DOOR —
A
B
C
D
E
G
NOTE —
THE PARTS ARE FURNISHED TO OUR STANDARD FINISH NOTED ON THIS DRAWING TO WHICH OUR REGULAR QUOTATION PRICES APPLY
IF OTHER FINISH IS WANTED WRITE FOR SPECIAL QUOTATIONS CONFORMING TO YOUR REQUIREMENTS.
NOTE —
FOR LOCKS WHICH CAN BE USED WITH THIS DESIGN OF DOOR SEE DRAWING NO. 2205-A DESIGNS - B.C.D.F.G.H.K

Fig. 813—Edwards Metal Trap Door for Grade Level Platforms.



ig. 814—Edwards Trap Door, Design 3-0, Applied to Observation Platform.

Fig. 815—Edwards Metal Trap Door, Grade Level Type.

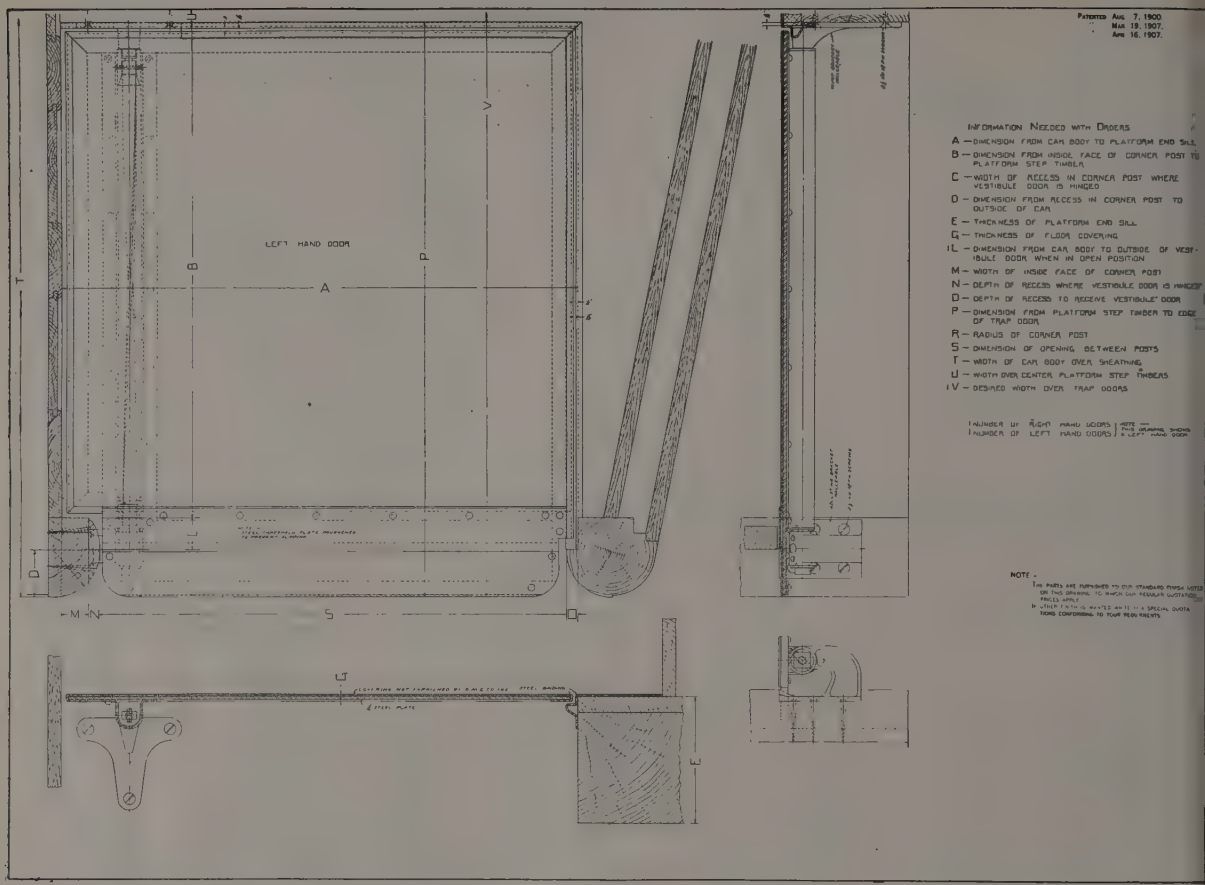

PATENTED APR. 7, 1900.
MAR. 19, 1907.
APR. 16, 1907.
INFORMATION NEEDED WITH ORDERS
A — DIMENSION FROM CAR BODY TO PLATFORM END SILL
B — DIMENSION FROM INSIDE FACE OF CORNER POST TO PLATFORM STEP TIMBER
C — WIDTH OF ACCESS IN CORNER POST WHERE VESTIBULE DOOR IS HINGED
D — DIMENSION FROM RECESS IN CORNER POST TO OUTSIDE OF CAR
E — THICKNESS OF PLATFORM END SILL
G — THICKNESS OF FLOOR COVERING
L — DIMENSION FROM CAR BODY TO OUTSIDE OF VESTIBULE DOOR WHEN IN OPEN POSITION
M — WIDTH OF INSIDE FACE OF CORNER POST
N — DEPTH OF RECESS WHERE VESTIBULE DOOR IS HINGED
O — DEPTH OF RECESS TO RECEIVE VESTIBULE DOOR
P — DIMENSION FROM PLATFORM STEP TIMBER TO EDGE OF TRAP DOOR
R — RADIUS OF CORNER POST
S — DIMENSION OF OPENING BETWEEN POSTS
T — WIDTH OF CAR BODY OVER SHEATHING
U — WIDTH OVER CENTER PLATFORM STEP TIMBERS
V — DESIRED WIDTH OVER TRAP DOORS
NUMBER OF RIGHT HAND DOORS
NUMBER OF LEFT HAND DOORS
NOTE —
NOTE -
LEFT HAND DOOR
A
B
D
L
M
N
S
T
V
E
LT

Fig. 817—Edwards Trap Door for Elevated Station Platform.

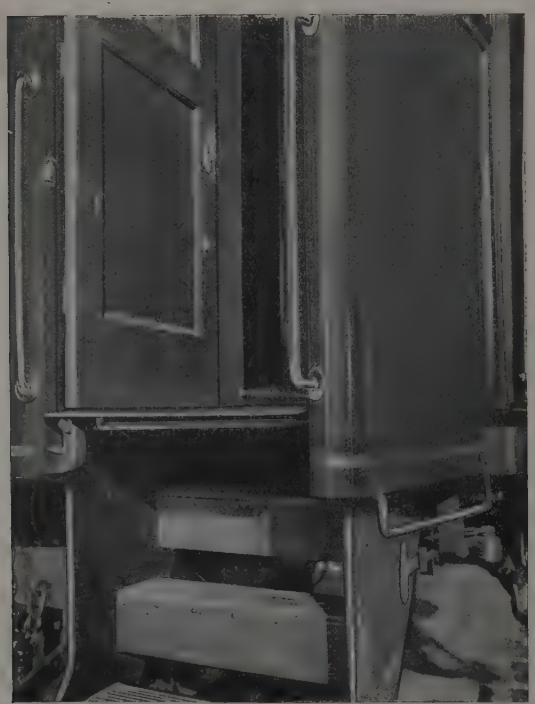


Fig. 818—Edwards Metal Trap Door for Elevated Station Platforms; Door Closed. Applied to Wooden Car.

Fig. 819—Edwards Metal Trap Door for Elevated Station Platforms; Door Closed. Applied to Steel Car.

O. M. Edwards Company, Inc.

(*See also Figs.* 813-815 *and Page* 447.)

Trap Doors and Fixtures

The trap door equipment of the modern vestibuled passenger car is in itself, comparatively simple yet it must meet certain requirements which are important from the standpoints of maintenance, operation, appearance and safety. The surface of the door should be smooth and unbroken to facilitate cleaning and all parts should be easily accessible so that adjustments or repairs may be made without the necessity of going beneath the car or removing the platform floor. The door should lock down securely and yet open quickly and easily.

The Edwards trap door proper consists of a 3/16 in. steel plate reinforced with a steel binding of a design suitable for the various thicknesses of floor covering. The construction is light, yet strong, and presents a smooth unbroken surface that can be cleaned easily. This door will not swell and bind, or work out of shape and, therefore, will always maintain a proper fit. A combination support bar and binding extends along the edge of the platform floor and end sill, the door resting on this when in a closed position.

The hinge construction permits easy application to any type of car construction, either wooden or all steel, and allows the door to be removed quickly and easily for repairs and adjustments without going underneath the car or disturbing any other part. The brackets are secured to the end sill of wooden cars with screws, and, in the case of steel cars, they are attached by rivets.

Fig. 820—Elevated platform type of door in open position.

The door hinge is formed from a separate piece of metal and is securely riveted to the bottom of the door. It contains the flat adjusting springs, which are used to balance and raise the door. An adjusting plug passes through the supporting bracket and into the end of the hinge forming the bearing at this point. This plug engages the adjusting springs which are set with a slight torsional strain existing when the door is in a vertical or open position. A series of holes in the plug are arranged in such a manner that a fine adjustment can be secured. The proper torsion on the springs is secured by means of a pin passing through the adjusting bracket and the holes in the plug, this feature making it possible for the door to balance when either fully opened or partly closed.

Fig. 821—Type H Trap Door lock.

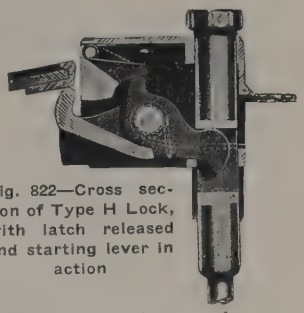


Fig. 822—Cross section of Type H Lock, with latch released and starting lever in action

To remove the door from the car, the door should be placed in a vertical or open position and the strain on the torsional bars relieved. The pin may then be removed readily and the adjusting plug pulled out far enough to permit taking down the door. Since the door and brackets are separate, the brackets can be attached permanently to the car body—a desirable feature, especially in steel cars—as rivets may be used instead of machine screws or bolts, which are liable to work loose in service.

The trap door lock holds the door in a closed position by means of a latch which projects over the top edge of the door. This lock is released by a downward pressure upon the foot pin, which withdraws the latch and allows the door to raise. If the door should stick, a starting lever in the lock comes in contact with the bottom of the door and forces it to open a sufficient distance to insure its full opening automatically. The lock can be placed at any point on the end sill, but preferably near the center of the opening. This type of lock insures easy and positive opening of the door and eliminates the possibility of injury. Hand holes are unnecessary in either the door or sill.

Only a few parts comprise the door operating mechanism, and lock. They are all of metal and simple in design thus insuring long life and low maintenance costs.

Several designs of trap doors and locks are made to meet individual requirements but the principle of operation is the same in all cases. For subway and elevated cars an additional feature is provided which permits the door to slide outward a sufficient distance to meet the station platform.

For other products and branch offices, see classified and alphabetical indexes.

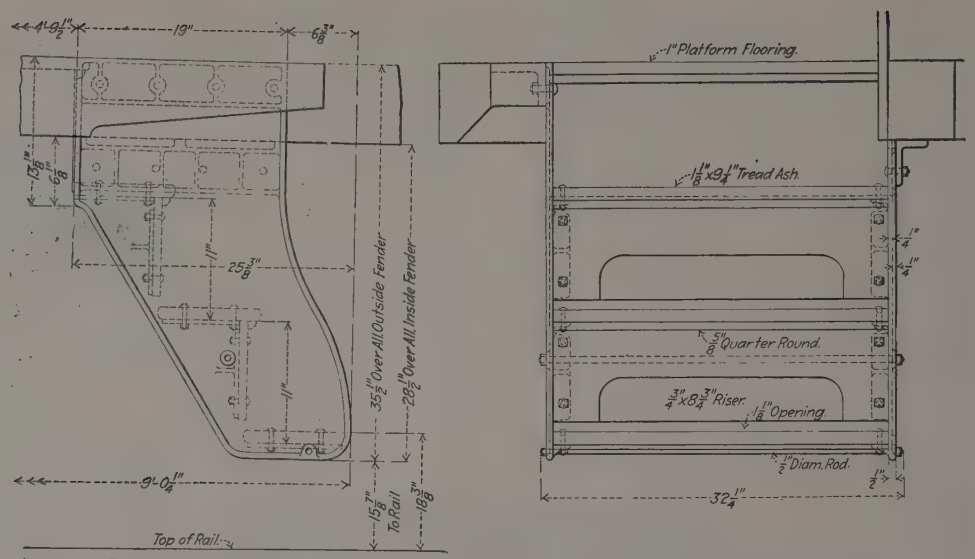


Fig. 823—Central Railroad of New Jersey Passenger Car Step with Malleable Iron Fenders.

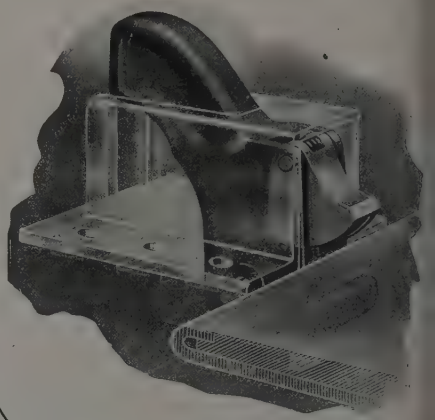
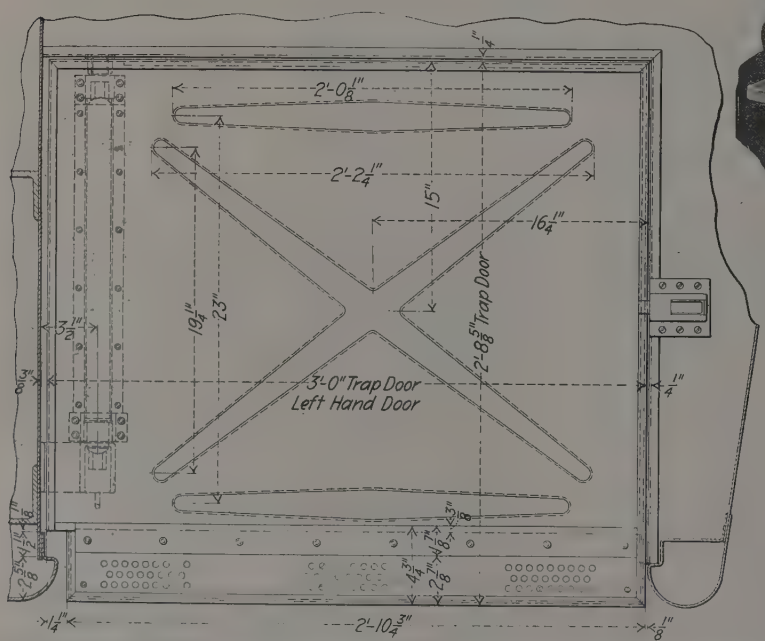
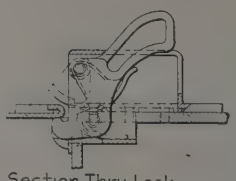


Fig. 824—Tuco K-1 Kicker Lock for Vestibule Trap Door. Tuco Products Corporation.

(See also Page 449.)





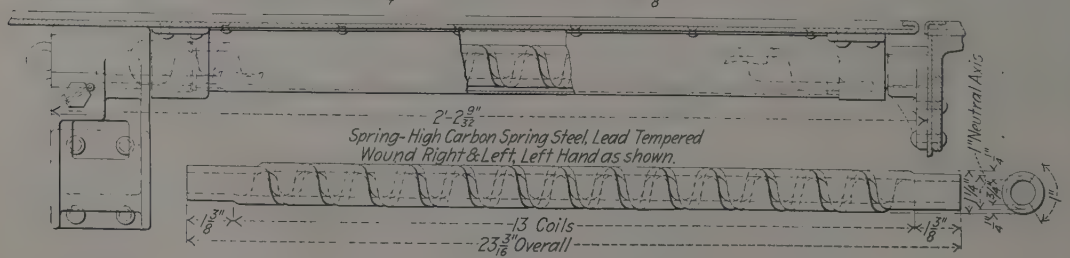

2'-2 9/32"
Spring-High Carbon Spring Steel, Lead Tempered
Wound Right & Left, Left Hand as shown.
13 Coils
23 3/16" Overall
1" Neutral Axis

Fig. 825—Universal Trap Door and Lifting Device. Tuco Products Corporation.

(See also Page 449.)

Vestibule Trap Doors and Trap Door Locks

Tuco Trap Doors and their attachments for the vestibules of passenger cars have for the past twenty years been in service throughout the United States and Canada and from the experience gained during that time the latest designs are now made lighter in weight and more perfect in operation. These doors are furnished in three types to meet the conditions for elevated station platforms, grade level platforms and light interurban service.

The Trap Door Plate is of No. 10 guage open-hearth steel with cross-rib depressions, combining light weight with the necessary strength and rigidity. The plates are furnished with turned over edges or, if preferred, separate binding edges of either steel or brass securely riveted on. The threshold is of the Tuco beaded thread type with a non-slip surface and of strong and rigid construction, or it can be provided in brass, if it is so desired.

The National Grade Level type of lifting device is of simple design and few parts, being fitted directly to the plate and therefore easily adjusted and repaired. The device proper consists of the following: Top bracket, top seat and spring guide, assembled and fitted to the trap door plate. Likewise there is a bottom bracket, bottom seat and adjusting plug assembled and fitted to the body end sheathing.

A compression spring is fitted over the spring guide and between the top and bottom seats. When the door is lowered the spring is compressed and when the lock is released the spring forces the trap door to rise, assuming the open position. The spring is easily adjusted by means of the adjusting plug. Platform locks of various types, platform and buffer wing nosings, open holders, lifts, hinges and bumpers are also provided.

In the National Elevated Station type, the lifting device is located under the platform, and its design is along lines somewhat similar to the grade level type, utilizing a compression spring to raise the trap door to a vertical or open position.

The Universal type door is designed to embody a lifting device fitted to the trap door plate. It is enclosed in a housing, and is so arranged that adjustments and repairs can be easily and quickly made. The spring, of special design, is of ¼ in. by 1 in. high carbon spring steel, carefully tempered and tested, and wound helically with coils ¼ in. apart. At one end it is anchored in a casting fastened to the plate, the other end is seated in the adjusting plug, fitted in the hinge bracket, and by means of this and the adjusting worm which meshes with it, the spring is easily adjusted to operate any size and weight of trap door plate.

The feature of this device is the low, smooth, and positive action it imparts to the trap door, this being directly due to the design of spring which provides a winding action and low fibre stress. The worm and plug arrangement permits any initial adjustment being made, no matter how fine, and insures all doors raising in the same manner.

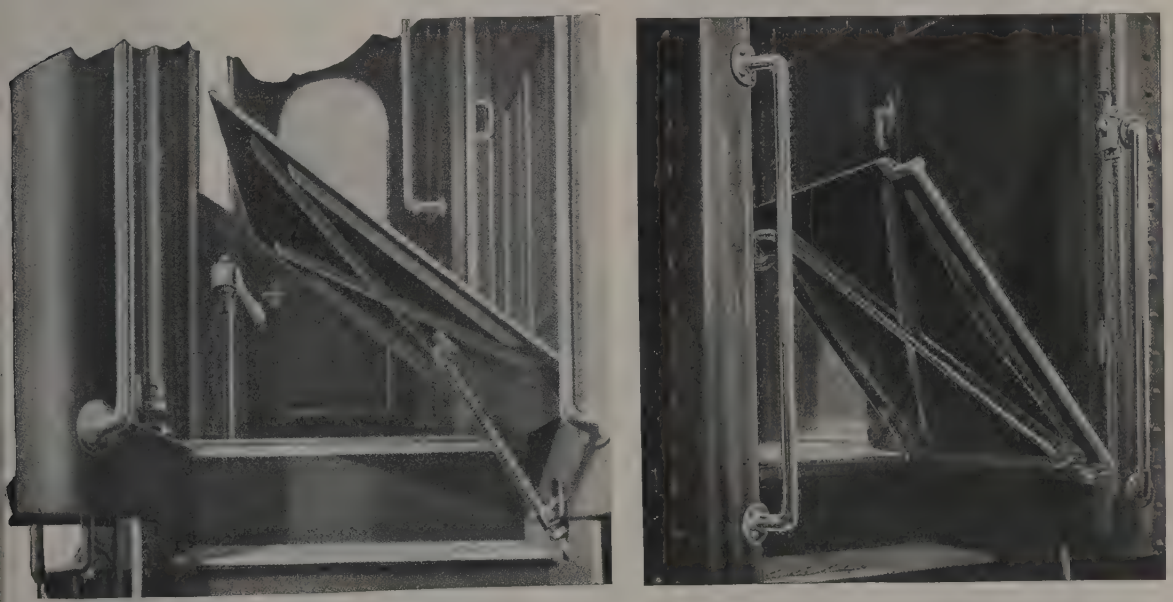


Fig. 826—National Steel Trap Doors

Various types of platform locks are provided from which a selection can be made. Either hand-operating or foot-operating locks are furnished. The K-1 lock, which permits the release of the trap door from the closed position by pressure of the foot on the starter, is especially recommended. This lock is equipped with a kicker, which is an integral part of the foot release. This construction insures full release of the trap door in all cases. It is shown in Fig. 824.

For other products and branch offices, see classified and alphabetical indexes.

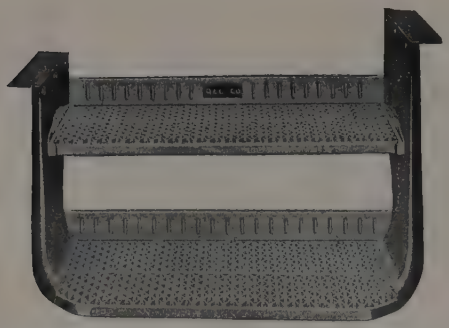


Fig. 827—Stanwood Self-Cleaning, Non-Slipping, Double Car Step. American Mason Safety Tread Company.

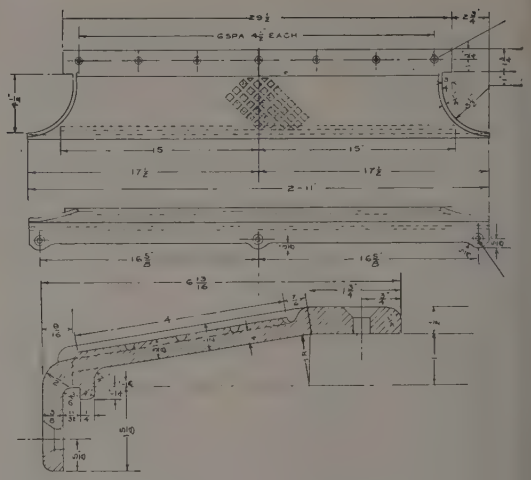


Fig. 828—End Door Threshold Plate for Passenger Cars. American Abrasive Metals Company.

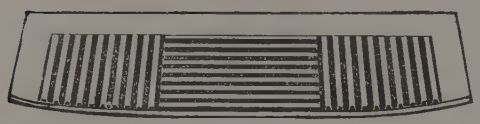


Fig. 829—Universal Safety Tread. Universal Safety Tread Company.

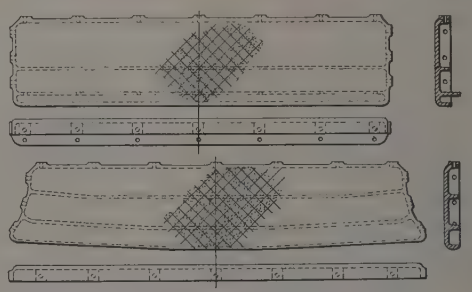


Fig. 830—Feralun Safety Treads for Passenger Cars. American Abrasive Metals Company.

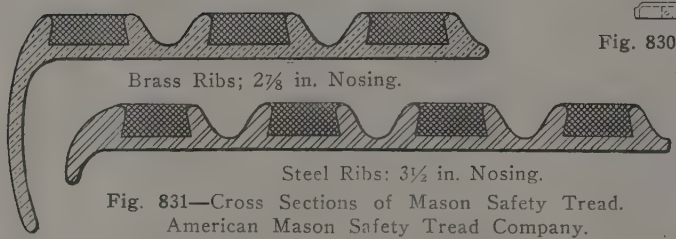


Fig. 831—Cross Sections of Mason Safety Tread. American Mason Safety Tread Company.

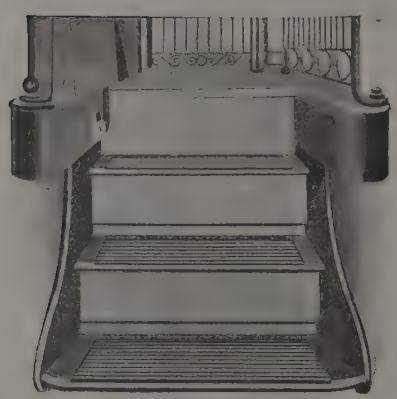


Fig. 832—Mason Safety Tread Applied to Steps of Pullman Car. American Mason Safety Tread Company.

Fig. 833—Steel Step Equipped with Kass Safety Treads. Morton Manufacturing Company.

(*See also Page* 451.)

Tail Gate, Step Box, Safety Tread

In addition to the manufacture of diaphragms for passenger car vestibules as described elsewhere in this book, the Morton Manufacturing Company make the Acme Folding Tail Gate for passenger equipment and the Kass Safety Tread for use on step boxes, in several standard forms for car steps, and also as a safety device on brake steps on freight cars.

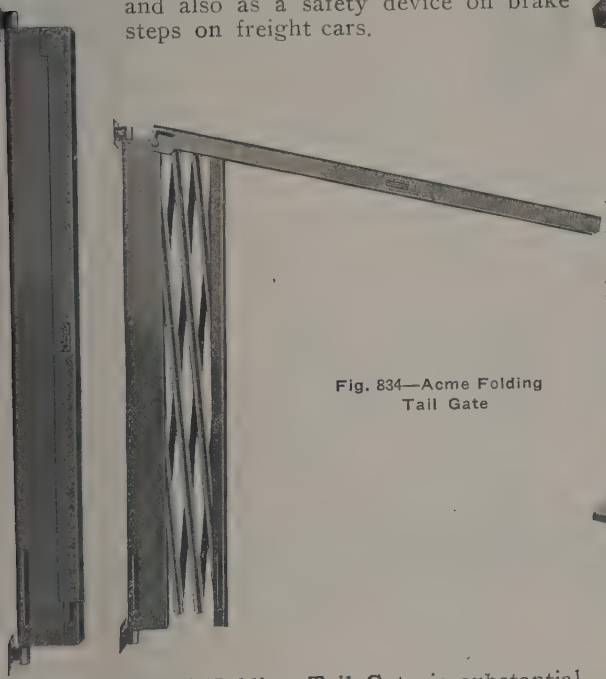


Fig. 834—Acme Folding Tail Gate

The "Acme" Folding Tail Gate is substantial in construction, simple in its encased design, neat in appearance, light in weight, has no projection to tear clothing and can be readily applied to the platform of any car.

The Kass Safety Step Box is designed for use on station platforms for the convenience of passengers when entering or leaving a car. The Kass Safety Tread top insures secure footing for the passenger and rubber feet hold the box safely in place, making an ideal anti-slipping combination. The edge of the top of the box is enameled white, thereby enabling passengers to distinguish readily the outline of the box when alighting from the car at night or in poorly lighted train sheds. Hand holes in the ends, a foot brace on one side, and the name of the railroad embossed on the opposite side, are additional attractive features.

Fig. 835—Acme Steel Step Box with Kass Safety Tread Top and Rubber Feet

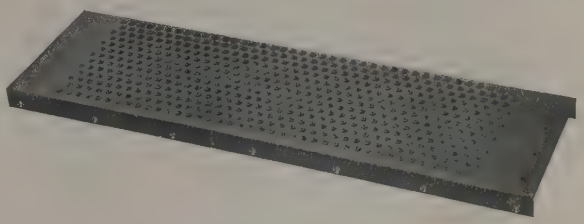


Fig. 836—Kass Safety Tread, Straight Drop

Kass Safety Step Treads applied to the steps of passenger cars prevent passengers from slipping when ascending or descending the steps, and possess a combination of merits for such service. They are made with a straight drop front and back—see Fig. 836—and with a round nose—see Fig. 837. For application to steps now in service, the flat plate illustrated in Fig. 838 is used. Complete sets of steel steps equipped with Kass Safety Treads as shown in Fig. 833 will be furnished if desired.

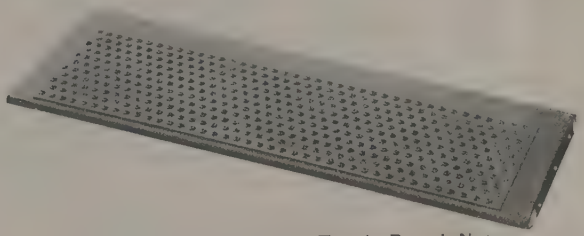


Fig. 837—Kass Safety Tread, Round Nose

The Kass Safety Brake Step for use on freight cars eliminates the danger of brakemen slipping while applying hand brakes; the standard Kass Safety Tread on the top of the step insures secure footing. The step can be furnished with or without brackets to suit any style of brake ratchet wheel and pawl. The application of this step obviates any further expense for maintenance repairs, as it is made of rust resisting steel plate and is practically unbreakable—See Fig. 1969 on page 848.

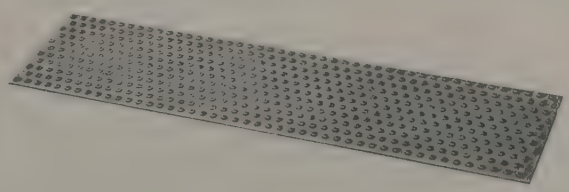


Fig. 838—Kass Safety Tread for Application to Steps now in Service

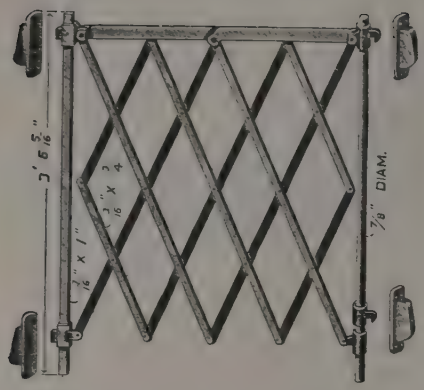


Fig. 839—Folding Tail Gate and Fixtures. The Dayton Manufacturing Company.

Fig. 840—Tail Gate Sockets. Adams & Westlake Company.

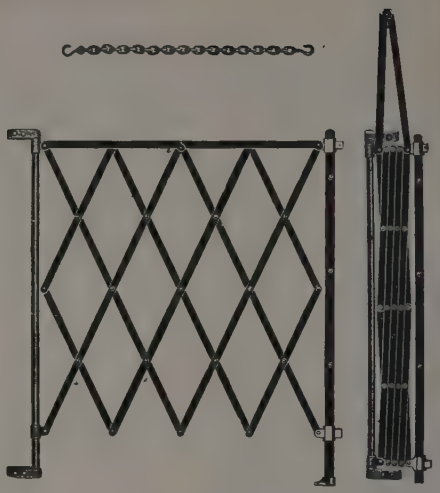


Fig. 841—Folding Platform Tail Gate. Adams & Westlake Company.

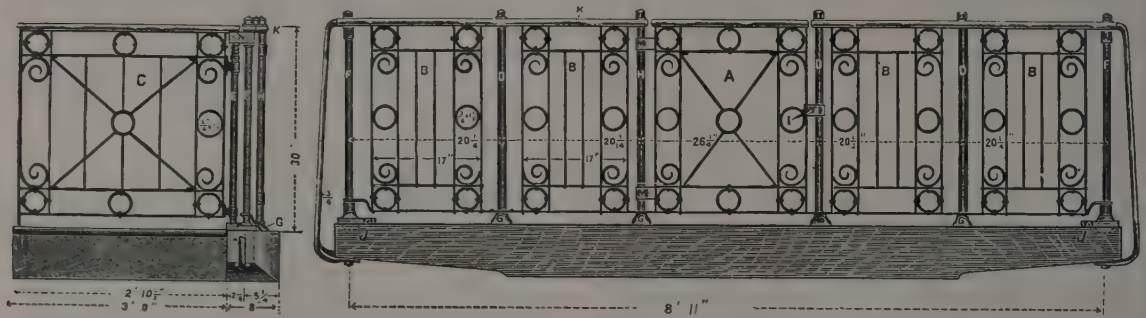


Fig. 842—Platform End Railing. The Dayton Manufacturing Company.

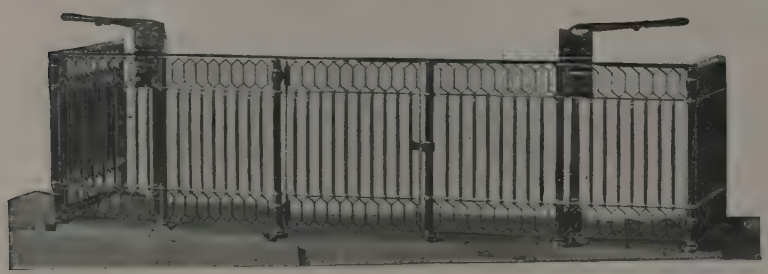


Fig. 843—Observation Platform Railing. Adams & Westlake Company.

Fig. 844—Observation Platform Railing. James L. Howard Company.

Fig. 845—Standard Tail Gate Brackets for New York, New Haven & Hartford. James L. Howard Company.

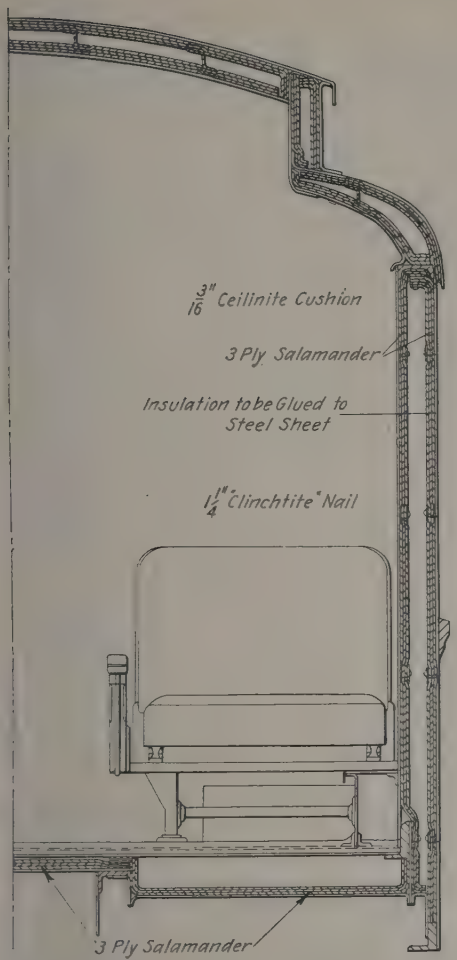


Fig. 846—Application of Three-Ply Salamander Insulation to Steel Coach.
Johns-Manville, Inc.

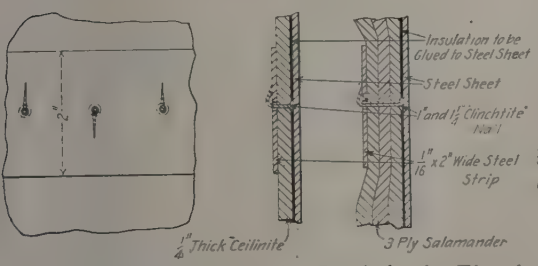

2"
Insulation to be Glued to Steel Sheet
Steel Sheet
1" and 1 1/4" Clinchtite" Nail
1/16" x 2" Wide Steel Strip
1/4" Thick Ceilinite
3 Ply Salamander

Fig. 847—Method of Fastening Insulation by Electric Spot Welding and Clinchtite Nails.
Johns-Manville, Inc.

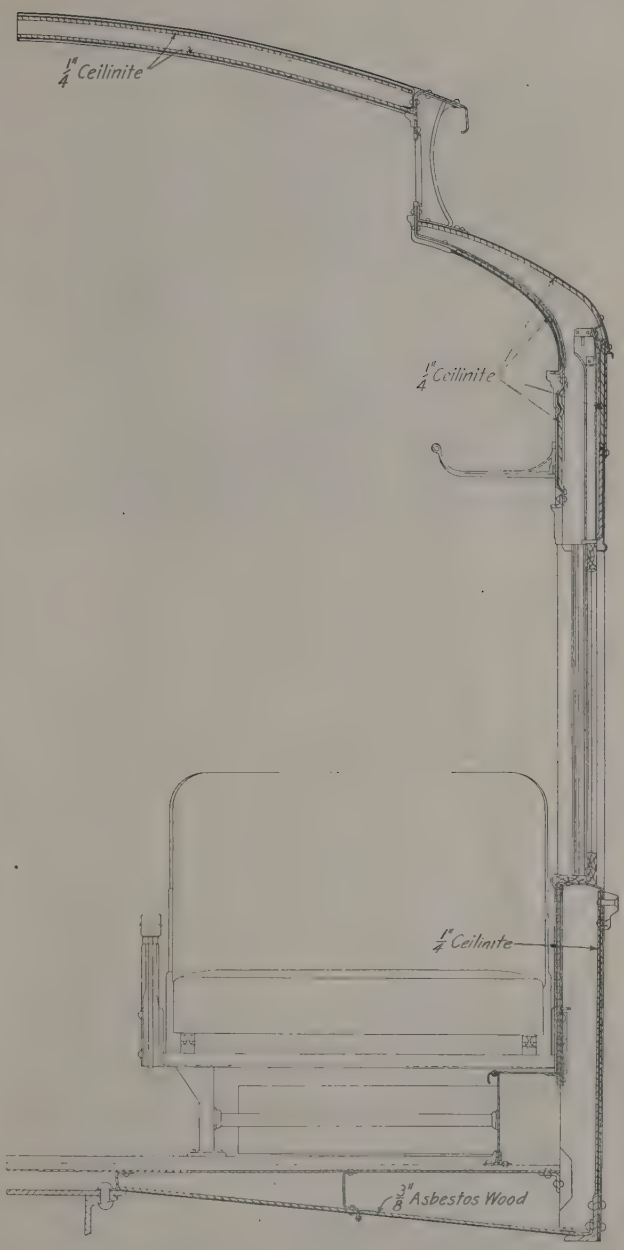


Fig. 848—Application of J-M Ceilinite Fireproof Insulation to Passenger Coach.
Johns-Manville, Inc.

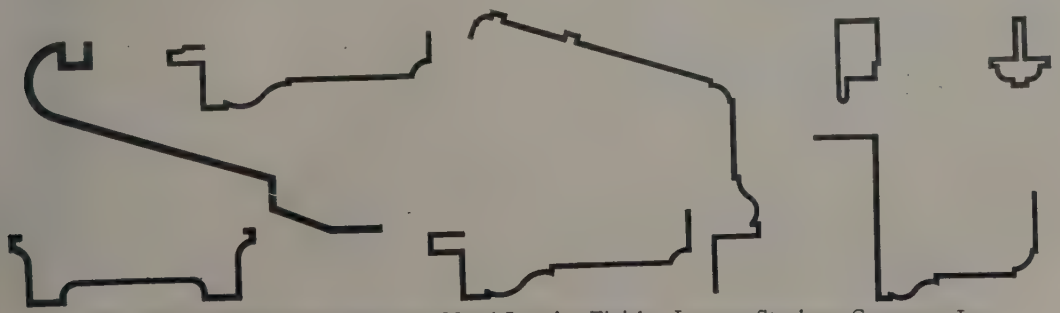


Fig. 849—Sections of Moldings for Metal Interior Finish. Lawton-Stephens Company, Inc.

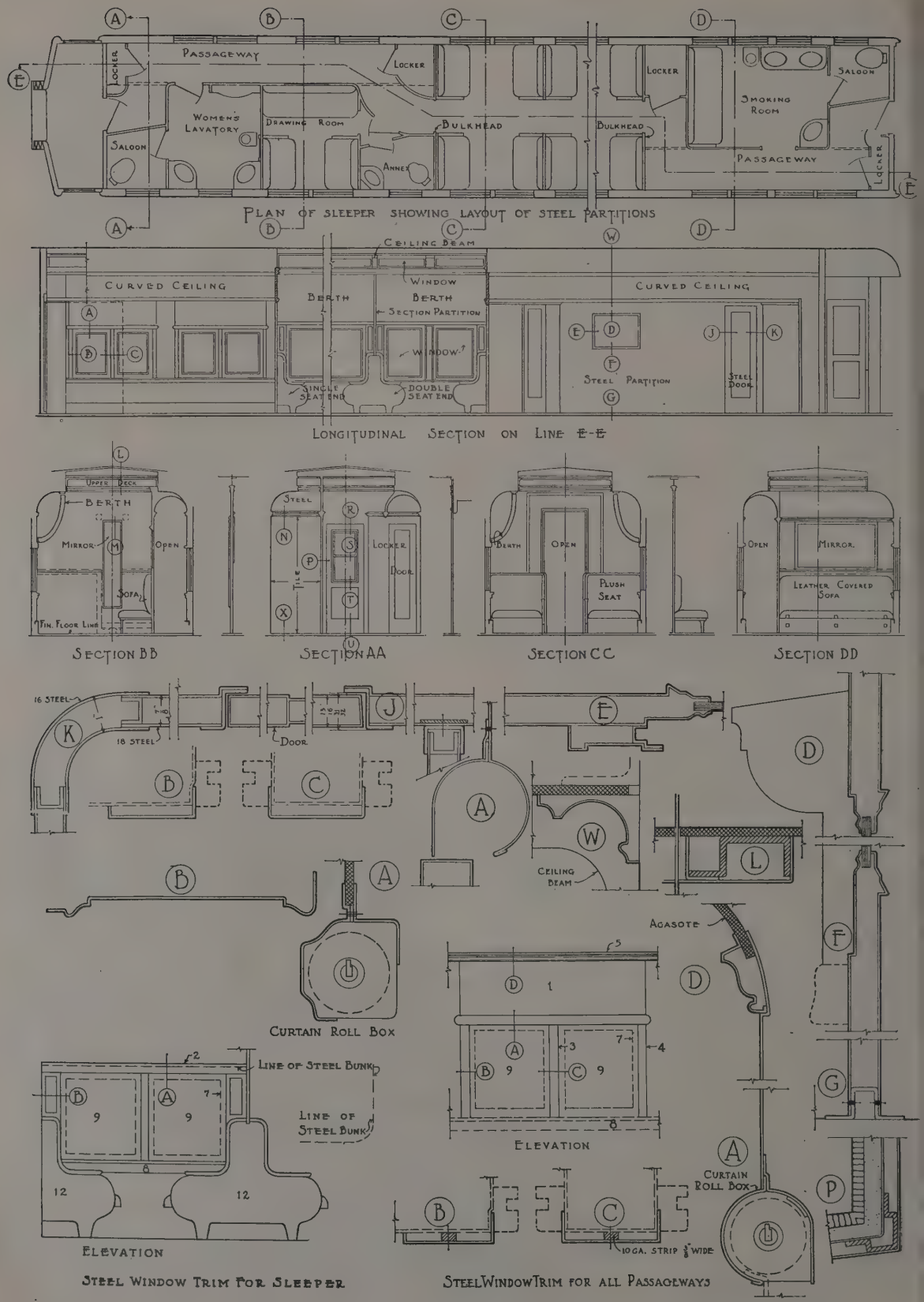


Fig. 850—Steel Interior Finish for Passenger Train Cars. Dahlstrom Metallic Door Company.

(*See also Page* 455.)

Dahlstrom Shapes, Cold Drawn and Pressed Steel

The convenience and appearance demanded for the interior of the all-metal passenger train car, are responsible for one of the important problems of car building, since the material and shapes used must be made to resemble wood and must have adequate strength without unnecessary weight. Even the strength of the car as a whole, as well as its satisfactory operation, depend upon the choice of interior steel work.

Dahlstrom interior trim proved satisfactory for use in fireproof building construction and when it was seen that the use of all-metal cars would become compulsory, Dahlstrom engineers were called upon to equip several cars with berths and other interior metal trim. The Pullman car "Jamestown" was the first absolutely all-steel car built and was completely

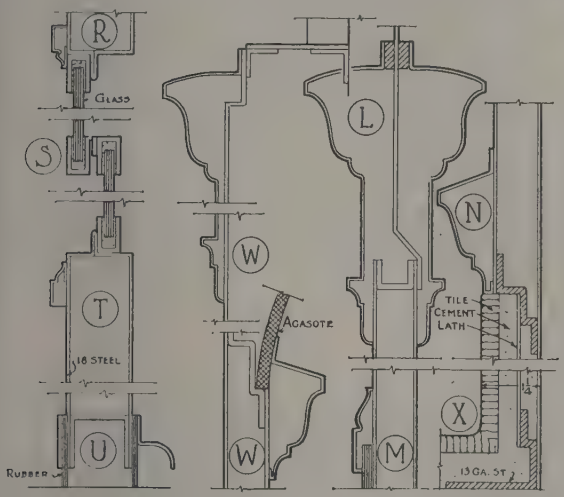


Fig. 851—Sections Showing Methods of Using Various Dahlstrom Shapes

fitted with Dahlstrom equipment. This car was exhibited at the Jamestown Exposition in 1907.

The manufacturing processes used in the fabrication of Dahlstrom products have been carefully developed. The finish is obtained by enameling and baking which results in an effect equal to that of the most costly woods. The beauty of both color and grain is retained indefinitely.

Dahlstrom metal berths have proved their worth ever since their adoption to replace wood. The finish is more lasting, they are stronger and more substantial, and they will not crack or warp out of shape. They are easy to keep neat and clean, and repair costs have proved to be very light.

Partitions and partition panels are other Dahlstrom products which are suitable for use in connection with the construction and operation of private and sleeping cars, but the use of Dahlstrom equipment is not confined to these types of cars. Such parts as sash rests, car posts, car moldings, doors, seat ends, window battens and many others are adaptable for day coaches, buffet cars, dining cars, baggage cars and mail cars.

The advantages which result from installing Dahlstrom equipment are in line with the development of railway cars in the direction of safer and

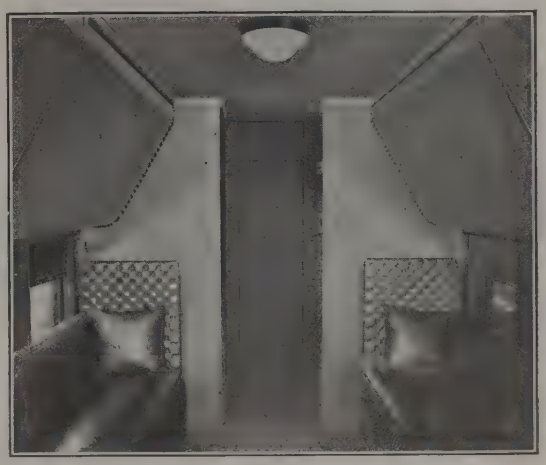


Fig. 852—Private Car Section, Showing Steel Berths and Partitions

better service for the traveling public. The use of metal interior trim adds considerably to the strength of the car and at the same time an absolute safeguard against fire risks is provided. Both of these characteristics are of great value in case of wrecks.

The uniformity of design and color are valuable in harmonizing the interior appearance of cars. Creaking noises, such as are caused by the wearing of the car structure acting upon wooden interior trim, do not occur in passenger cars which are fitted with Dahlstrom equipment. In all respects, Dahlstrom equipped cars are quiet in operation.

From the standpoint of durability, Dahlstrom shapes and moldings are effective in keeping down maintenance expenses. As previously mentioned,

Fig. 853—Dahlstrom Steel Berth with Partition Panel in Place

the finish lasts and the parts themselves are made true to design and of high grade cold rolled steel and are as permanent as the car structure itself.

For other products and branch offices, see classified and alphabetical indexes.

DAHLSTROM METALLIC DOOR COMPANY, JAMESTOWN, N. Y.

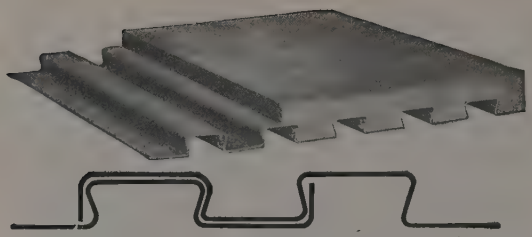


Fig. 854—Keystone Car Flooring. Berger Manufacturing Company.

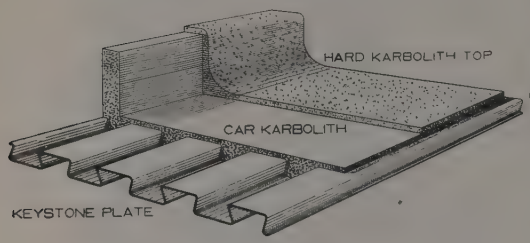


Fig. 855—Karbolith Flooring as Applied to Steel Passenger Cars. American Mason Safety Tread Company.

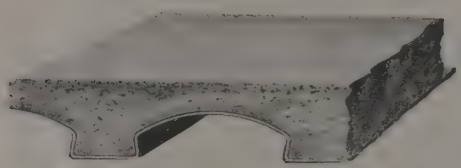


Fig. 857—Flexolith Composition Flooring. Tuco Products Corporation.

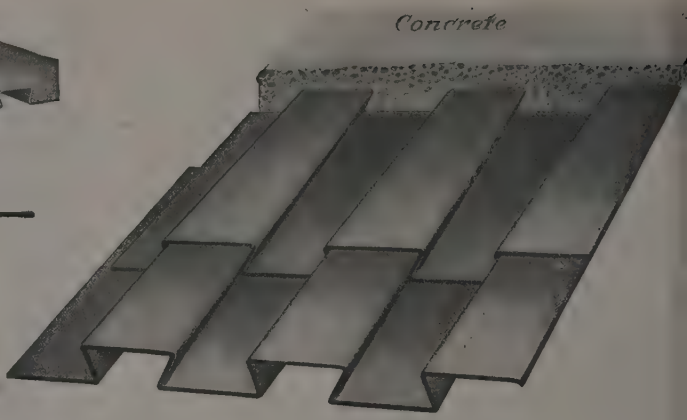


Fig. 856—Ferroinclave Floor Covering. Brown Hoisting Machinery Company.

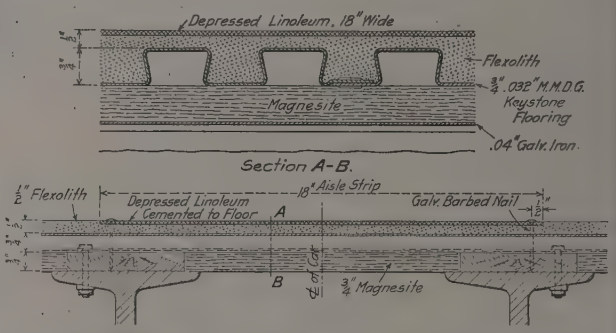


Fig. 858—Depressed Aisle Strip. Tuco Products Corporation.

(See also Page 457.)

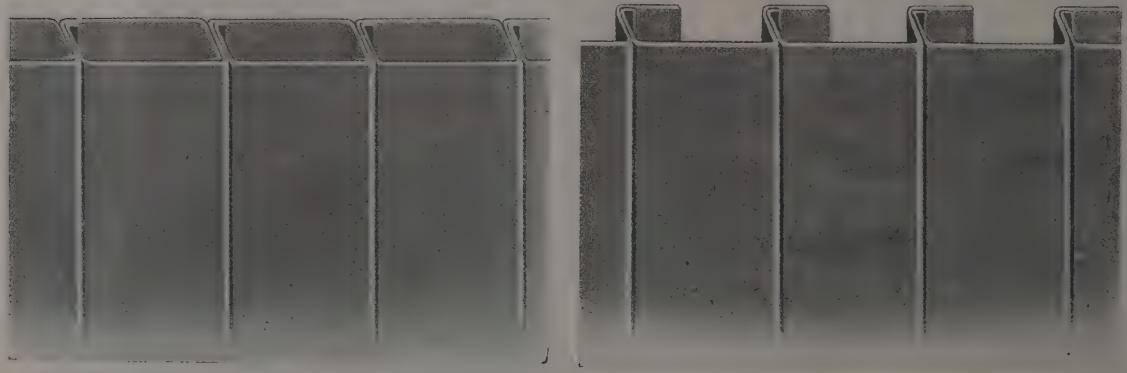


Fig. 859—No. 3 and No. 3-A Slat Metallic Steel Sheathing for Wood Cars. Tuco Products Corporation.

Fig. 860—No. 1 and No. 1-A Panel Metallic Steel Sheathing for Wood Cars. Tuco Products Corporation.

Composition Flooring and Floor Insulation

Flexolith or Tucolith is a plastic composition flooring which has been developed particularly to meet the severe wear and tear continuously found in passenger car service. It is a mineral product, which careful study and experimentation has shown will provide a durable and economical floor. At the same time it gives the proper degree of resiliency and elasticity to provide a

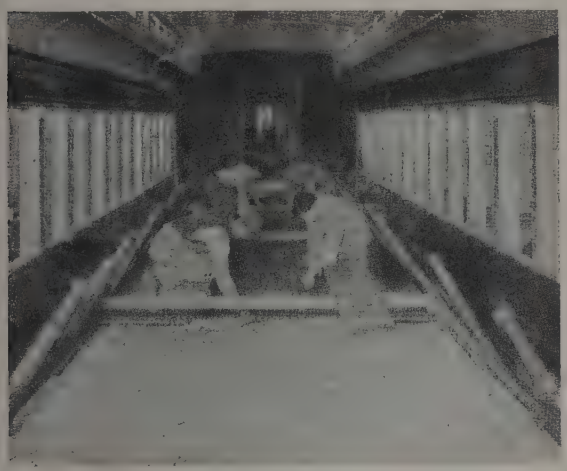


Fig. 861—Laying Flexolith Composition Flooring

floor comfortable to walk upon. In addition, Flexolith meets the present day requirements of train service, for it is fireproof, waterproof, sanitary, dustless, and is a non-conductor of electricity.

It is furnished in two forms: ready mixed dry material, and the necessary liquid binder. At the time of application the two are mixed to a plastic condition and then laid, the complete operation being finished within the ordinary working day, after which it is allowed to harden and is ready for service in approximately twenty-four hours. A sketch of the cross-section of a Flexolith floor is shown in Fig. 857.

Tucork is a mineral insulating material for use in passenger car floor construction, somewhat resembling wool felt in appearance and texture. It is manufactured from a material secured in rock form, which is melted and blown into a mineral wool. This in turn is mixed with a liquid binder, the mixture being poured into containers of the desired depth. These containers have a wire mesh bottom through which the liquid is permitted to drain, the solid material settling on the screen in sheets, the thickness of which depends upon the depth of the liquid mixture in the tank. After draining, the material is placed in drying ovens where all the moisture is evaporated, the material in its final form being made up of 85 per cent to 90 per cent enclosed air cells.

Being of mineral structure, the insulation is fire resisting and tests have shown that it is practically waterproof. After being submerged in water for a period of one hour, the material shows a gain in weight of only one per cent. The material is light in weight and is manufactured in the form of blocks or sheets which are quickly and easily applied. A cement is furnished with which the blocks are secured to the sheets on which they rest, and with which all joints are sealed.

Flexolith and Tucork are products made in strict accordance with Tuco principles of reliability and dependability and the Tuco Products Corporation maintains a service department which is at all times ready to co-operate with and instruct the users in the proper handling and application of these materials. Results of tests are available for distribution.

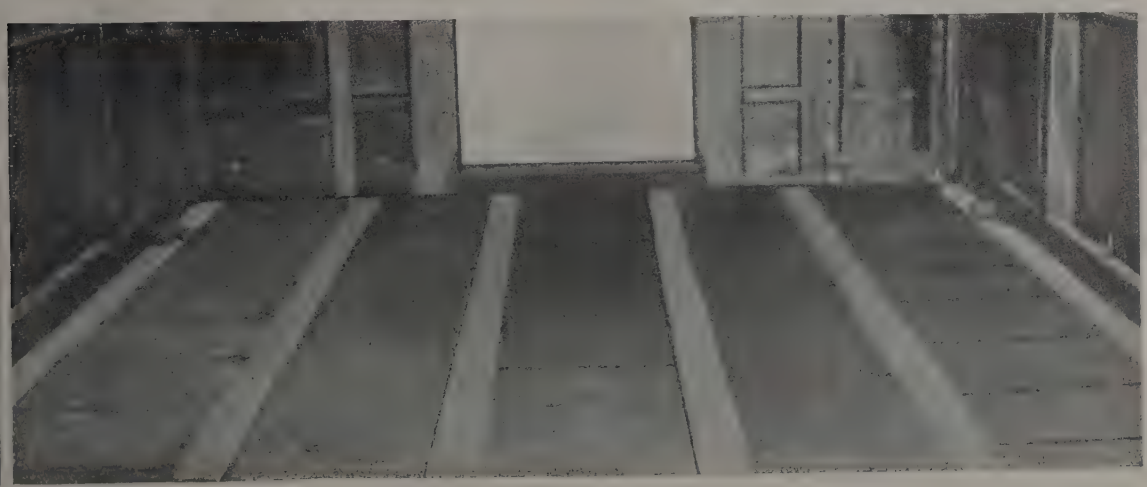


Fig. 862—Tucork Floor Insulation Applied to a Steel Passenger Car

That this product has met adequately the severe service conditions of railway passenger equipment is well proven by the long period of service it has given. Having been in use for the past 18 years, it is now on nearly every railroad in the country and is in use on some 36,000 passenger cars.

For other products and branch offices, see classified and alphabetical indexes.

TUCO PRODUCTS CORPORATION, 30 CHURCH ST., NEW YORK, N. Y.

Resisto, Rockwul and Tucork Insulation

With the advent of steel passenger car equipment it was found necessary to protect the passengers from the cold in winter and the heat in summer which would otherwise, due to the high heat conductivity of steel, penetrate into the car and make travel extremely uncomfortable. Resisto, Rockwul and Tucork—Tuco Products—have been developed after thorough laboratory and service tests, for just such a purpose.

Resisto is a hair-felt insulation composed of special long fibre animal hair woven with a burlap center into a closely knit felt, and covered on both sides with a fabric which has been given a special treatment rendering it both water and fire resisting, thus insuring maximum insulating qualities. This treatment at once bonds the fabric to the felt and hermetically seals the dead air cells. This material has ample flexibility and can be made to conform to curved or irregular surfaces without injury to its composition or efficiency.

Being of light weight, Resisto does not materially add to the weight of the cars. With its high insulating value and its fire resisting qualities—a condition that must be met in passenger service—it is an ideal material for insulation.

The application of Resisto to the side of the car is done by forcing it over nails which have been spot-welded into the side sheets, a tin washer being slipped over the nail which is then bent to hold the washer on. This practice insures the sheets of Resisto being held firmly and permanently in place and greatly simplifies the problem of proper application. Steel bands or wires are used to support the insulation in the decks and ceilings. Resisto insulation is manufactured in single and double ply of ¼ in. and ½ in thickness respectively and is furnished cut to size, with a maximum width of 36 in.

Rockwul—another Tuco Product—is particularly adapted for refrigerator and tank car insulation. Rockwul is made from an argillaceous limestone which is melted, by means of high grade coke, in a water-jacked cupola at temperatures much higher than the melting point of steel. As the melted limestone is drawn off from the cupola, in a small stream, it is blown by a powerful jet of steam, acting across the flow of the stream, into light fluffy shreds which are exactly similar to natural wool. This material when made into quilts has a very high heat resisting value. Being entirely of a mineral nature it is fire proof; it does not absorb water and is entirely waterproof; weather has no effect upon it nor does it deteriorate with age. Rockwul, therefore, is most suitable for refrigerator and tank car insulation.

Tucork—described elsewhere in this book—is an insulation particularly adapted for car flooring and other purposes where insulating board is desired. It is compressed Rockwul made into blocks with a suitable binder; is fireproof, water proof and has a high insulating efficiency. It has no capillary attraction for moisture and will not support combustion.

Extensive tests have been made of the Tuco Insulating Materials at the Purdue University which show a high rating for these products.

Fig. 863—Method of Applying Resisto Insulation

For other products and branch offices, see classified and alphabetical indexes.

TUCO PRODUCTS CORPORATION, 30 CHURCH ST., NEW YORK, N. Y.

Fig. 864—Perspective View Wedge Type Sash Lock A-89 with Extruded Brass Stop Bar Applied to Steel Stop Casing. Side and Bottom Weather Stripping are Also Shown.

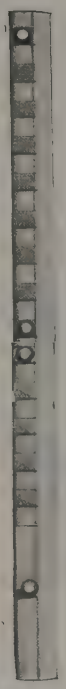


Fig. 865—Lock Rack A-204.

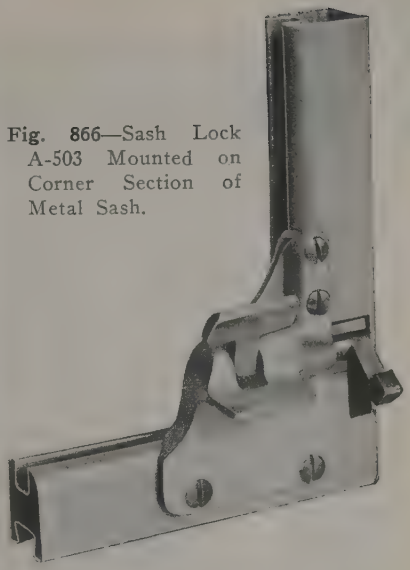


Fig. 866—Sash Lock A-503 Mounted on Corner Section of Metal Sash.

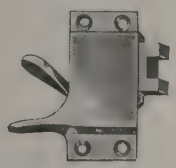


Fig. 867—Lock No. A-89.

Fig. 868—Plan View of Wedge Type Sash Lock A-89 Applied to Sash with Sectional View of Detented Steel Stop Casing.

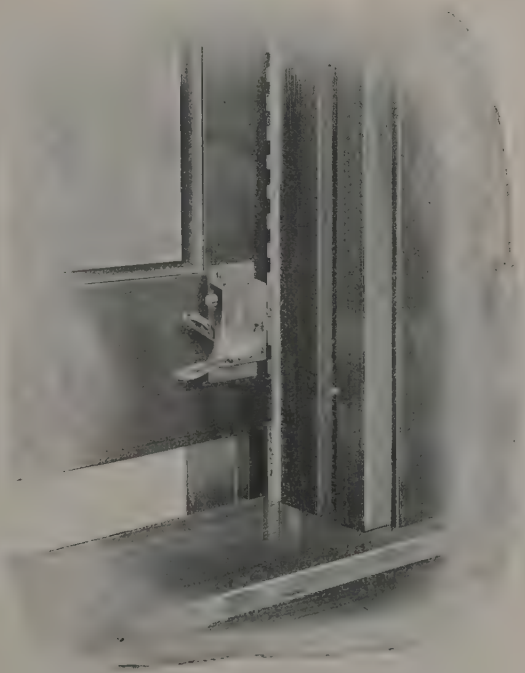


Fig. 869—Perspective View Wedge Type Sash Lock A-89 with Extruded Brass Stop Bar Applied to Wood Stop Casing.

Fig. 870—Edwards All-Metal Sash Balance with Continuous Chain.

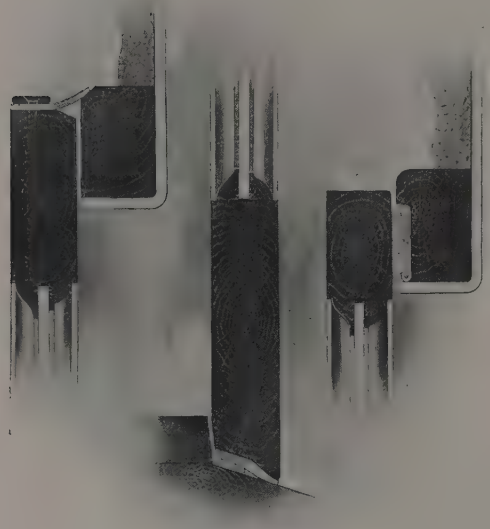


Fig. 871—Edwards Top and Bottom Weather Stripping.

Fig. 872 — Edwards Compression Brake Device.

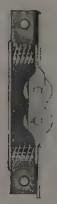


Fig. 873—Compression Device A-101.

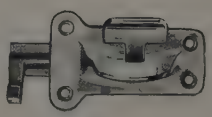


Fig. 874—Lock No. A-22.

Fig. 875 Lock Ra A-201.

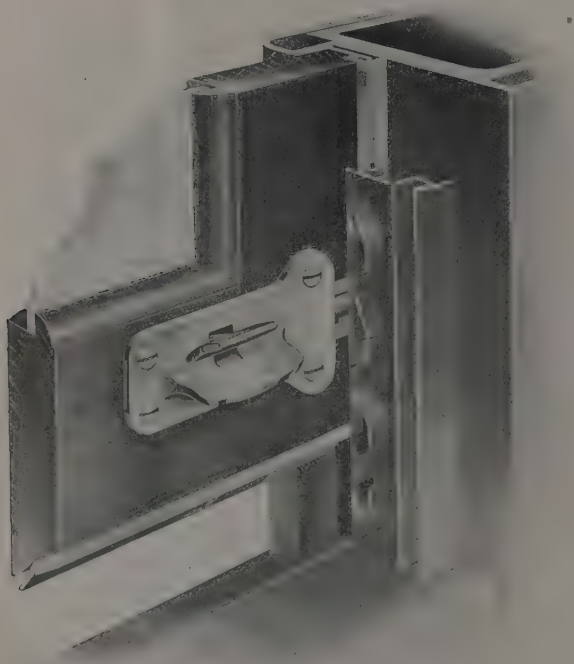


Fig. 876—Edwards A-21 Sash Lock with Phantom View of Detents in Steel Stop Casing. Side and Bottom Weather Stripping Also Shown.

Fig. 877—Edwards Extension Lock A-501 with Phanton View of Detents in Steel Stop Casing.

(*See also Page* 461.)

Balanced and Unbalanced Sash Fixtures

Two distinct types—balanced and unbalanced—window fixtures are manufactured by the O. M. Edwards Company. Various designs of both classes can be furnished to suit any standard or special type of passenger equipment. All sash are applied to the window frame with a clearance space of about 1/8 in. edgewise and 3-32 in. between the face of the sash and the stop casings. At each side of the window a corrugated metal bar is fastened to the front edge of the stop casings.

A combined lock and sash tightener is placed near the bottom corners of the sash. This device has a rocker shaft lever operated by a finger latch extension, which controls an extending arm for making contact with the corrugated bar on the front of the stop casings. This arm presses the sash against the outside stops at the bottom with a self-adjusting force and thereby maintains

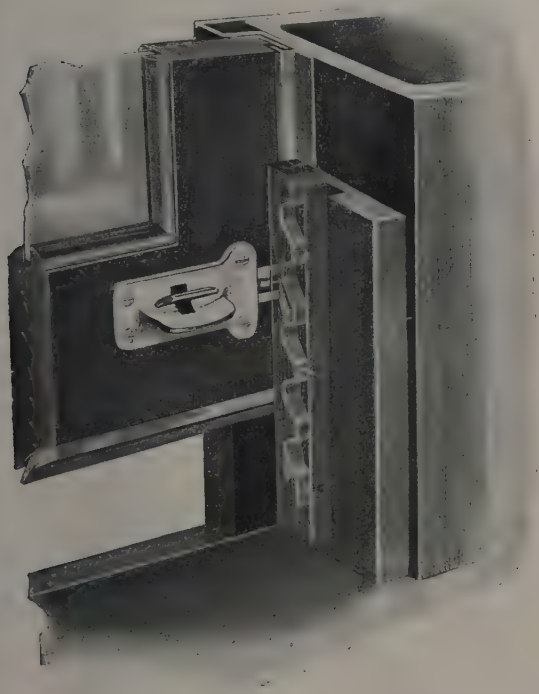


Fig. 878—No. 13 Sash Lock and Side Weather Stripping—Phantom View of Stop Bar in Operative Position

a tight joint. It is possible to lock the sash in any position since the stop bars have notches for receiving the bolt.

The unbalanced type of sash is arranged so that the top is held tightly against the outside stop by two compression rollers attached near the two upper corners of the sash and placed so as to bear against the edges of the inside stop casings. For use with thin sash, these rollers may be attached to the inside casings so as to bear against the top of the sash. The pressure of the rocker arms at the bottom and compression rollers at the top render the sash tight and free from any tendency to rattle. The lock lever is released by the compression of two small levers between the thumb and finger, when the sash can be readily raised

Fig. 879—Interior Finish Removed, Showing Application of Sash Balance

or lowered by hand. The pressure of the compression rollers at the top remains the same.

The balanced type of sash is raised by a roller sash balance. The sash is connected to the roller by a chain arranged to draw at an angle without overlapping in winding on the roller. The chain is attached to the sash by two tightening devices placed on the top at each corner. This construction causes an even pull on each side and forces the sash firmly outward against the outside stops. The balance roller is supported in plain brackets, located so that the pull will be in a

Fig. 880—Sash Lock and Side Weather Stripping—Phantom Eliminating Vibration at Top of Sash

perpendicular line from the point of attachment. Rubber buffers are provided and placed to strike against the bracket flanges when the sash is raised to its limit. The tension can be adjusted to slightly underbalance the weight of the sash. This adjustment can be made from the outside.

Edwards' window fixtures with top, bottom and side weatherstripping keep the window dust and draft proof at all times. They insure easy operation and yet permit sufficient looseness to allow for swelling of wooden sash.

For other products and branch offices, see classified and alphabetical indexes.

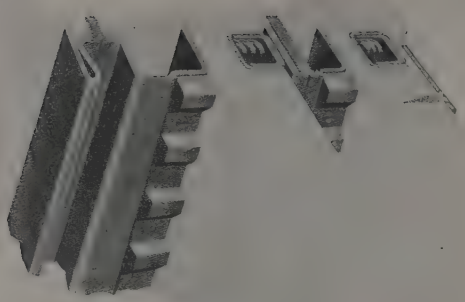


Fig. 881—Cross Section of Weatherproof Window for Double Sash. Morton Manufacturing Company.

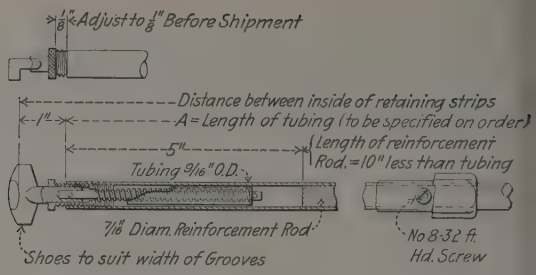

1/8" Adjust to 1/8" Before Shipment
Distance between inside of retaining strips
A = Length of tubing (to be specified on order)
1/2"
5"
Length of reinforcement Rod = 10" less than tubing
Tubing 9/16" O.D.
7/16" Diam. Reinforcement Rod
No 8-32 ft. Hd. Screw
Shoes to suit width of Grooves

Fig. 882—Acme Enclosed Groove Curtain Fixture. Morton Manufacturing Company.

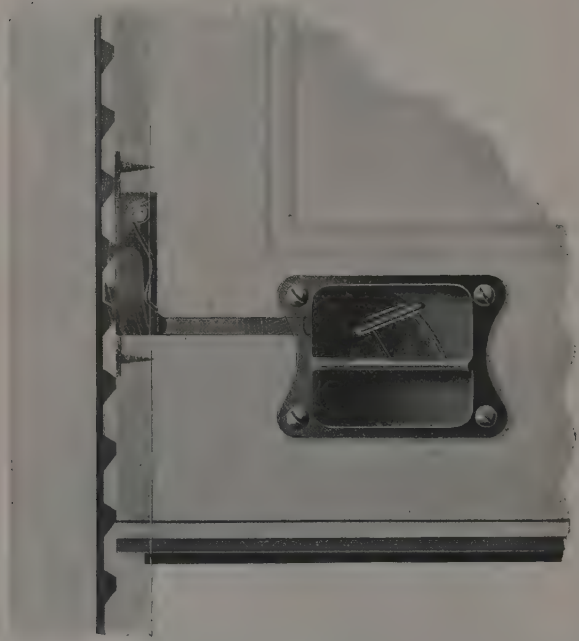


Fig. 883—Acme Flush Lock No. 3, Applied to Sash. Morton Manufacturing Company.

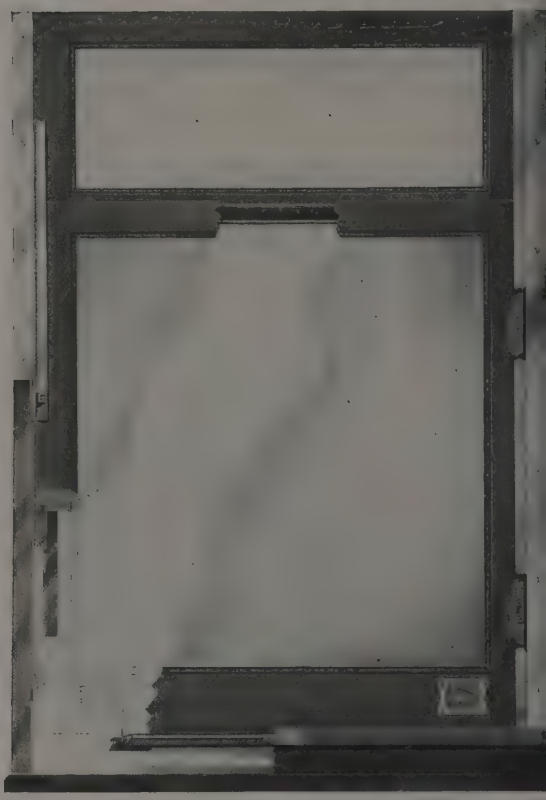


Fig. 884—Weatherproof Window, Showing Arrangemer of Side Compression Springs and No. 3 Flus Lock. Morton Manufacturing Company.

(See also Page 463.)

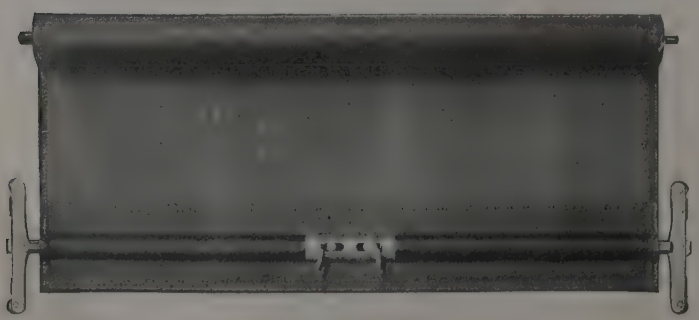


Fig. 885—Sta-rite Curtain with Fool-proof Fixture. Railway Supply & Curtain Company.

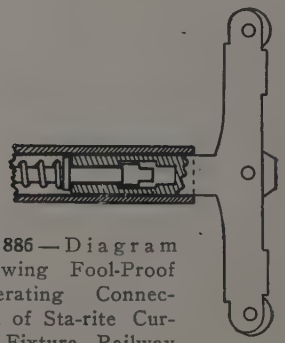


Fig. 886—Diagram Showing Fool-Proof Operating Connection of Sta-rite Curtain Fixture. Railway Supply & Curtain Company.

"Acme" Curtains, Fixtures, Weather Strips

Car window curtain fixtures as made by the Morton Manufacturing Company are fitted with various grades of Pantasote and Fabrikoid material to meet any specifications. This company manufactures three principal types of "Acme" fixtures namely, Crown, Friction and Protected Groove.

The Crown Curtain Fixture consists of a rod passing through the hem in the bottom of the curtain with a pinch handle in the center operating a brass shoe at either end. The shoes which carry small wheels at the top and bottom and a friction surface at the center, are pressed against the bottom of the groove by a spring sufficiently strong to hold the curtain securely.

The Protected Groove Fixture has flanged shoes bearing against a metal strip and is so constructed that it will not creep, tilt, jamb or leave the groove. This fixture—Fig. 882—is made without pinch handles, but can be raised or lowered by taking hold of the bottom rod at any point.

Fig. 887—Crown Curtain Fixture, Showing Ticket Holder

The Friction Fixture, unlike the other types, is operated by means of a friction plug inserted in one end of the roller. It permits the curtain to be raised or lowered easily, but will hold it at any desired point. By having the friction or holding device at the top, the shoes at the ends of the bottom rod are allowed to move freely in the groove; the gravity weight in the bottom of the curtain prevents any tendency toward upward creeping.

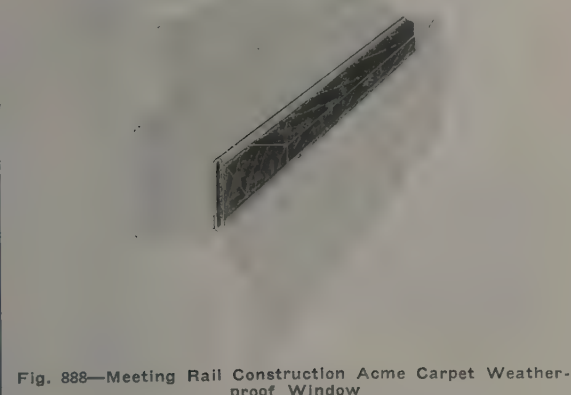


Fig. 888—Meeting Rail Construction Acme Carpet Weatherproof Window

The "Acme" Weather Strip, for use on car windows, is simple and effective. The sides of the sash are fitted with brass weather-stripping, which overlap outside steel strips attached to the window posts. The top meeting-rail weatherproofing consists of a strip of metal bound velvet carpet bearing against the top rail of the lower sash. At the bottom of the sash a double-lipped rubber strip, reinforced with metal, is applied along the bottom of the lower rail, bearing tightly on the window sill when the sash is down. The Acme weather strip system provides a permanent weatherproofing; permits the sash to be raised and lowered easily; at the same time tight joints are insured, thus effectually excluding all dirt and dust. Various applications of weather-stripping are shown in Figs. 881, 884, 888 and 889.

Fig. 889—Acme Double Lip Rubber Weather-Strip for Bottom of Sash

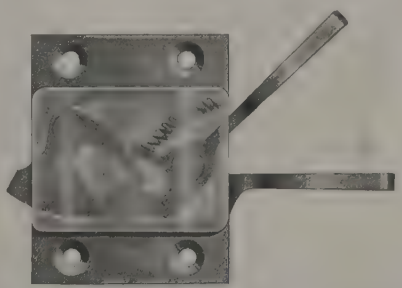


Fig. 890—Acme Type C Sash Lock for Application to the Base of the Sash

The "Acme" Type C and Type D Sash Locks for car windows are designed for application to the sash face and to operate in connection with a rack on the window stop. A projection on the lock lever engages the rack and holds the window in a fixed position at any desired height. It is operated by a thumb lever, which, when depressed, withdraws the lock bolt, releasing the sash. The simplicity of the operating mechanism practically eliminates sash lock trouble. There is no possibility of corrosion as all parts are made of brass, excepting the spring which is of sherardized steel.

The "Acme" No. 3 Flush Sash Lock is intended for use on the inside of the outside sash of cars having double windows. It operates in combination with an invisible rack located in the bottom of the groove in which the sash slides. Applications of the device are shown in Figs. 883-4.

For other products and branch offices, see classified and alphabetical indexes.

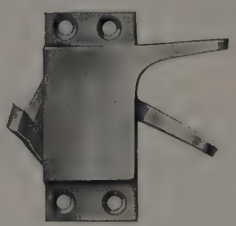
MORTON MANUFACTURING COMPANY, CHICAGO, ILL.

Fig. 891—Application of Sash Lock No. 135.

Fig. 892—Application of Sash Lock No. 121.

No. 135.

No. 121.



No. 106.

No. 102.

Fig. 893—National Sash Locks.

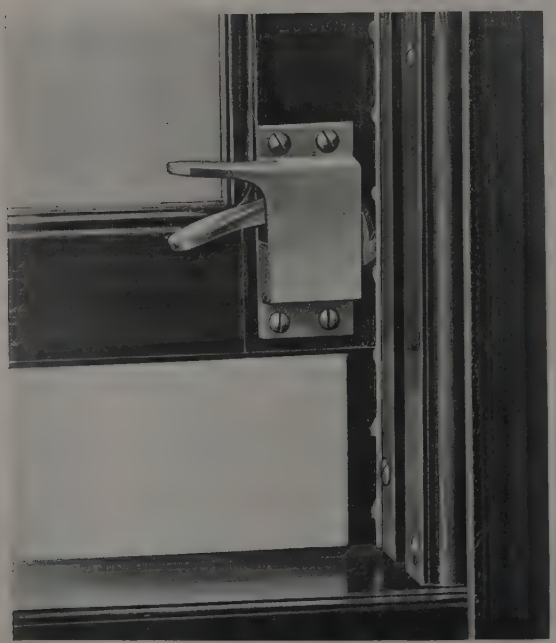


Fig. 894—Application of Sash Lock No. 106.

Fig. 895—Application of Sash Lock No. 102.

The National Lock Washer Company.

(See also Page 465.)

National Window Fixtures

The National Sash Lock No. 121—Fig. 892 and Fig. 893—is one of the latest developments by the National Lock Washer Company, and its original and unique design is characterized by several valuable features.

No wood screws are required in its application and its holding power is increased considerably over that of wood screw construction. This holding power is obtained by means of four dowel pins working in conjunction with a bronze machine screw entering outside of sash rail and going into lock case at center through a substantial boss. This design enables the lock case to be considerably diminished in size, since no flanges are necessary for wood screws, so that the sash lock is adaptable to the extremely narrow type of sash rail. The greater tendency the sash has to fall, the more securely the lock tends to hold. National Sash Lock No. 121 is designed with locking lever both plain and beveled, the beveled type being designated as No. 141.

The National Sash Lock No. 108—as with most National Sash Locks—has for the basic principle, that of the cam or eccentric. Its teeth engage in the teeth of a cast bronze rack and its bottom locking lever prevents the sash from falling. The top lever prevents the sash from being raised from the outside of the car. For the convenience of passengers, the operation of the lower lever also operates the upper lever. However, the upper lever can be compressed without affecting the lower lever. This lock is shown in Fig. 896.

Fig. 896—National Sash Lock No. 108

The National Sash Lock No. 135—Fig. 891 and Fig. 893—is designed in accord with a well established type of lock. Its detailed construction, however, is of superior design. The lock case is made of solid bronze; the locking lever and shaft are drop forged alloy steel, which drop forgings are made in the shops of the company.

Increasing popularity has characterized the use of this type of lock for many years. One of the early shortcomings of its design has been overcome by providing the locking lever and shaft with well designed and adequately spaced bearings. The method of attaching the locking shaft to operating lever has also been improved. Formerly this construction consisted of a driven fit of the shaft into the operating lever, secured by a rivet. All National shafts have a square section at the junction point of the shaft and the operating lever. This arrangement allows the use of a driven fit of square shaft into a slotted hole in the operating lever. Other designs of this same type of lock are available upon request, or special designs to suit any special sash rail will be made up.

The National Sash Lock No. 102—Fig. 893 and Fig. 895—requires no mortising for application. The design is based upon the eccentric principle and, as in the case of the No. 121 lock, the greater tendency the sash has to fall, the more securely the lock tends to hold.

The National Sash Lock No. 106—Fig. 893 and Fig. 894—has the nose of its locking lever beveled so that it engages itself in a rack applied to the sash stop on a bevel. Thereby the sash is forced toward the outside stop of the car and increases the security of the outside joint between the sash stop and the sash rail.

The National Compression Cam No. 104—Fig. 897—is a device primarily designed to force the sash towards the outside window stop and thereby increase the security of the joint between outside stop and sash rail. The spring compression of this anti-rattler very slightly impedes the raising of the sash; however, because of the eccentric or cam principle of the device, the compression cam materially impedes the falling of the sash.

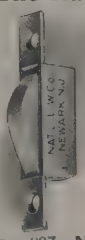


Fig. 897—National Compression Cam No. 104

The National Sash Balance No. 109 is decidedly unique in construction in that the patented attaching device permits connecting the chain to the roller in the roller groove, without the use of solder. This type of balance is furnished with either a solid bronze chain or a steel chain copper plated, according to the purchaser's desires. The chain is equalizing and in one piece; thus improper application of balance is prevented. The rubber fender on the center of the chain prevents rattle by preventing contact of the chain with the sash rail and in the event of the chain breaking along any point of its length, immediately the chain is retrieved by the tension of the roller, the fender is drawn up to the pulley, and held in that position. Injury to passengers is thereby prevented. This sash balance is furnished with or without bronze pulleys integral with the compression cam No. 104 according to the purchaser's desires.

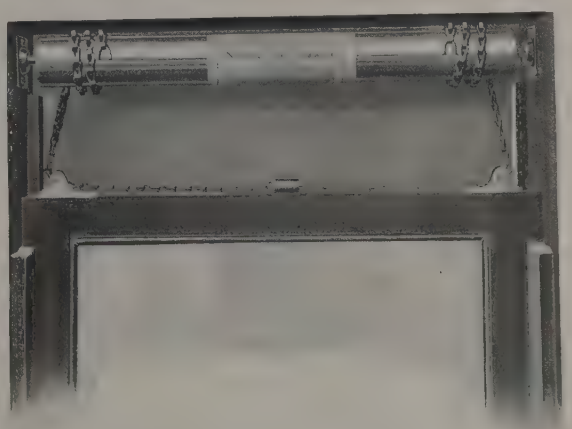


Fig. 898—Window Equipped with National Sash Balance No. 109

For other products and branch offices, see classified and alphabetical indexes.

THE NATIONAL LOCK WASHER COMPANY, NEWARK, N. J.

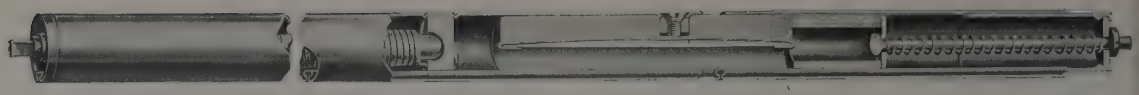
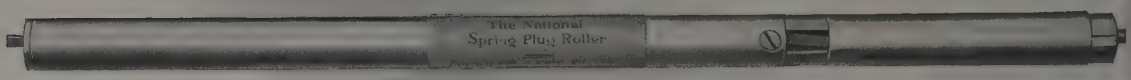


Fig. 899—Sectional View of National Curtain Roller No. 112.



No. 900—National Curtain Roller No. 112.

Fig. 901—Sectional View of National Curtain Fixture No. 114.

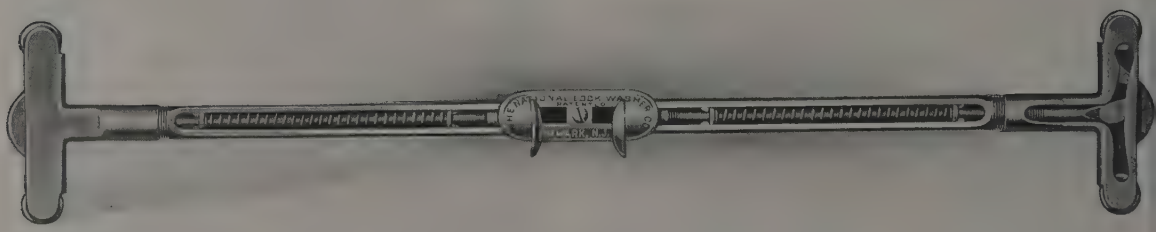


Fig. 902—Sectional View of National Curtain Fixture No. 151.

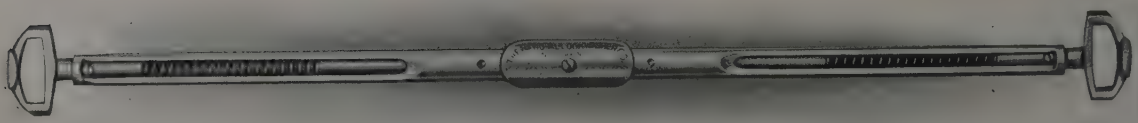


Fig. 903—Sectional View of National Curtain Fixture No. 111.

The National Lock Washer Company.

(*See also Page* 467.)

National Curtain Fixtures and Rollers

The National Curtain Fixture No. 151 is a type of curtain fixture adapted for use in connection with open grooves in both steam and electric railway cars. It is so designed that the holding power is secured by means of spring-actuated cams working through the curtain fixture heads. This type of construction permits the greatest tension to be imparted to the curtain roller and prevents at

Fig. 904—Curtain Equipped with National Curtain Fixture No. 151

all times, so-called creeping of curtain, due to vibration of the car.

The view showing the detailed construction of this fixture evidences the fact that when the curtain fixture is adjusted to proper length the manipulation of the finger pieces at center does not alter the fixed length of fixture. This arrangement prevents to a large extent the curtain fixture leaving the grooves when manipulated.

The heads, name plate, finger pieces and holding cams of the No. 151 fixture are made of bronze: the tube, springs and rods are steel. All parts of this fixture made of corrosive metals are rust-proofed. The exposed metal parts, unless otherwise specified, are furnished in bright polished bronze, lacquered. Special finishes, such as statuary bronze, nickel plate, verd antique, enamel, etc., will be furnished at slight additional cost upon request.

The National Curtain Fixture No. 114 is designed for use in enclosed or protected grooves. The fixture heads are solid bronze and at the end of each head and integral therewith is a bronze lug which, when the fixture is applied, sets behind a steel protecting strip, which prevents the curtain fixture from leaving the grooves when manipulated. The design of the heads is such that when the fixture is tilted in an extreme position, it is impossible for the heads to jam, owing to the fact that they are rounded to an acute degree.

The heads, name-plate, finger pieces and lugs of the No. 114 fixture are bronze; the tube, springs and rods are of steel. All parts made of corrosive metals are rust-proofed. Exposed metal parts, unless otherwise specified, are furnished in bright polished bronze lacquered. As in the case of the No. 151 fixture, special finishes will be furnished at slight additional cost upon request.

The National Curtain Fixture No. 111—Fig. 903—is a type of curtain fixture designed especially for use upon electric railway cars. The basic design is similar to that of the No. 114 fixture, the only difference between the two fixtures being that the No. 111 fixture has no finger pieces. The springs actuating the heads are of slight tension and with this curtain fixture is furnished a balance bar which is sewn into the bottom hem of curtain and in functioning, cooperates with the springs on fixture heads.

The heads, name plate and lugs of the No. 111 fixture are bronze; the tube, springs and rods are steel. All parts made of corrosive metals are rust-proofed. Exposed metal parts, unless otherwise specified, are furnished in bright polished bronze, lacquered. Special finishes will be furnished at slight additional cost upon request.

National Curtain Roller No. 112—Fig. 899 is unique in all respects. For many years railway officials have been desirous of obtaining a design of curtain roller which would automatically adjust itself to the variations in bracket measurements incident to the manufacture of rolling equipment. A satisfactory solution to this problem has been achieved in the No. 112 National Curtain Roller. As will be noted from the detailed construction view the No. 112 Curtain Roller can be adjusted for major discrepancies in bracket measurements by means of a set screw. For minor descrepancies the adjustment is taken care of by means of an automatic spring plug. Such a type of construction enables the curtain roller to be applied and removed from curtain brackets easily and automatically.

In the case of car repairs especially this feature is of greatest import. Without such a type of curtain roller it is necessary, when painting or varnishing cars, for each curtain to be marked for

Fig. 905—Curtain Equipped with National Curtain Fixture No. 114

its respective window opening, due to the fact that in all cars there are slight differences in distances between curtain brackets. In the case of curtains equipped with No. 112 rollers such precaution is unessential, since the automatic spring plug is designed to accommodate itself to these slight discrepancies. All No .112 Curtain Rollers are easily distinguishable by means of the copper plated spring plugs.

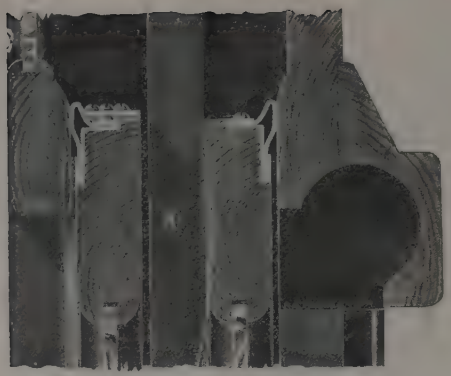


Fig. 906

Fig. 909—Universal Top Weather Stripping.

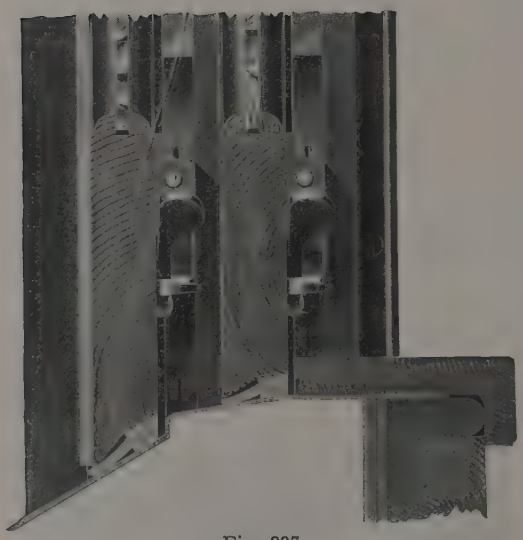


Fig. 907

Fig. 910—Universal Bottom Weather Stripping and No. 20 Wedging Sash Lock and Rack.

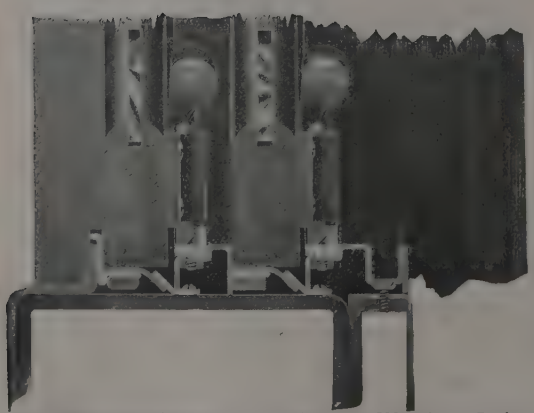


Fig. 908—Application of Universal Weather Stripping, No. 10 Gravity Wedging Locks and Racks.

Fig. 911—Universal Malleable Iron Deck Sash Ratchet.

Fig. 913—Universal Metal Roller Sash Balance with Positive Chain Adjusting Connections.

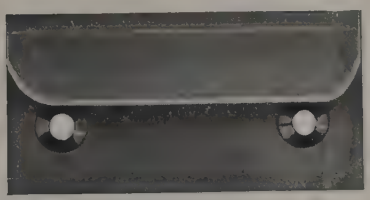


Fig. 914—Universal No. 5 Plain Sash Lift.

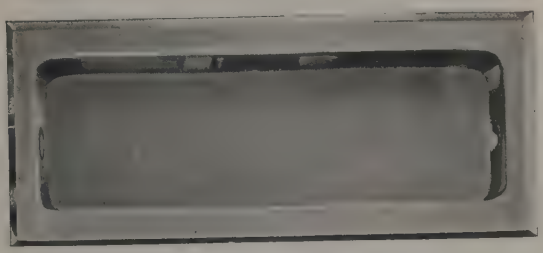


Fig. 915—Universal No. 15 Flush Sash Lift. McCord Manufacturing Company.

Fig. 912—Universal Wedging Racks.

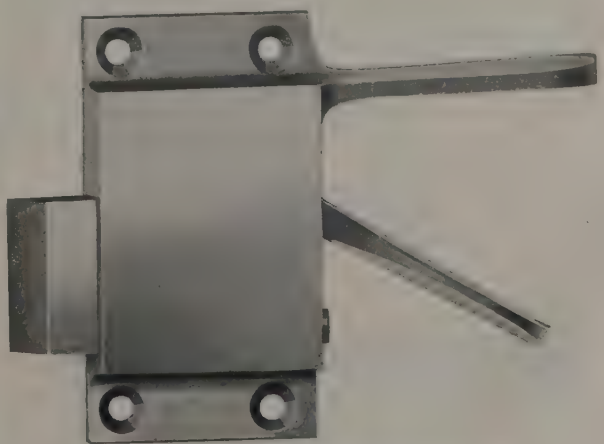


Fig. 916—Universal No. 24 Wedging Sash Lock.

McCord Manufacturing Company.

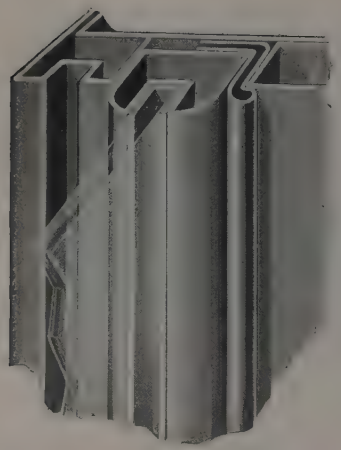


Fig. 917—Rex Side Weather Stripping as Applied to Rex Brass Sash. Curtain Supply Company.

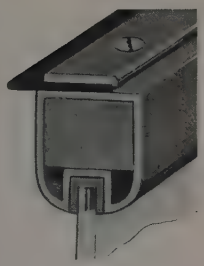


Fig. 918—Rex Top Weather Stripping. Curtain Supply Company.

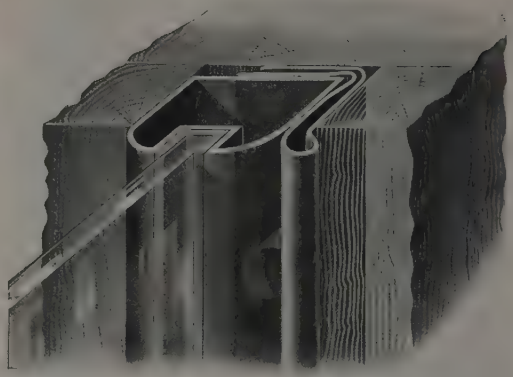


Fig. 919—Forsyth Spring Bronze Side Weather Stripping, Applicable to Either Brass or Wooden Sash. Curtain Supply Company.

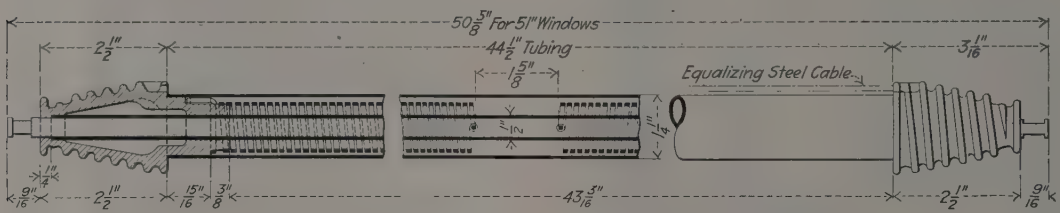


Fig. 920—Reliance Sash Balance. Tuco Products Corporation.
(*See also Page* 471.)

Fig. 921—Reliance Sash Balance. Tuco Products Corporation.
(*See also Page* 471.)

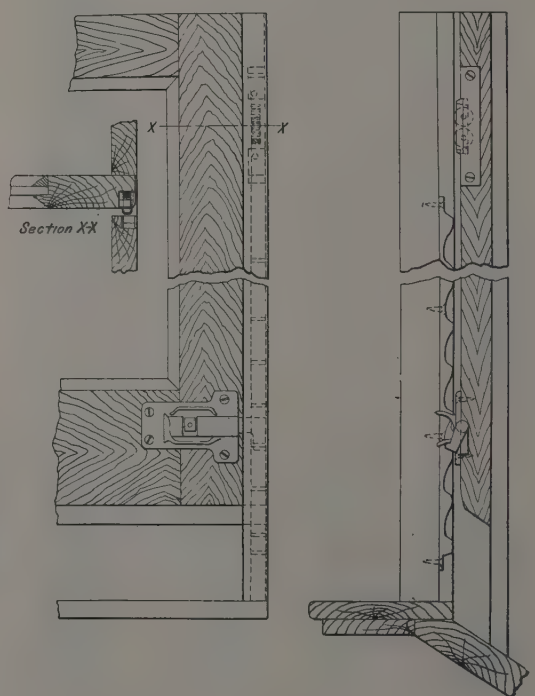


Fig. 922—No. 177 Lock Applied to Sash. Dayton Manufacturing Company.

Tuco Screens and Window Fixtures

Every device added to the window opening of a passenger car should contribute directly to the comfort and protection of the passenger. Therefore, it is essential that this condition be met by all window appliances which are presented to the railways for recognition and adoption. That all of the

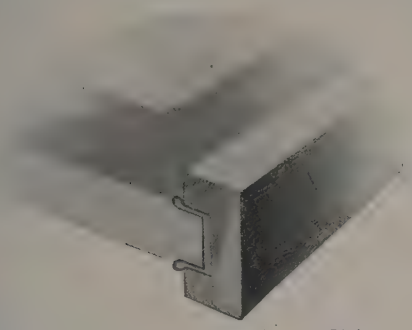


Fig. 923—Brown Metallic Window Strip

products described and illustrated on this page have measured up to this demand is demonstrated readily by their many years of successful operation on passenger equipment.

The Tuco Imperial, Universal and Royal Adjustable Shoe Screens are designed particularly to provide a screen which will meet every requirement of railway service, and that they have done so with success is attested by 18 or more years of their extended use on passenger car equipment. The screen frame is of strong and durable construction, is furnished in either bronze or a special treated non-corroding steel, and contains the following features: Locking bolts and finger guards, double anchored side springs, removable top and bottom weather strip reinforced bottom hook pocket, and removable tubular beading by means of which the copper wire cloth is secured to the frame. This arrangement provides a continuous contact and permits of easy removal if necessary. Two-part slides and hooks for lowering the screen are also furnished. The bronze frame screens are given the Tuco No. 20 finish and the steel frame screens are finished in chocolate brown or standard car green enamel. Screens for end and other doors are also furnished.

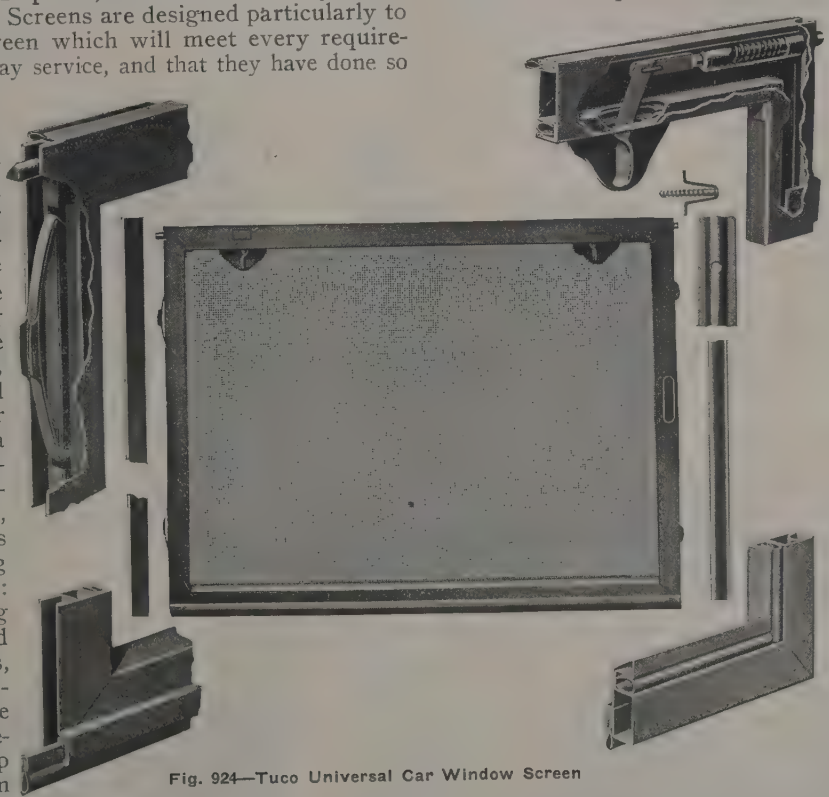


Fig. 924—Tuco Universal Car Window Screen

The Tuco Deck Sash Fixture provides a properly functioning device for the adjustment of the ventilator. The Eclipse Deck Sash Ratchet—a long established Tuco product—is designed with this distinct feature in mind. Being of such substantial and durable construction that it will operate easily, positively and at all times under all conditions it is a product that admirably serves its purpose. The ratchet allows of three positions of the ventilators: Full shut; 30 deg. opening, and 60 deg. opening. It is already in extended use on passenger equipment. This fixture consists of either two ratchets or one ratchet and one pivot.

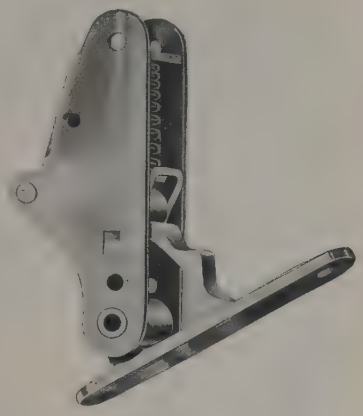


Fig. 925—Eclipse Deck Sash Ratchet

The Tuco Brown Weather strips are designed particularly for passenger car windows, and to meet in every respect the exacting demands of passenger car service.

An idea of the design of Brown Weather-strip may be gained from illustration above. It consists simply of a single metallic strip attached to the sash and so looped as to include the sash in a spring fit, ample clearance being allowed.

For other products and branch offices, see classified and alphabetical indexes.

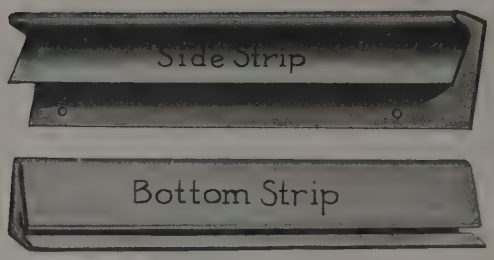


Fig. 926—Detroit Metal Weather Strips. Frost Railway Supply Company.

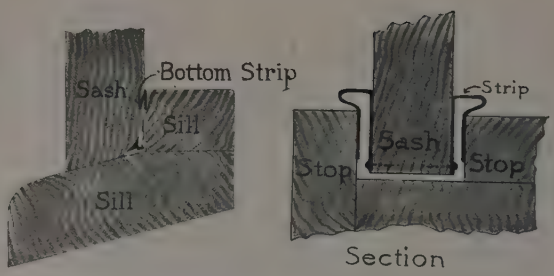


Fig. 927—Application of Detroit Metal Weather Strips. Frost Railway Supply Company.

Fig. 928—Rex All-Metal Roller for Window Curtains, with Extension Sleeve and Lock. Curtain Supply Company.

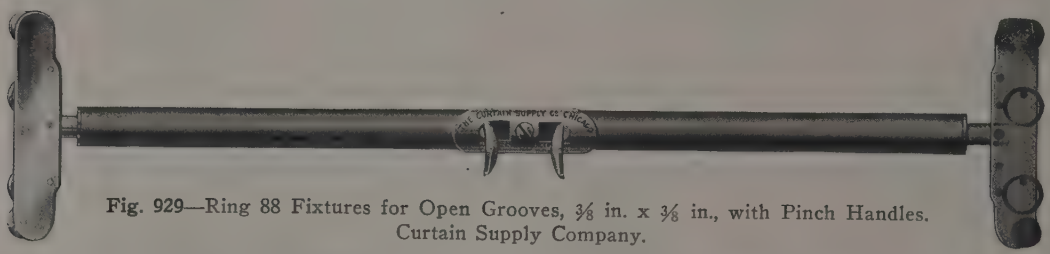


Fig. 929—Ring 88 Fixtures for Open Grooves, 3/8 in. x 3/8 in., with Pinch Handles. Curtain Supply Company.

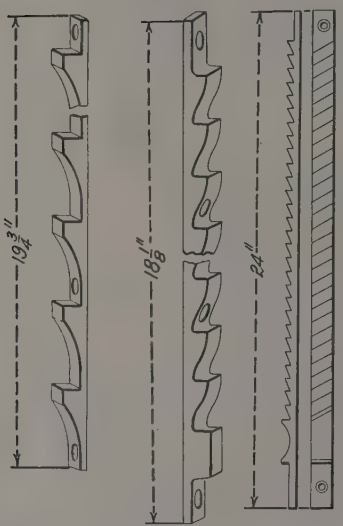


Fig. 930—Sash Lock Racks or Stop Bars. Dayton Manufacturing Company.

Fig. 933 — Sash Lock Racks. Adams & Westlake Company.

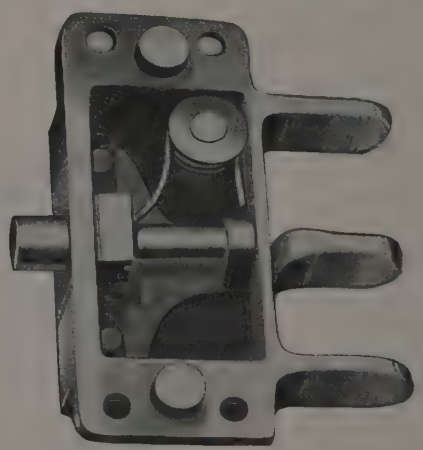


Fig. 931—No. 763 Sash Lock. Adams & Westlake Company.

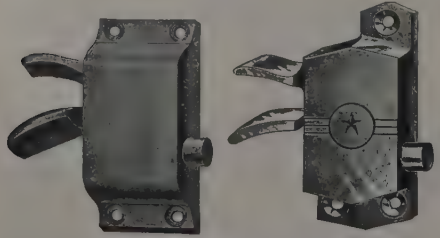


Fig. 932—Window Sash Locks. James L. Howard & Company.

Fig. 934—Sash Locks. Adams & Westlake Company.

(*See also Page* 954.)

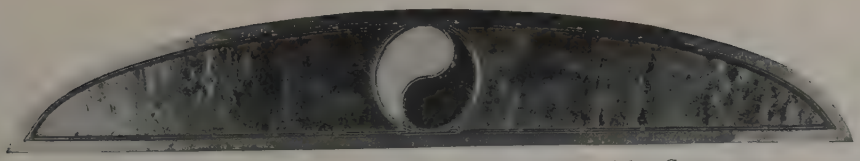


Fig. 935—Art Glass Deck Light. Adams & Westlake Company.

Fig. 936 — Hart's Combined Deck Sash Ratchet, Pivot and Stop. Dayton Manufacturing Company.

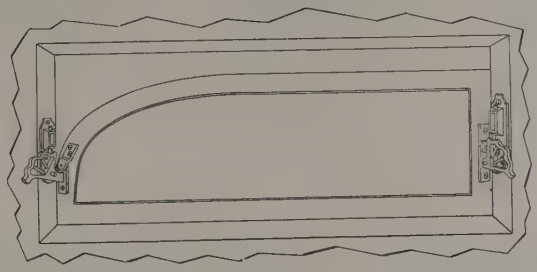


Fig. 937—Hart's Deck Sash Ratchet Applied to Deck Sash. Dayton Manufacturing Company.

Fig. 938—Deck Sash Openers. Adams & Westlake Company.

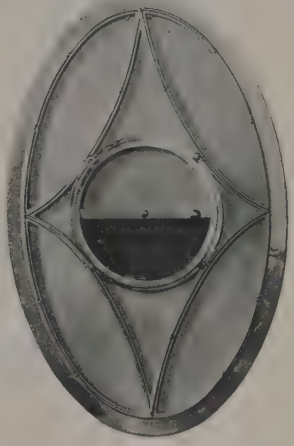


Fig. 939—Art Glass Oval Sash, with Ventilator, for Saloons. Adams & Westlake Company.

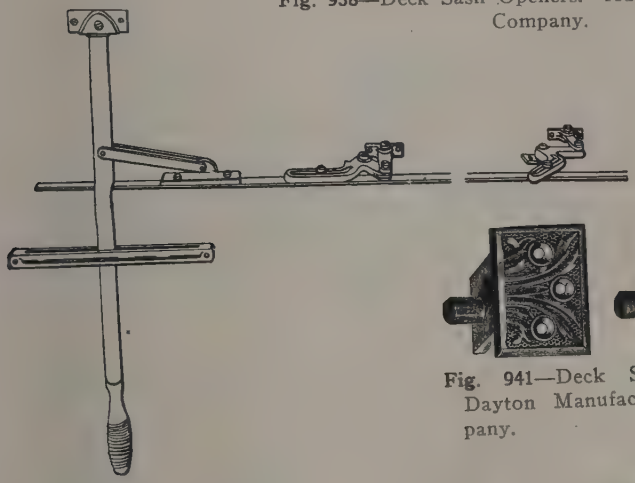


Fig. 940—Continuous Deck Sash Opener. Adams & Westlake Company.

Fig. 941—Deck Sash Pivots. Dayton Manufacturing Company.

Fig. 942—Deck Sash Pivots. Adams & Westlake Company.

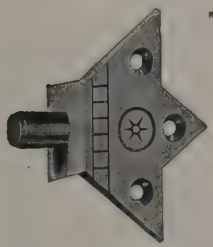


Fig. 944—Deck Sash Pivot. Jas. L. Howard & Co.

Fig. 945—Deck Sash and Transom Catches. Adams & Westlake Company.

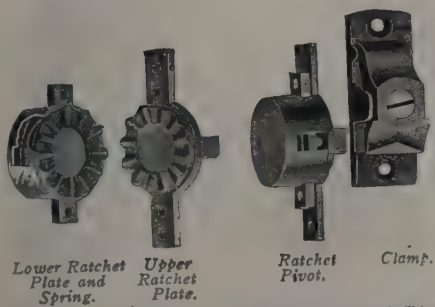


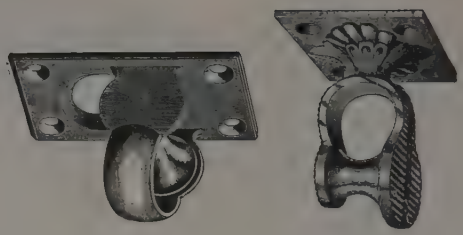
Fig. 943—Morgan Automatic Deck Sash Pivot and Clamp. Adams and Westlake Company.

Fig. 946—Deck Sash Pulls. Adams & Westlake Company.

Fig. 947—Overhead Guide. D. M. Co.

Fig. 948—Corner Guide. A. & W. Co.

Fig. 949 — Side Pulley Guide. A. & W. Co.



A. & W. Co. D. M. Co.

Fig. 950—Angle Signal Cord Guides.

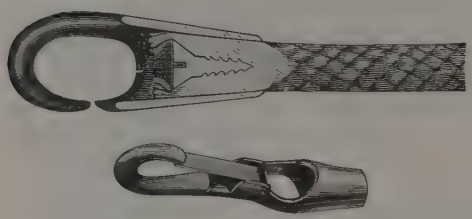


Fig. 951—Signal Cord Couplings. Samson Cordage Works.

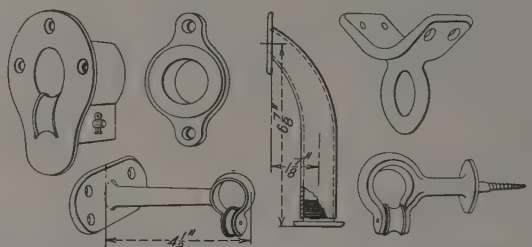


Fig. 952—Signal Cord Bushings. Dayton Manufacturing Company.

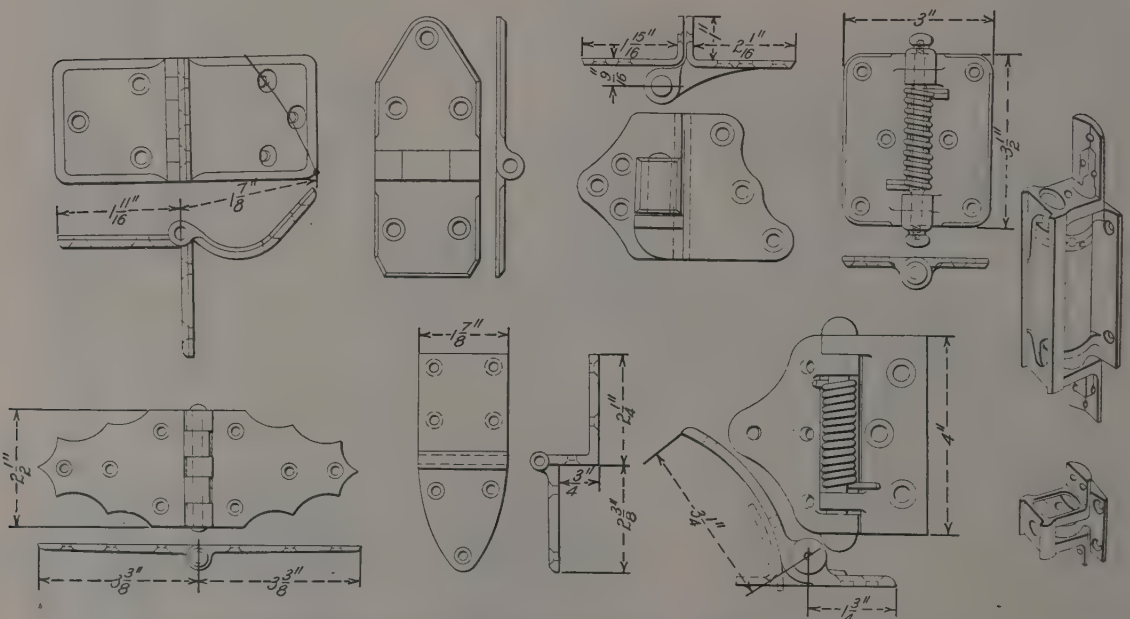
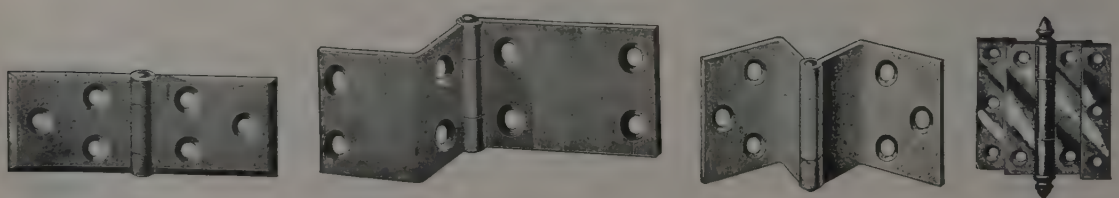


Fig. 953—Miscellaneous Plain and Spring Hinges. Dayton Manufacturing Company.



Riveted Joint Butt Hinge.

Offset Riveted Joint Butt Hinge.

Pocket Hinge.

Rabbeted Door Hinge.

Fig. 954—Miscellaneous Hinges for Cars. Adams & Westlake Company.

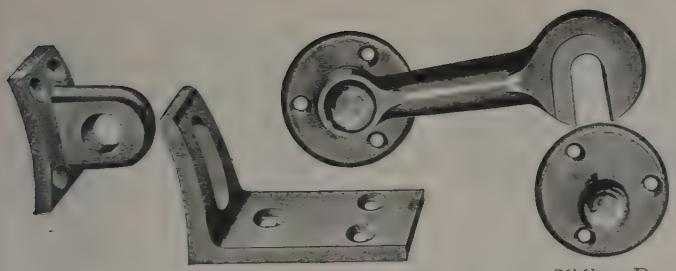


Fig. 955—Sliding Door Hasp and Staple for Mail Car.

Fig. 956—Sliding Door Hook and Button for Baggage Car.

Adams & Westlake Company.

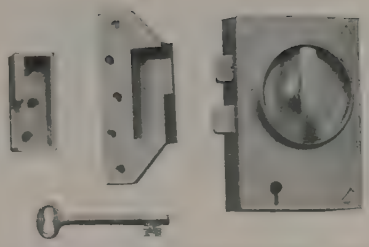


Fig. 957—Motorman's Cab Door Lock No. 48. Jas. L. Howard & Company.

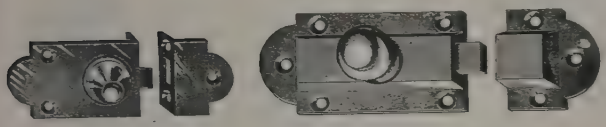


Fig. 958—Cupboard Catches and Bolts. Adams & Westlake Company.

Fig. 959—Refrigerator Door Latch. Dayton Manufacturing Company.

Fig. 960—Vestibule Trap Door Latch and Pull. Dayton Manufacturing Company.

Fig. 961—Vestibule Door Mortise Latch. Dayton Manufacturing Company.

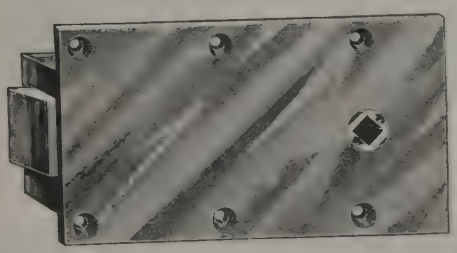


Fig. 962—Vestibule Trap Door Latch. Dayton Manufacturing Company.

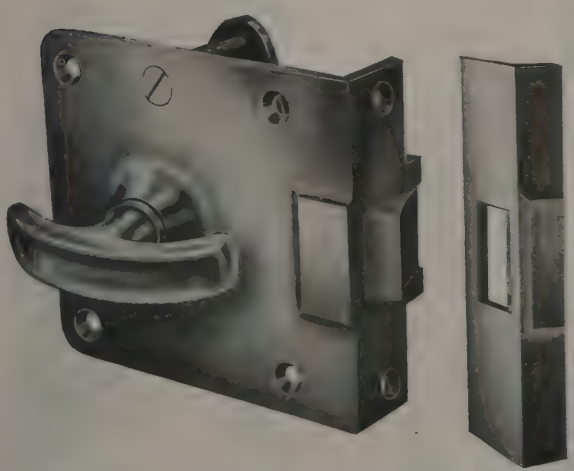


Fig. 963—No. 696 Vestibule Door Latch and Keeper. Dayton Manufacturing Company.

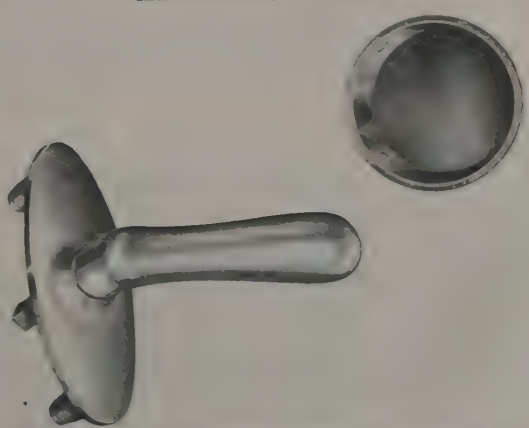
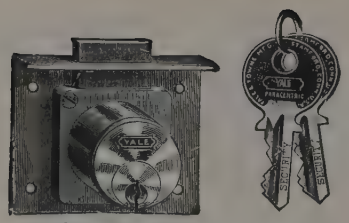
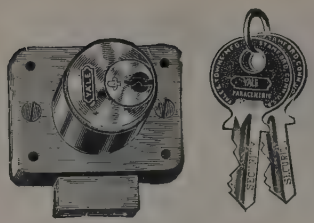


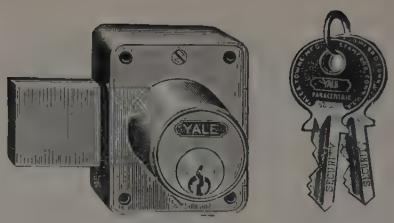
Fig. 964—Handle and Flush Handle Receiver for No. 696 Vestibule Door Latch. Dayton Manufacturing Company.



No. 561, Drawer Lock.



No. 521, Wardrobe Lock.

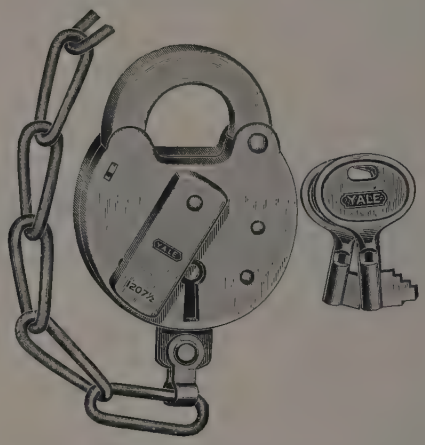


No. 611, Locker Lock.

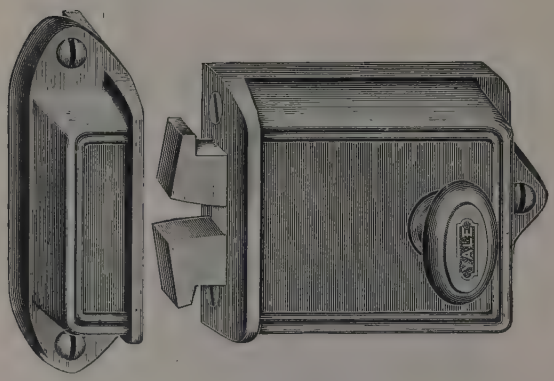
No. 8515, Padlock.

No. 2853, Padlock and Keys.

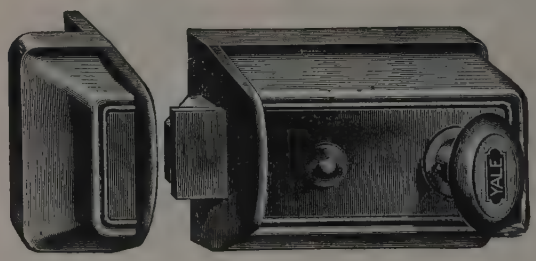
No. 19575½, Padlock.



No. 1207½, Padlock, Chain and Keys.



No. 92, Guard Lock.



No. 44 Rim Night Latch.

Fig. 965—Door Locks. The Yale & Towne Manufacturing Company.

Fig. 966—Extra Long Saloon Door Lock and Keeper. Adams & Westlake Company.

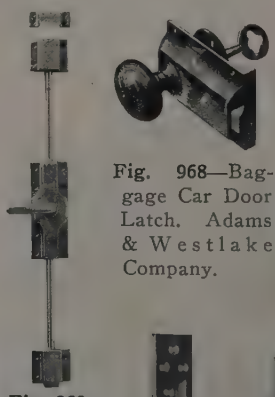


Fig. 969—Door Top and Bottom Latch. James L. Howard & Company.

Fig. 968—Baggage Car Door Latch. Adams & Westlake Company.

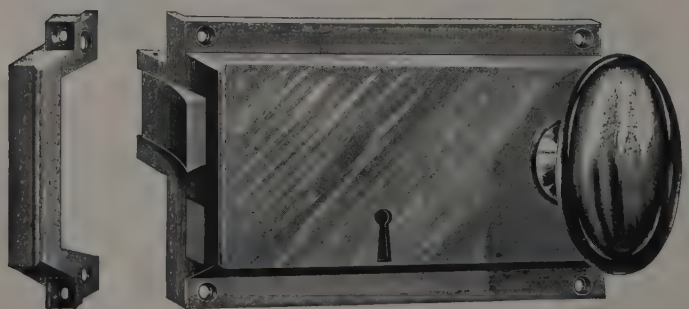


Fig. 967—End Door Lock. Dayton Manufacturing Company.

(See also Page 957.)

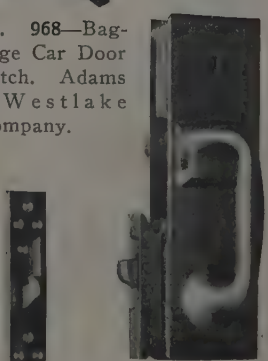


Fig. 970—Sliding Door Lock. Jas. L. Howard & Company.

(See also Page 958.)

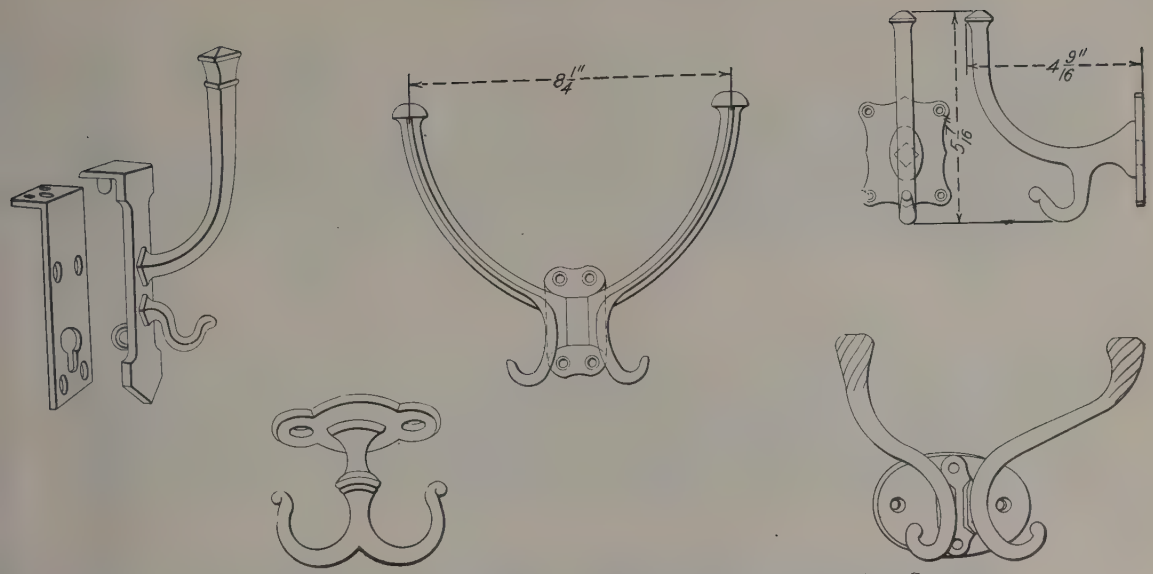


Fig. 971—Miscellaneous Coat and Hat Hooks. Dayton Manufacturing Company.

Fig. 972—Miscellaneous Coat and Hat Hooks. **Adams & Westlake Company.**

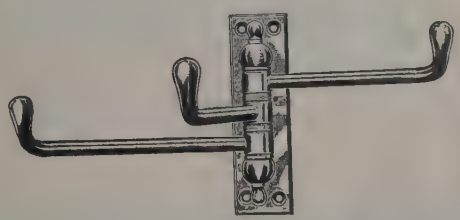


Fig. 973—Folding Coat Hook. Adams & Westlake Company.

Fig. 974—Ash Receiver. Adams & Westlake Company.

Fig. 975—Match Striker and Cigar Holder. Adams & Westlake Company.

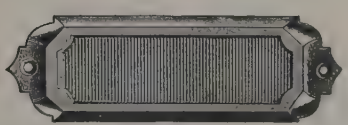


Fig. 976—Match Strikers. Adams & Westlake Company.

Fig. 977—Menu Card Holder for Dining Cars. Dayton Mfg. Co.

Fig. 978—Telegraph Blank Rack. Adams & Westlake Company.

Fig. 979—Match Box Holder and Match Safe. Adams & Westlake Company.

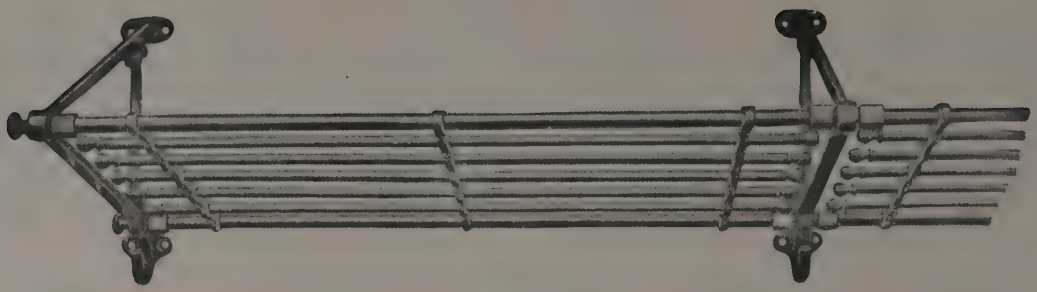


Fig. 980—Rex Rod Basket Rack and Removable Bottom.

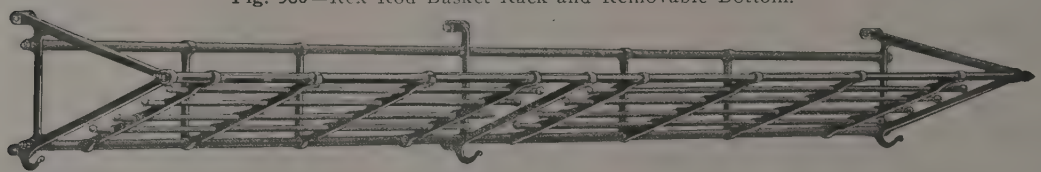


Fig. 981—Rod Basket Rack with Fixed Bottom and Back Rod. Length, 62 in.; Width, 12¾ in.

Fig. 982—Basket Rack No. 184 for Flat Surface.

Fig. 983—Rex Wire Cord Basket Rack with Removable Bottom. Length of Section, 36 in.; Width, 12½ in.

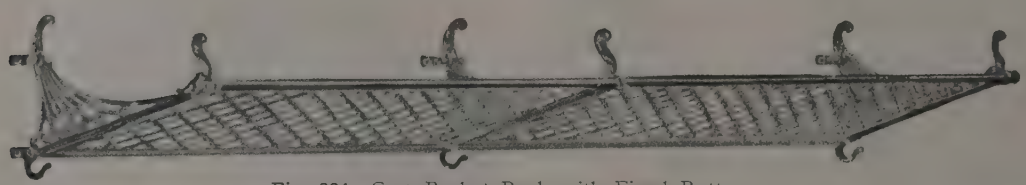


Fig. 984—Cast Basket Rack with Fixed Bottom.

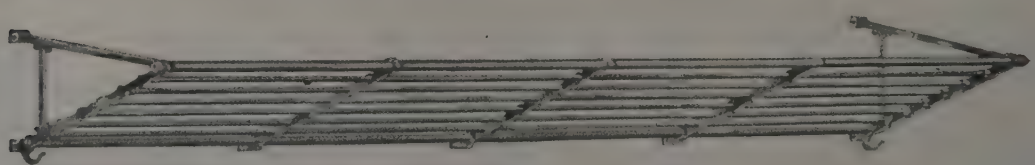


Fig. 985—Rod Basket Rack. Length, 48½ in.; Width, 12½ in.

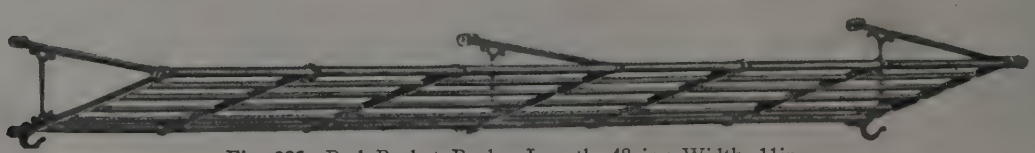


Fig. 986—Rod Basket Rack. Length, 48 in.; Width, 11in.

Dayton Manufacturing Company.

(*See also Page* 957.)

Fig. 987—Continuous Baggage Rack No. 63. Jas. L. Howard & Company.

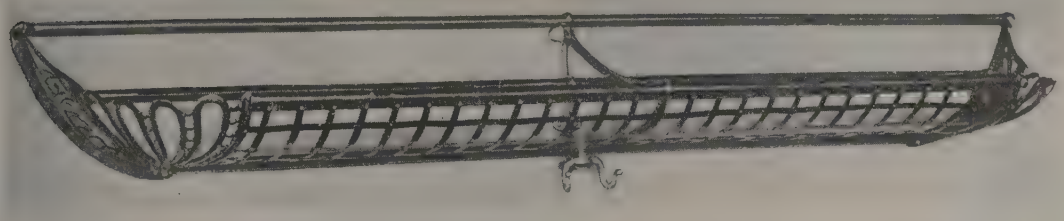


Fig. 988—Single Baggage Rack No. 40. Jas. L. Howard & Company.

Fig. 989—Continuous Baggage Rack No. 61. Jas. L. Howard & Company.
(*See also Page* 958.)

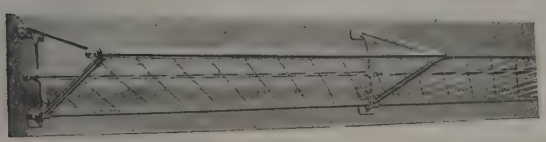


Fig. 990—Continuous, Removable Bottom Baggage Rack No. 55. Jas. L. Howard & Company.

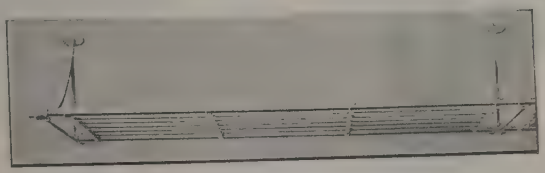


Fig. 991—Removable Bottom Basket Rack. Adams & Westlake Company.

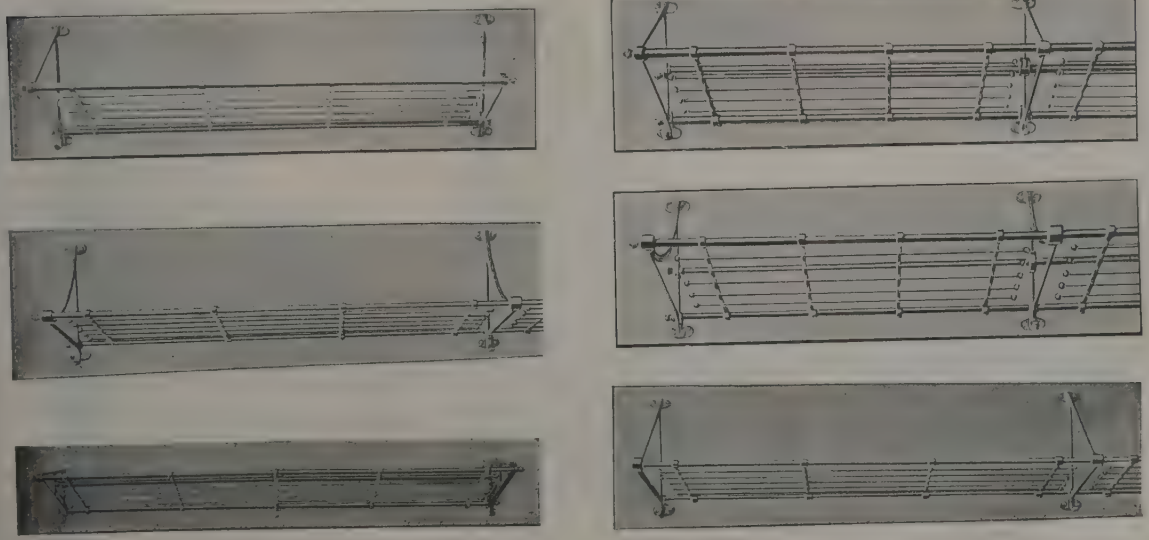


Fig. 992—Removable Bottom Basket Racks. Adams & Westlake Compuany.
(*See also Page* 954.)

Fig. 993—H & K Walkover Reclining Chair in Plain Plush Upholstery. Adjustable Cushion, Back and Leg-rest.

Fig. 994—H & K W over Vis-a-Vis C in Woven Rattan holstery as Use the Tropics.

Fig. 995—H & K Walkover Coach Seat in Woven Rattan Upholstery. Used in South American Service.

Fig. 996—H & K No. 197 Walkover Coach Seat in Diamond Pattern Frieze Plush Upholstery, for Atchison System.

Fig. 997—H & K No. 197 Walko Style Bulkhead Seat. Atchi Topeka & Santa Fe Standard

Fig. 998—H & K No. 96 Walkover Coach Seat, in Woven Rattan Upholstery. Seat used in the Tropics.

Fig. 999—H & K No. 197 Walkover Coach Seat in Morocco Leather Upholstery, as used in the Tropics.

Fig. 1000—H & K No. 197 Walko Coach Seat in Frieze Plush Uph stery for New York Central.

1001—H & K No. 25 Club Car
air in Solid Mahogany, and
orocco Leather Upholstery.

Fig. 1002—H & K No. 20 Club Car Chair in Fleur de Lys Friezette Upholstery.

Fig. 1003—H & K No. 21 Club Car Chair in Fleur de Lys Friezette Upholstery.

ig. 1004—H & K No. 39 Revolving Parlor Car Chair in Woven Rattan Upholstery.

Fig. 1005—H & K No. 194 Walkover Coach Seat in Frieze Plush Upholstery. Pennsylvania Railroad Standard.

Fig. 1006—H & K No. 197 Walkover Coach Seat in Plain Mohair Upholstery.

g. 1007—H & K Revolving Parlor Car Chair
n Star Pattern Frieze Mohair Upholstery.

Fig. 1008—H & K No. 24 Revolving Parlor Car Chair for Metre-Gauge Cars in Foreign Service.

Fig. 1009—H & K Revolving Parlor Car Chair in Fleur de Lys Friezette Upholstery.

Hale & Kilburn Corporation

(*See also Pages* 480 *and* 482-3.)

H & K Coach Seats, Reclining and Revolving Chairs

The provision of artistic and comfortable seating equipment in passenger cars is one of the most direct means afforded for creating favorable public sentiment toward the railways in general; for competing roads it is a factor which plays no small part in determining which shall get the volume of traffic required for profitable operation. At the same time this equipment must be durable, sanitary, easy to clean, and must present a minimum of risk in case of fire or other accidents. Embodied in the chairs and seats manufactured by the Hale & Kilburn establishment are features which make them efficient from all the standpoints previously mentioned and enable them to meet the requirements of any railway.

The complete H & K line embraces every class of seating equipment, including upholstered chairs such as are used in club cars and buffet cars; the revolving chairs for parlor cars; and reversible seats suitable for all types of steel passenger coaches for through line and suburban service on steam and electric railways.

The Walkover seat for day coaches has been applied to a large number of cars. This seat can be varied to conform to varying standard requirements for height and style of upholstered back and cushion. Many roads prefer the plain spring back 22 in. to 24 in. in width, while others use the extra-high head roll and spring back.

The cushion and back are equipped with the H & K flexible steel band and spiral spring foundation for the upholstery, an arrangement which provides great comfort, while insuring the durability of these parts throughout the life of the seat. In the manufacture of all-steel seats, the framework of the cushion and back is made of pressed steel, and a hardwood tacking strip is provided for securing the upholstery covering.

Other details include a steel oval base, aisle and wall end plates and frame. The aisle end may be embossed steel with hardwood arm-rest or the entire aisle end and arm-rest may be hardwood. In the reversing mechanism both malleable iron and steel are used. The H & K single-rail automatic foot-rest not only allows ample storage space under the seat, but also facilitates cleaning the floor of the car.

A choice of coverings is offered. The materials available include mohair plush, hand-buffed leather, woven rattan, or a leather-substitute.

The principal dimensions of these seats are approximately the following:

Length of seat over all—from car wall to over arm rest	41 in.
Height from floor to top—crown—of spring cushion	19 in.
Height from floor to top of spring back	40 in.
Height from floor to top of arm rest	24 in.
Width of spring upholstered cushion	17 to 19 in.
Width of spring upholstered back	20 to 24 in.

Fig. 1010—Neverbreak Pressed Steel Walkover Coach Seats with Plain High Backs

These dimensions may be varied, however, to suit the requirements and the construction of every type of passenger car for steam or electric railway service.

The workmanship is of a uniformly high quality as the product represents the experience of many years, aided by the best that modern factory accommodations can afford. All parts of the seat, as well as the complete seats, are subjected to rigid inspections, before and after assembling, to insure only a first-class article leaving the plant. A permanent organization of efficient and trained workers is maintained, directed by experts in each department. The guiding motive of the complete unit is to make the equipment

H & K Coach Seats, Reclining, and Revolving Chairs *(Cont'd)*

which bears the "H & K" trade mark, worthy of the confidence of the railways, and pleasing to the traveling public.

The most prominent types and patterns of seating equipment in general use in the modern day coach of the United States, Canada and Mexico, as well as on the principal lines of Argentine, Brazil, Peru and Cuba, are illustrated in Figs. 993-1011, inclusive.

An H & K double reclining chair—No. 166—is shown in Fig. 993. It is upholstered in plain mohair plush, has an adjustable cushion, back, and leg rest, and is used in chair car service on many railways from Chicago to the Pacific Coast.

A vis-a-vis coach seat—H & K No. 192—in woven rattan upholstery with reversible spring cushion and back, adjustable for chair car service is shown in Fig. 994. This seat is popular on prominent lines in Brazil.

The H & K Walkover automatic seat No. 393—Fig. 995—is covered with woven rattan upholstery and has a spring-edge cushion plain high spring back. A single-rail automatic foot rest is furnished. This seat is used on the railways of Argentine, Chile and Peru.

An H & K Walkover coach seat—No. 197—in frieze plush upholstery is shown in Fig. 996. A spring-edge cushion, an extra-high headroll spring back, and a single-rail automatic foot rest complete the equipment of this seat.

Another style of the No. 197 seat is shown in Fig. 1006. The upholstery is plain plush, but the spring-edge cushion, extra high headroll spring back, and single-rail automatic foot rest are retained. The aisle end and arm rest are solid mahogany. This style of seat is used on many lines in the United States, Canada and Mexico.

The finest leather upholstery as applied to the H & K No. 197 Walkover seat is shown in Fig. 999. This design is used largely in Argentine, Peru and Mexico, and has a spring-edge cushion, extra-high headroll spring back, single-rail automatic foot rest, and hardwood arm rest and aisle end.

A standard seat on the New York Central; the Michigan Central; and the Cleveland, Cincinnati, Chicago and St. Louis Railway, is illustrated in Fig. 1000, which shows the H & K No. 197 Walkover seat, in frieze plush upholstery, with spring-edge cushion, extra-high headroll spring back and single-rail automatic foot rest.

A bulkhead type of seat which matches the No. 197 Walkover seat and is used in the cars of the Atchison, Topeka & Santa Fe Railway, also the Florida East Coast Railway, is shown in Fig. 997.

Fig. 1011—Neverbreak Pressed Steel Walkover Seats with Headroll Backs

On the principal lines of Brazil and Cuba the H & K No. 96 Walkover seat—Fig. 998—is used. Woven rattan upholstery is used, and other features include a spring-edge cushion, extra-high headroll spring back, hardwood arm rest and aisle end.

A seat which is a standard on the Pennsylvania Railroad, lines east and west of Pittsburgh, the Vandalia Line. etc., is shown in Fig. 1005. This is an H & K No. 194 Walkover seat in frieze plush upholstery, with spring-edge cushion, plain high spring back, embossed steel aisle end and mahogany arm rest.

The records of this company indicate that more than one million H & K car seats have been placed in service in the passenger coaches of North and South America. It is the purpose of the manufacturers to produce a seat which will last as long as the car itself; and the durability and convenience embodied in the Neverbreak Pressed Steel Walkover Seat No. 197, give it rank as one of the important improvements in passenger car equipment.

For other products and branch offices, see classified and alphabetical indexes.

Fig. 1012—No. 85 B. C. F. Universal Slideover Seat, Leather Upholstering Steel Armrest.

Fig. 1013—No. 8C-4 Non-reversible Seat. Imitation Leather Upholstering.

Fig. 1014—No. 85 A. C. F. Universal Slideover Seat, Rattan Upholstering.

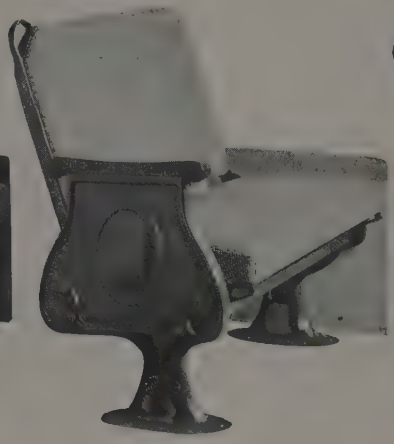


Fig. 1015—No. 327 C. F. Reversible Slideover Seat, Rattan Upholstering.

Fig. 1016—No. 85 A. C. F. Universal Slideover Seat, Rattan Upholstering.

Fig. 1017—No. 85 A. C. F. Universal Slideover Seat, Plush Upholstering.

Fig. 1018—No. 85 A. C. F. Universal Slideover Seat, Frieze Plush Upholstering.

Seats for Coaches, Parlor, Club, Gas and Electric Cars

The line of seating equipment manufactured by the Heywood-Wakefield Company includes types of seats which are adaptable to all classes of service, from the light-weight seat of the one-man car and more severe city street car use, to the luxurious, heavy, upholstered spring seats and chairs which make long journeys comfortable in the day coaches and parlor cars of steam railways. Combined in this product are elements recognized as the best in seat manufacture, carefully arranged and improved in every detail.

The upholstery of a Heywood-Wakefield seat—see Fig. 1019—is a unit of strength, durability and sanitation. The frame is constructed of tough white ash or from steel pressings, and the springs are heavy and strong yet resilient. The spring and frame assembly is covered with canvas, on top of which is laid the curled hair stuffing. The final covering may be one of a large variety of materials in-

Fig. 1019—Improved Steel Cushion and Back Upholstery as Embodied in Heywood-Wakefield Seats

cluding the best grades of rattan, plushes, leather and leather substitutes. The same general methods apply also to the construction of the back, which may be plain or a selection of several styles of head rolls is offered.

The reversing mechanism is known as the Wheeler Slideover Type and has proved by long service to be suitable for all classes of traffic. It consists of only a few pressed steel parts so arranged that the maximum strength is obtained. The design is such that the danger of injury to the persons or clothing of passengers has been removed. The smooth and noiseless operation resembles that of ball bearings and breakage due to binding of the parts is entirely eliminated.

The general arrangement of the parts contributes to the excellence of service obtained. Harmony in the design of the stamped metal parts adds to the interior appearance of the car; no bolt heads are exposed in the seat end. The cushions shift and tilt automatically and are easily kept clean; the back is detachable. An interlocking steel wall-fixture holds the seat at the wall and yet allows easy removal of the seat mechanism if necessary. A single foot-rest reverses with the movement of the back.

Corner and bulkhead seats, unless otherwise specified are made to correspond with reversible seats but without reversing mechanism and with the

Fig. 1020—No. 85 A. G. F. Steel Universal Sideover Seat, Plush Upholstered

back upholstered on the face side only, to allow fastening against the side of the car or bulkhead.

The Heywood-Wakefield Company provides an adequate engineering service, but confusion and delay may often be avoided by giving the proper information. The type of seat desired should be given, also the length over-all and the height of back; and

Fig. 1021—Double Reclining Chair No. 185 A. E. F. with Plush Upholstery

a sketch showing the side wall construction, the projections of truss plank, window ledge and the location of steam pipes or heaters. Other items in which should be specified include the covering material; the styles of back, of foot rail and of arm rest; and the finish desired on the arm rest and mechanism.

For other products and branch offices, see classified and alphabetical indexes.

Fig. 1022—Wooden Chair for Club Car. S. Karpen & Brother.

Fig. 1023—Reed Chair for Parlor and Observatio Cars. S. Karpen & Brother.

Fig. 1024—Revolving Parlor Car Chair. S. Karpen & Brother.

Fig. 1025—Revolving Parlor Car Chair with Plush Upholstery. Heywood-Wakefield Company.

Fig. 1026—Revolving Parlor Chair with Rattan Upholst Heywood-Wakefield Company

(*See also Page* 485.)

Fig. 1027—"Scarritt" Reclining Chair No. 39. Hale & Kilburn Corporation.

Fig. 1028—"Scarritt" Reversible Seat No. 34. Hale & Kilburn Corporation.

(*See also Pages* 482-483.)

Chase Goat Brand Car Plush

The characteristics of the material used for upholstering car seats is important not alone from the standpoint of comfort or sanitation; it is a governing factor in the appearance of passenger coach interiors. There is, perhaps, no more inexpensive means to produce the effect of richness and luxury than by the selection of suitable seat coverings.

Chase "Goat Brand" Car Plush is made from the lustrous fleece of the Angora Goat and is constructed by the unique "W" weave in which all the mohair strands are firmly embedded by three, strong, interlocking threads. Mohair has a lustre peculiarly its own, and because the oil is inside rather than outside the individual hair, a mohair fleece may be washed, scoured, steamed, dyed, and worked up into fabrics, and all these processes intensify rather than destroy the brilliant lustre. The surface of the individual mohair fibre is smooth and shiny like silk, whereas wool fibre has a rough surface, covered with scales or barbs which cause the fibres to "felt" or cling together. Mohair, according to Government tests, has more than two and one-half times the strength of wool, and affords the longest wearing surface known to the textile world.

That Chase "Goat Brand" Car Plush possesses remarkable wearing qualities has been thoroughly demonstrated, but the usual conception of long wear is limited to a few years. That this is not so with "Goat Brand" Car Plush was shown recently; there was exhibited a seat upholstered in "Goat Brand" Car Plush, which had been in constant service for over 25 years. The reason for this comparatively longer service is that Mohair is extremely elastic, all wear comes on the top ends of the pile while in any smooth-surface, woven fabric the wear comes directly on the sides of the individual fibres, so that a moderate service-friction soon causes the fabric to break out fuzzy or show wear in spots.

The great elasticity of mohair material can be readily demonstrated by the application of sufficient hydraulic pressure to make it as flat as a piece of paper. If it is then soaked in warm water the pile of "Goat Brand" Car Plush will return to a standing position. This is a distinctive feature of mohair plush—no other fabric known to the textile world can successfully meet such a test.

Its quality of elasticity makes this plush a very comfortable upholstery fabric; the surface has a smooth appearance yet sufficient friction is developed to prevent the passenger from slipping from side to side under the swaying influence of train movement. This, together with its rich appearance, beautiful, unfading colors and frieze designs—scores of different designs are obtainable—gives the material a unique distinction and renders it eminently suitable for passenger car service.

The first beauty and brightness of "Goat Brand" Car Plush remains unchanged through years of use; none but the finest dyes are employed so that clothing is never soiled by contact. Like many other products of enduring value, length of service makes the use of "Goat Brand" Car Plush economical; it will last from eight to twenty-five years, according to the grade used.

Careful, scientific tests carried on through many months by one of America's leading railroad systems have demonstrated conclusively that Mohair Plush has sanitary qualities of a very high degree. Dust does not remain on the surface to come off on passenger's clothing, but

Fig. 1029—Railway Coach Upholstery of "Goat Brand" Car Plush

enters the pile, and can be readily removed by rattan beating or the vacuum cleaning process.

Chase "Goat Brand" Car Plush has been made a standard by many American railroads. This was done after these roads had conducted careful tests to develop the qualities of various fabrics and their effect upon the interior appearance of passenger equipment.

For nearly three quarters of a century, the production of strictly high-grade materials has established a reputation for Chase products. Carefully developed and long established quality standards are carefully maintained under all conditions of raw material regardless of price variations.

The name of "Chase" on any fabric is a reliable guarantee of service, quality and expert workmanship.

Other important features of the Chase Mohairs are the wide variety of desirable patterns which may be furnished in almost any shade required. The variety of weights to choose from is also large. Where samples of the leading varieties are not available, through the regular supply channels they will be furnished by the company.

For other products and branch offices, see classified and alphabetical indexes.

L. C. CHASE & COMPANY, BOSTON, MASS.

Bay State Brand Mohair Car Plushes

Mohair Plush has been used by the railroads in the United States for 75 years and has proved more satisfactory under all conditions than any other fabric or material that is used for seat covering. Mohair is the hair or fleece of the angora goat. It is exceedingly long staple and being a smooth, silky fibre does not attract and hold either dirt or dust.

Mohair Plush is a very durable fabric and its length of service is as long or longer than the smooth surfaced materials. There have been cases where Bay State Plush has been in constant service on car seats for 25 years; but the general average of service is 12 to 15 years. The nature of the weave is the principal reason for the unusual wear, as, being a pile fabric, all of the wear comes on the end of the fibre instead of on the side as in a flat woven fabric, and in every square inch there are over 50,000 separate fibres, each one receiving about the same amount of wear.

Fig. 1030—Frieze Pattern Number 22

For long rides plush is a most comfortable seating surface, as the passenger is seated on thousands of little springs which give with the vibration of the body and the occupant of the seat is held firmly in place instead of constantly slipping towards the front of the seat.

The construction of this fabric also practically eliminates wear on the clothing of the traveler; the constant rubbing caused by vibration against a hard surface which so quickly wears the nap from clothing does not occur with Mohair plush. In case dirt or dust lodges between the seat back and the back of the passenger it is not ground into the clothing but falls into the pile and remains in the back of the plush until removed by beating or using the vacuum cleaner at the end of the trip. The back of the fabric which holds the pile in place, is very closely woven so that the dirt will not very easily sift through into the padding and hair beneath.

There is a mistaken idea that plush is uncomfortable to the passenger in warm climates, but this is not the case as Mohair makes one of the coolest fabrics known when woven into cloth for suitings and dress goods. A pile fabric appears warmer than a flat surface, but as a matter of fact there is a very efficient ventilation in a plush fabric as the air has an opportunity to circulate between the fibres and through the back of the cloth.

Mohair has a great affinity for and holds color longer than most other fibres, so that plush looks well for a long period and is easily renovated when the coach is shopped. There are various methods of cleaning the seat and brightening and redyeing the plush which makes it appear almost as good as new.

The weave of plushes made in the United States is different from those made in other countries. Each tuft of hair in the pile is held in place by what is called the W weave instead of the V weave. That is, each tuft is held by two threads over and one under, whereas in the V weave there is only one thread over and one under each tuft. This W weave doubly binds the pile to the back and it is not easily pulled out.

A number of railroads are using frieze or figured plushes, many of them having their own distinctive design. This design is made by having a pattern or figure with the fibre woven in a loop while in the background the fibre is cut, the cut fibre taking the dye in a deeper shade than the loop, which brings out the pattern in the same color but in a lighter shade than the ground. The frieze makes a richer appearing seat and breaks up the worn appearance if the pile becomes laid down after long and constant wear.

Plushes for railroad use are made in widths of 24, 28, and 30 inches and the pieces are from 40 to 42 yards in length. They are carried in stock in the grey or undyed state and dyed as desired by the users as most railroads have their individual colors and an accurate match can thus be obtained. This leads to economy in repair work, as often a few cushions only in a coach need recovering and if the colors match exactly it is not necessary to recover the entire coach. By adopting one standard pattern and color the necessity of carrying a large stock of upholstering material at the shops is avoided as was the case when new coaches were upholstered in a pattern or color that was selected by whoever had had charge of the purchase of equipment.

Standard grades of the Massachusetts Mohair Plush Company are well known; quality No. 803 is the lowest priced plush that is practicable for railroad use, it being a firmly woven low pile plush having excellent wearing qualities. The other qualities most generally used are known as Nos. 875 and 935, which vary in the fineness of the stock used and the closeness of the weave. The high pile plushes are Nos. 554, 558 and 908 and those made with a linen warp are No. 46A, a low pile, and No. 46C a high pile plush. The linen warp has an advantage over the cotton in that it does not stretch. The cotton will sometimes shrink when the cushions are washed and when they are put in use again will stretch with the weight of the passenger, thus necessitating retacking to take up the slack. The linen back accordingly lasts longer and gives the best service.

The Bay State Brand Plush has been standard with most of the leading railroads for 20 to 30 years. Samples of standard qualities and colors are always available on request.

For other products and branch offices, see classified and alphabetical indexes.

MASSACHUSETTS MOHAIR PLUSH COMPANY, BOSTON, MASS.

1031—North Pole Sanitary Drinking Fountain. Henry Giessel Company.

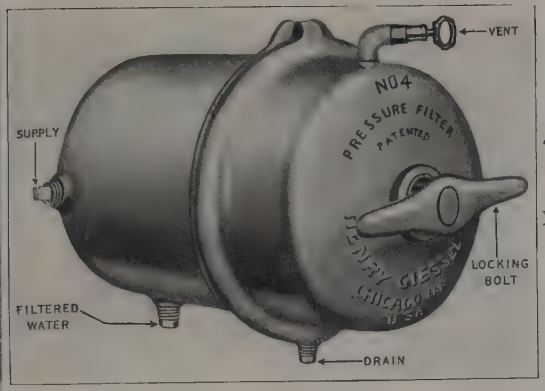


Fig. 1032—No. 4 Pressure Filter for Dining Cars. Henry Giessel Company.

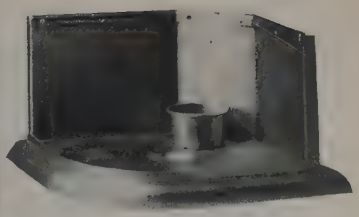


Fig. 1033—White Metal Drip Tray. Jas. L. Howard & Company.

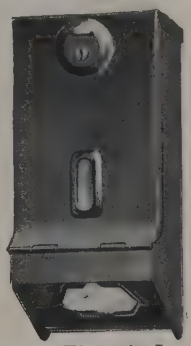
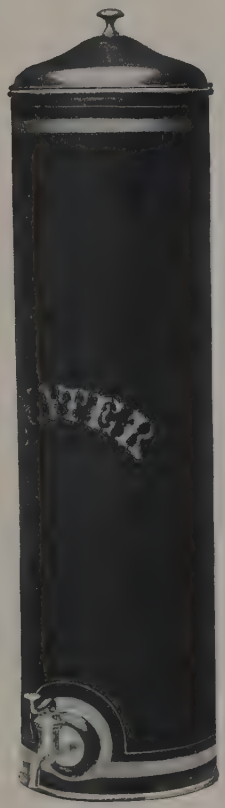


Fig. 1034—Finback Junior Cabinet for Drinking Cups. Peter Gray & Sons.

Fig. 1035—Paper Cup Vendor. Individual Cup Company.



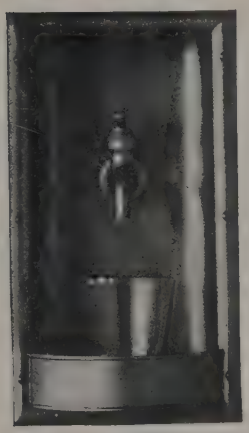


Fig. 1037—Water Alcove. Jas. L. Howard & Company.

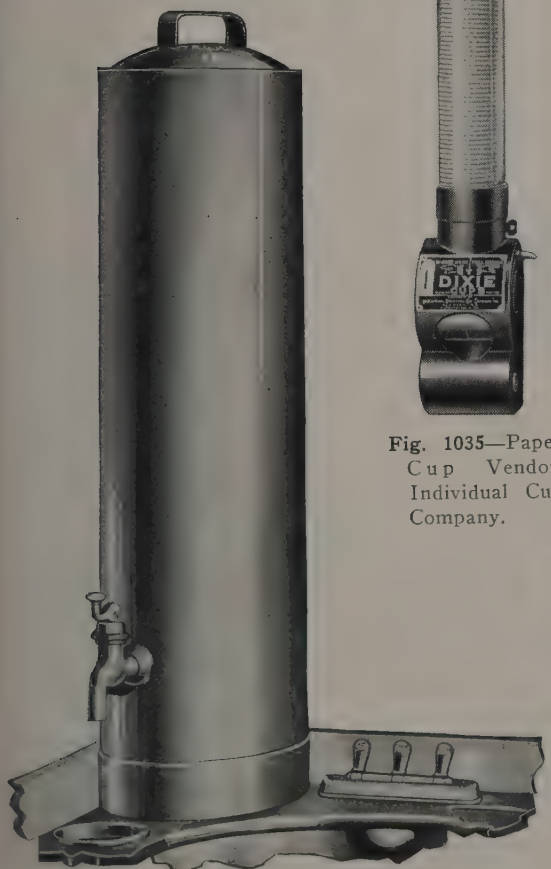


Fig. 1038—Water Cooler and Lavatory Faucets. Adams & Westlake Company.

Fig. 1039—Passenger Coach Water Cooler with Self-Closing Faucet. Also Drip Pan. Peter Gray & Sons.

Fig. 1040—Galvanized Iron Compartment Water Cooler for Postal Cars. The Dayton Manufacturing Company.

Fig. 1041—Folding Lavatory. Adams & Westlake Company.

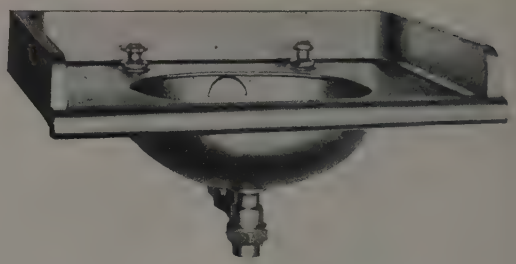


Fig. 1042—White Metal Washstand for Pressure System. Cold Water Only. James L. Howard & Company.

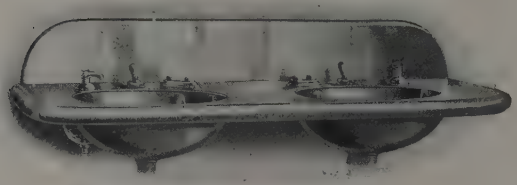


Fig. 1043—Double White Metal Lavatory. The Watrous Company.

Fig. 1044—White Metal Corner Lavatory. The Watrous Company.

Fig. 1045—Dental Lavatory. Dayton Manufacturing Company.

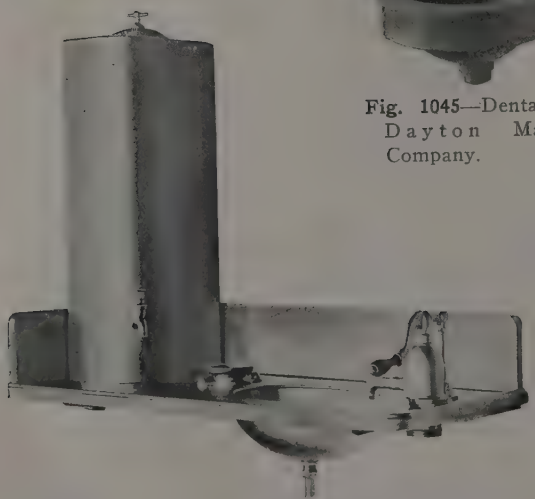


Fig. 1046—White Metal Washstand with Pump and Water Cooler. James L. Howard & Company.

Fig. 1047—Folding Corner Lavatory Dayton Manufacturing Company.

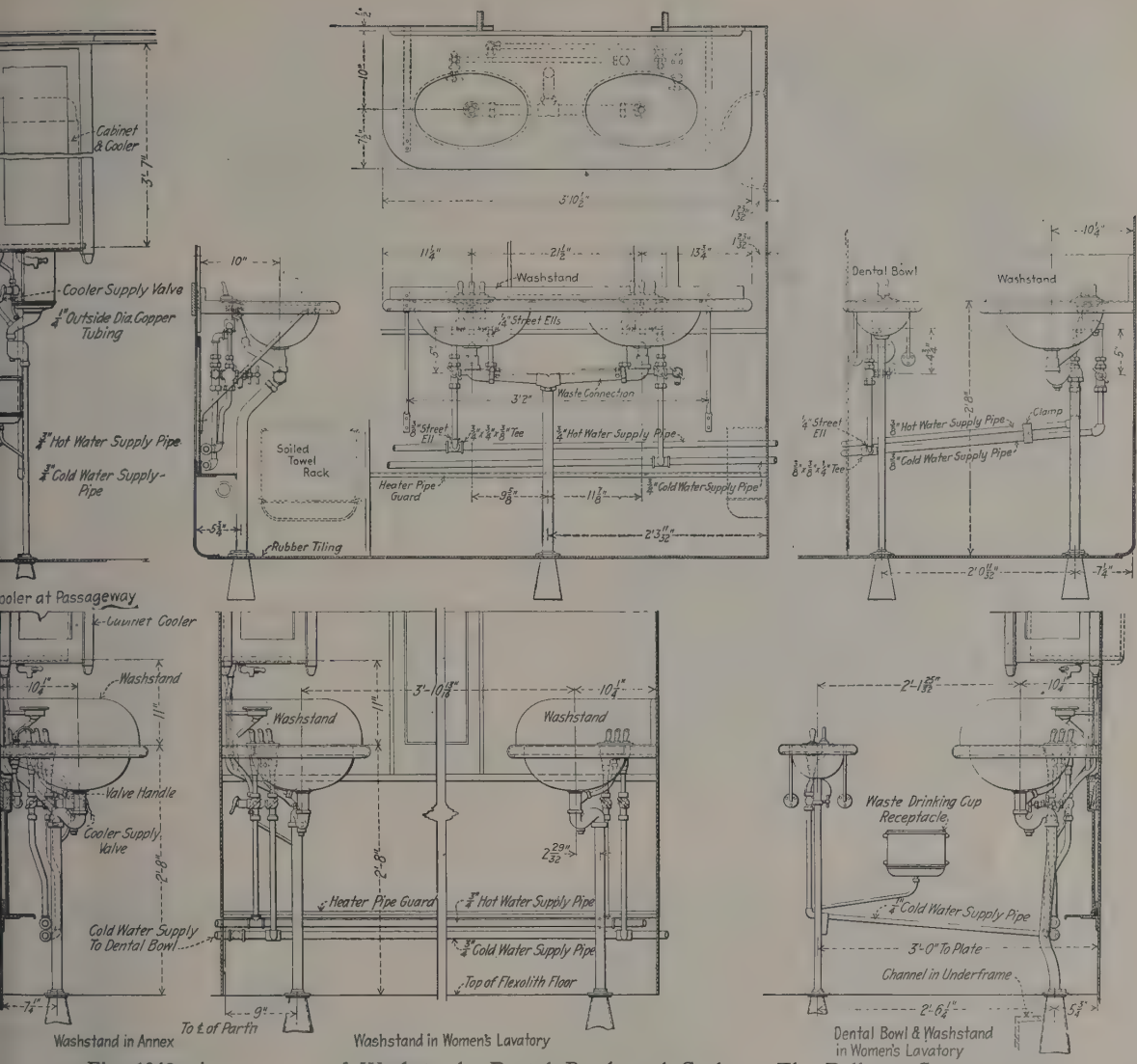


Fig. 1048—Arrangement of Washstands, Dental Bowls and Coolers. The Pullman Company.

1049—Vitreous Ware Dental Lavatory. The Watrous Company.

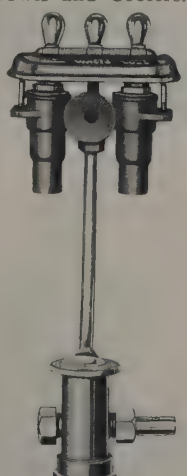


Fig. 1050—Combination Tilting Lever, Hot and Cold Basin Cock and Waste Valve. The Dayton Manufacturing Company.

Fig. 1051—Tilting Lever Type Waste Valve. The Dayton Manufacturing Company.

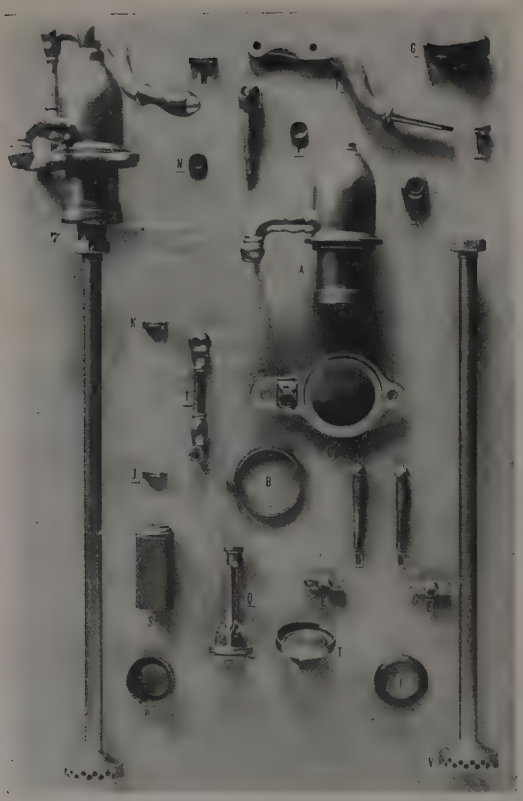


Fig. 1052—Washroom Pump and Fittings. Jas. L. Howard & Company.

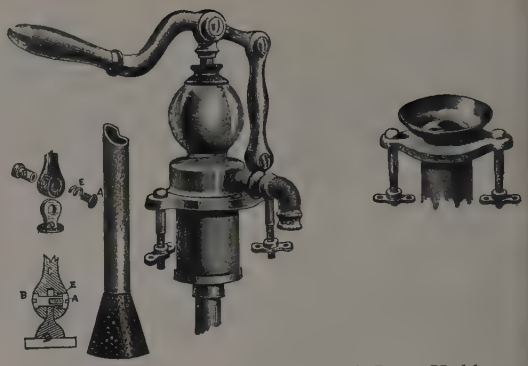


Fig. 1053—Washroom Pump and Soap Holder. Dayton Manufacturing Company.

Parts of Washroom Pump, Fig. 1052.

A *Pump Body with Spout and Cylinder*
B *Nut for Attaching Body to Base*
C *Base*
D *Screws for Attaching Base to Slab*
E *Nuts for Attaching Base to Slab*
F *Lever*
G *Rosewood Handle*
H *Handle Nut*
I *Rocker Arm*
J *Rocker Arm Pivot Screw, Upper*
K *Rocker Arm Pivot Screw, Lower*
L *Piston Rod*
M *Piston Rod Pivot Screw*
N *Piston Rod Shock Absorber (Leather)*
O *Piston Rod Stuffing Box Nut*
P *Piston Rod Stuffing Box Collar*
Q *Piston and Valve*
R *Piston Packing (Leather)*
S *Plunger*
T *Cylinder Head with Valve*
U *Cylinder Head Washer (Leather)*
V *Suction Pipe, with Coupling Nut and Strainer*

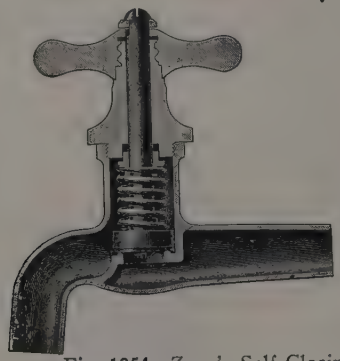


Fig. 1054—Zane's Self-Closing Bibb Cock.

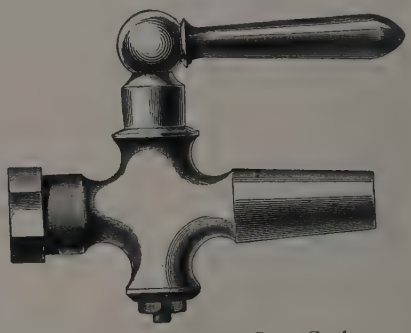


Fig. 1055.—Stop Cock. Dayton Manufacturing Company.

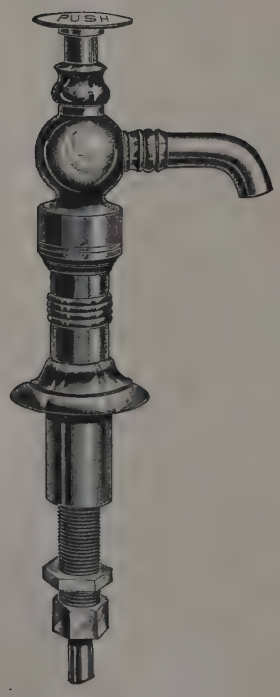


Fig. 1056—Compression Faucet. Adams & Westlake Company.

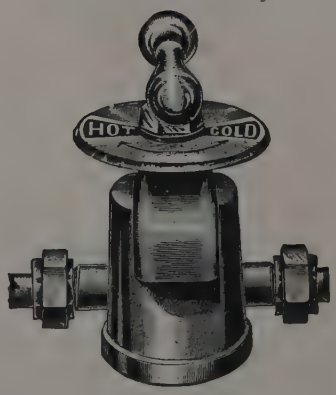


Fig. 1057—Combination Hot and Cold Water Faucets. Adams & Westlake Company.

Fig. 1058—Telegraph Faucet. Dayton Manufacturing Company.

Fig. 1059—Toilet Rack. Adams & Westlake Company.

1060—Rack for Used ıps. Dayton Manu- cturing Company.

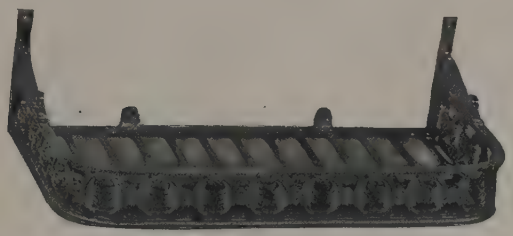


Fig. 1061—Comb and Brush Rack. Adams & Westlake Company.

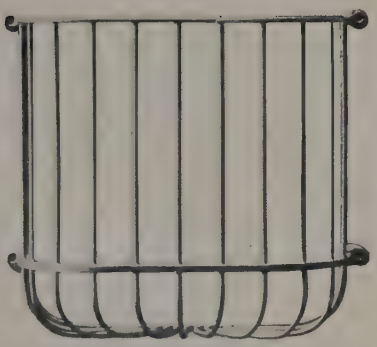


Fig. 1062—Rack for Soiled Towels. Jas. L. Howard & Company.

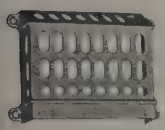


Fig. 1063—Rack for Used Cups. Dayton Manufacturing Company.

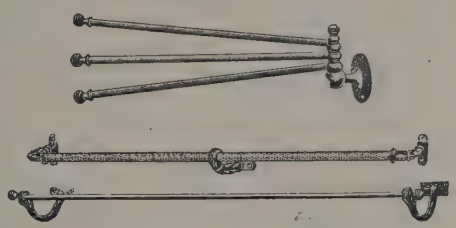


Fig. 1064—Towel Rods. Dayton Manufacturing Company.

Fig. 1065—Corner Toilet Rack. Adams & Westlake Company.

Fig. 1067—Soap Dish. Adams & Westlake Company.

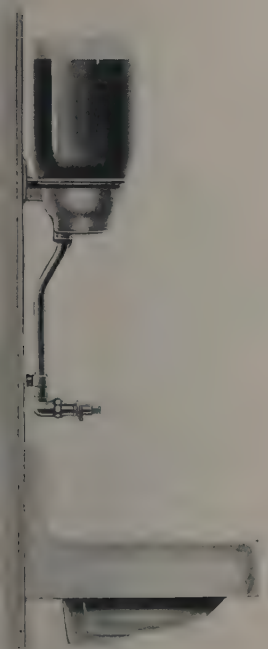


Fig. 1068—Gravity Liquid Soap Dispenser. Single or Multiple. The Watrous Company.

Fig. 1069—Towel Vendor. Individual Drinking Cup Company.

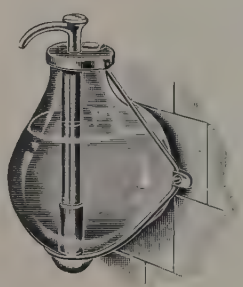


Fig. 1066—Watrous, Style M, Liquid Soap Fixture. The Watrous Company.

Fig. 1070—Soap Dish. Adams & Westlake Company.

Fig. 1071—Watrous, Style V, Concealed Liquid Soap Fixture. The Watrous Company.

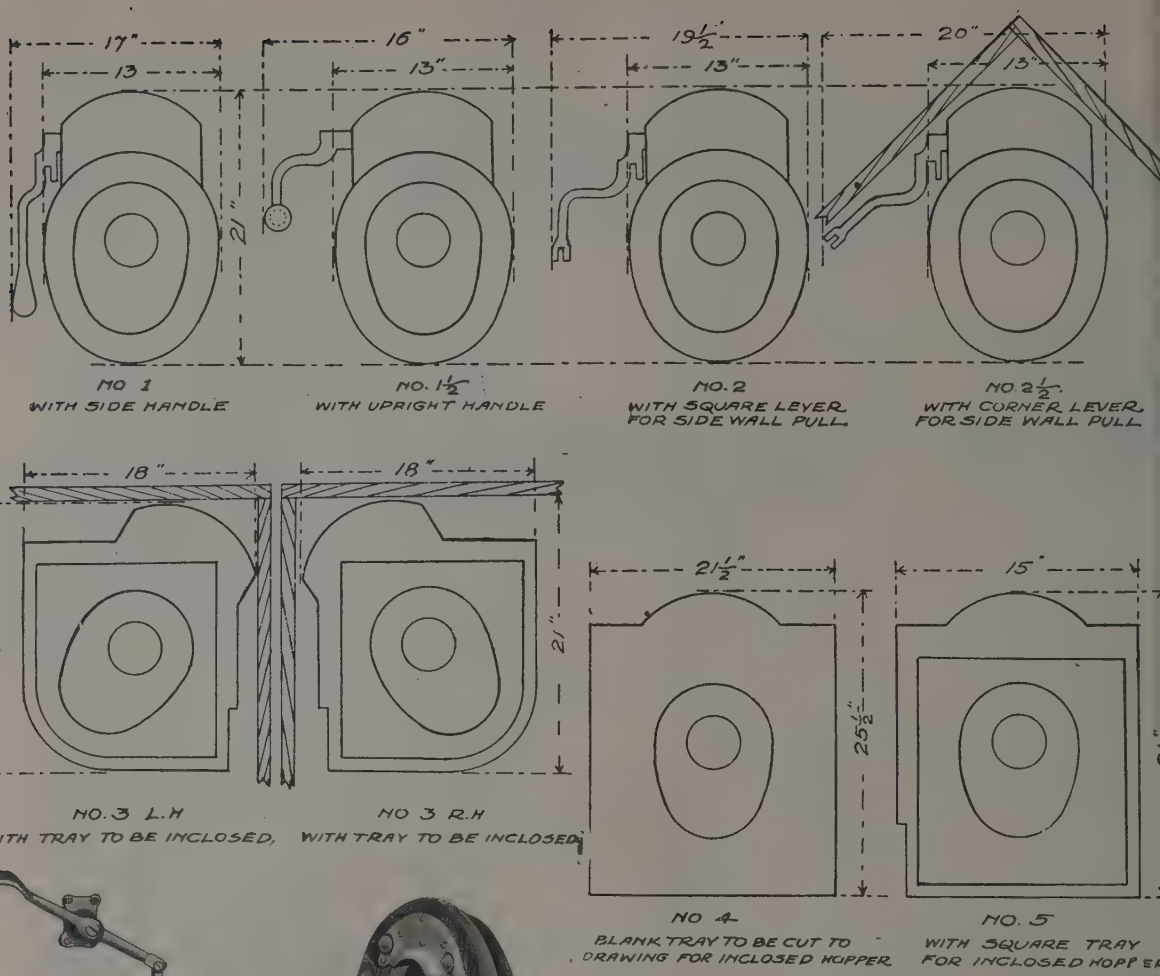


Fig. 1072—Types and Dimensions of Duner Car Closets

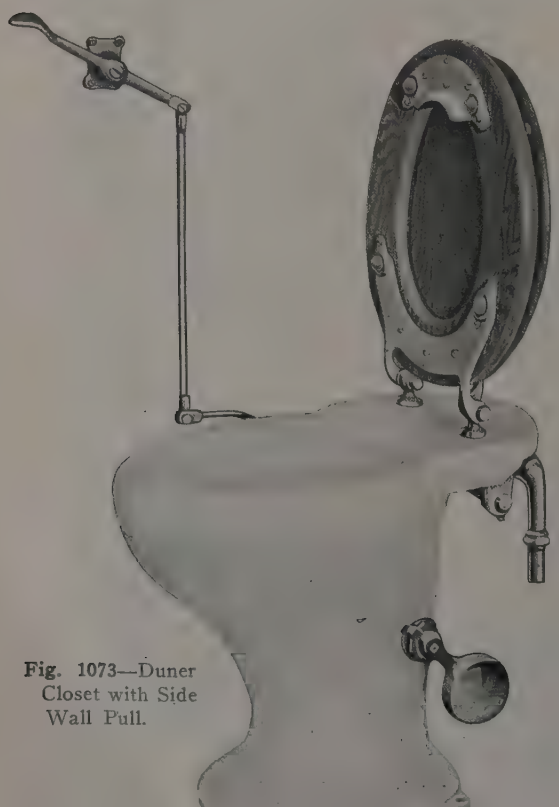
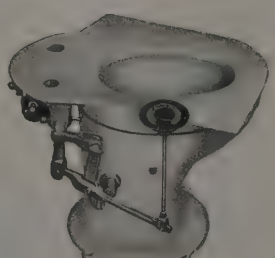


Fig. 1073—Duner Closet with Side Wall Pull.



No. 3

Fig. 1074—Duner Enameled Iron Corner Flush Hopper with Tray to be Inclosed.

No. 1

Fig. 1075—Duner Fl Hopper with S Wall Pull.

Duner Company.

(*See also Page* 495)

Duner Car Water Closet

The Duner Flush Hopper, or Car Water-Closet, has been in most successful use upon railway equipment, in different climates, and in many parts of the world—Europe, South America, China and Japan—as well as upon the sleeping cars and most of the first-class equipment in Canada and the United States, for more than 16 years. The Duner Hopper is of simple and durable construction; does not get out of order.

Many improvements which have been made since its first introduction are so designed that any part furnished now will fit the first hopper made. This means that every part is made to standard and applicable to all Duner Hoppers of its type.

The Duner Flush Hopper secures the most effective flush with the use of less water than any

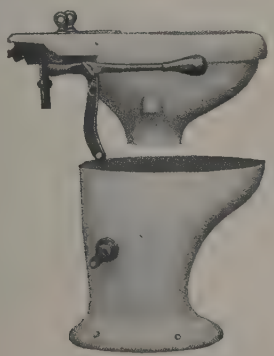


Fig. 1076—Showing Bowls Detached for Cleaning; Also Side Handle

other closet on the market, which is most important on account of the limited water storage on cars. The Duner Hopper will not freeze from outside cold owing to the construction of the insulated pan which seals the lower extension of the hopper and keeps out the cold air as well as all dust from entering the car through the closet. Should the water supply fail while the car is running, the closet need not be put out of service. The pan can be fastened back permitting the use of the device as an open hopper.

The Duner Hopper is made in two parts, see illustration herewith, facilitating cleaning and also permitting the use of either porcelain—vitreous ware—or enameled cast-iron for the top bowl, as may be preferred. The bottom bowl or base, being made of enameled cast-iron, should never need to be replaced. Any type of Duner upper or top bowl will fit the standard bottom bowl.

For information as to some of the different top bowls which are used on the same base or bottom bowl, see Fig. 1072, which is shown on page 494.

There are several operating devices. If it is desired to have the operating lever attached to a part of the hopper itself, the "side handle" would be used. Fig. 1076 also shows the bowls detached.

If it is desired to have the operating mechanism placed above the hopper and separate from it, the "side wall pull" should be specified. It is fastened to the side of the car or bulkhead. The hopper can be set in a corner, that is corner-wise, not square, and if so specified, will be fitted with the proper corner lever.

Either of the operating mechanisms can be easily changed from right hand to left hand, or vice versa.

The Duner Hopper can be operated with water

Fig. 1077—Duner Flush Hopper No. 6 with Lip Bowl and Side Wall Pull

from an overhead tank—gravity system—or from a tank under air pressure—pressure system. This should be borne in mind when placing an order. There is a difference in valves and supply pipes.

The Duner Company also furnishes when desired an enameled cast-iron tube to be used as an extension below the hopper, making a continuous enameled surface. It can be set at any angle desired. Galvanized sheet iron tubes in a very short time rust through causing damage to the floor and

Fig. 1077-A—With Side Wall Pull

framing before the same is noticed. This enameled tube makes an effective, sanitary and permanent outlet.

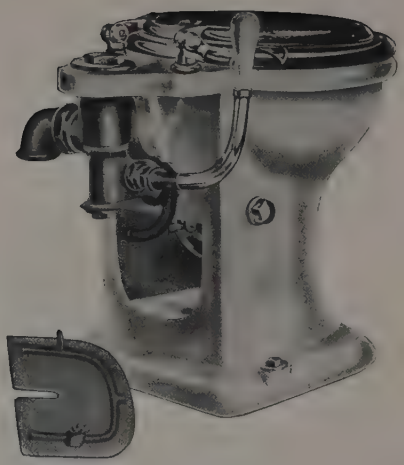


Fig. 1078—Americo Car Closet. The Watrous Company.

Fig. 1079—Atlas Combination Dry Closet, Hopper and Urinal with Seat-Raising Device. Railway Supply & Curtain Company.

Apron and Lid Partly Raised.

Apron and Lid Raised.

Fig. 1080—Protection Dry Closet. Adams & Westlake Company.

Fig. 1081—Special Dry Hopper. Sherburne & Company.

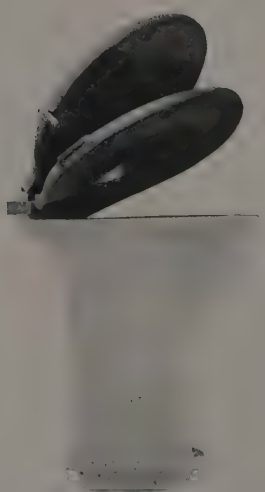


Fig. 1082—Enameled Iron Hopper with Seat-Raising Attachment. Jas. L. Howard & Company.

Fig. 1083—No. 32 Hopper. Adams & Westlake Company.

Buffers and Draft Gear

THE DEVELOPMENT OF BUFFERS AND DRAFT GEAR for railway cars has kept pace with the constant increase in size and weight of rolling stock and the great increase in length of trains. The draft capacity required for heavy modern traffic has necessitated larger and stronger gear and these conditions have been met very successfully. However no standard of draft gear design has been established except for certain limitations of draft sill dimensions into which the draft gear must enter; and the size of follower plates and stops. These requirements are specified in the American Railway Association Standards for "Fundamentals of Car Design" as adopted in 1920, and are as follows:

Distance between center sills, 12⅞ in.

Area of center sills between rear followers—minimum, 48 in.

Draft gear travel—on car, 2¾ in.

Minimum draft gear capacity, 150,000 lb.

Draft gear follower thickness, 2¼ in.

Ratio of unit stress to end load—maximum—for draft attachments, .125.

Tension or compression—sq. in.—grade "A" steel, 12.

Cor shear—sq. in.—15.

For bearing—sq. in.—7½.

Buffers

The passenger car buffer is a combination of draft gear, similar to gear used on freight cars and an additional cushioning device consisting of springs on side stems or bars built in the platform attached to the end of the car. The side buffers receive and absorb the initial shocks caused by other cars running against it; the complete device functions in absorbing heavier shocks and the gear alone when the car is being hauled.

Various different managements of passenger car buffers have been developed. Our design in general use is known as "three-stem equipment." In this device the coupler head is connected to the center stem and also to the two side stems and its movement to either side of the center line of the car is resisted by the side stem springs. The center stem is backed by the draft spring proper which is held in a pocket between the sills and absorbs most of the shocks.

In other types of buffers the coupler head is connected only to the center buffer or draft gear while the separate spring buffers at each side are attached to the buffer plate and thus receive and "cushion" the impact of other cars.

Draft Gear

Draft gear is the term used to designate the apparatus which connects the coupler or drawbar with the car sills; it receives and dissipates the shocks received by the coupler, thus tending to prevent damage to the car. Various forms of gears have been developed.

The form of gear now in general use is known as the Friction Draft Gear—a gear which makes use of friction for absorbing and dissipating the energy of buffing and tension shocks transmitted through the couplers. It is made in many different designs utilizing a combination of steel plates, cast blocks, and springs.

Some types of gear consist simply of heavy springs arranged in pairs—either twin springs—side by side; or tandem springs—one behind the other—and placed between follower plate contained within a coupler yoke. A special design of Friction Draft Spring which is of such design as to increase its capacity by friction between the coils has also been devised.

The range in size, weight, and nominal travel of draft gear as used on American railway cars is as follows:

FRICTION GEARS

Length	20 in. to 24⅝ in.
Travel	2 in. to 3 in.
Weight	200 lb. to 440 lb.

SPRING GEARS

Length	7⅞ in.
Travel	1⅜ in.
Weight	104 lb. to 110 lb.

Draft Gear Attachments

The A. R. A. requirements for follower plates, front and back draft stops, and draft gear or coupler yokes are as follows:

Standard—Adopted, 1907.

Flat followers shall be made of wrought iron or open-hearth steel, and shall be 1⅝ in. thick for tandem spring gear and 2¼ in. thick for twin spring and friction draft gear.

The standard dimensions for the front and back draft stops are shown in the drawing.

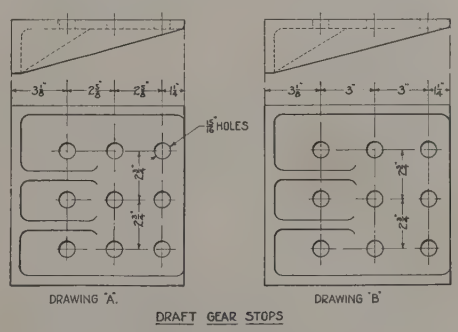


FIG. 1084—A. R. A. STANDARD DIMENSIONS FOR FRONT AND BACK DRAFT STOPS.

The standard dimensions for yokes as adopted in 1911 and revised in 1914 are as shown in the drawings.

Standard—Adopted 1911, Revised 1914.

In 1918 an extensive test of draft gears was made under the supervision of the United States Railroad Administration and some valuable data were obtained on various phases of draft gear performance. A complete report of this has been published in book form.

The following table gives some idea of the range of draft gear capacities as brought out in this test. The apparent wide range in capacity is not obtainable from any individual

design of gear but is due to the great variety of designs adapted for light and heavy service.

	Work Done Foot Pounds	Work Absorbed Foot Pounds
FRICTION GEARS		
Drop Test*	7,830 to 23,250	4,340 to 19,962
Static Test	6,409 to 53,100	1,708 to 50,267
Impact Test	6,833 to 27,184	2,150 to 20,750
SPRING GEARS		
Drop Test†	4,279 to 7,722	1,208 to 4,448
Static Test	3,800 to 9,034	434 to 4,767
Impact Test	4,117 to 4,992	450 to 2,709

* 9,000-lb. dropped from heights varying from 10.8 in. to 31.2 in.
† 9,000-lb. dropped from height varying from 5.8 in. to 9.5 in.

Reports and Papers

A committee report in the 1901 M. C. B. Proceedings, page 265, discusses the question of making car design favorable to the draft gear, designs of draft gear, wooden draft timbers and metal beams, springs, etc. An appendix includes drawings of different types of draft gear in use at that time and reports of tests made by different roads.

The committee recommended in the 1904 Proceedings, page 129, a standard spacing for center sills, stops for metal sills, distance from horn of coupler to facing of buffer beam, distance between stops and designs for followers and yoke. This was referred to the committee on standards.

A topical discussion on the advisability of a stronger draft gear for passenger cars will be found in the 1904 M. C. B. Proceedings, page 257.

A topical discussion on "To What Extent Does Friction Draft Gear Reduce Repairs, Expenses, Etc.?" will be found in the 1904 M. C. B. Proceedings, page 241.

A report in the 1902 M. C. B. Proceedings, page 143, includes complete reports of tests of 10 different draft gears at the Purdue University testing plant.

The committee reported in the 1903 Proceedings, page 94, that steps were being taken to secure data as to the service results from different types of draft gears.

A report in the 1908 M. C. B. Proceedings, page 143, includes an investigation as to the most desirable capacity of friction draft gears, the travel, and the value of the friction draft gear under service conditions.

A report in the 1910 Proceedings, page 371, presents the details of a draft gear testing machine to provide applications similar to those encountered in actual road service.

The strength requirements for the draft gear on cars for interchange is considered in the 1914 M. C. B. Proceedings, page 396.

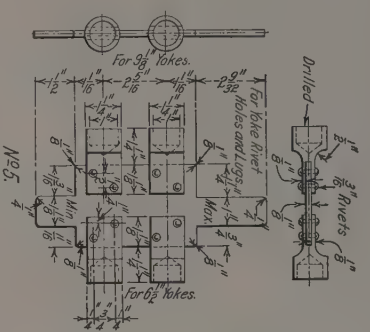
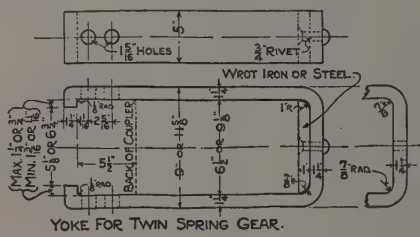


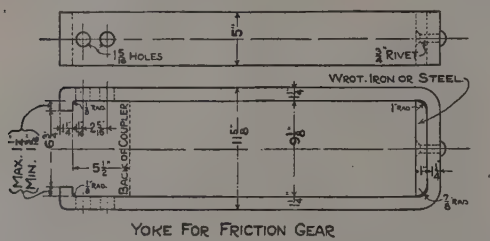
FIG. 1085A—INSPECTOR'S GAGE FOR COUPLER YOKE.

A report of a committee on draft equipment in the 1915 M. C. B. Proceedings, page 443, discusses the result of a circular of inquiry to ascertain the general practices as to draft equipment and its weaknesses.

A report of a special committee on draft gear in the 1916 M. C. B. Proceedings, page 326, concerns the minimum end force that can be put on the underframe of freight cars without overstraining them.

An individual paper on the impact between freight cars in switching service, by Professor Louis E. Endsley, will be found in the 1915 M. C. B. Proceedings, page 458. It includes a description of the testing and recording apparatus and the results of a series of tests.





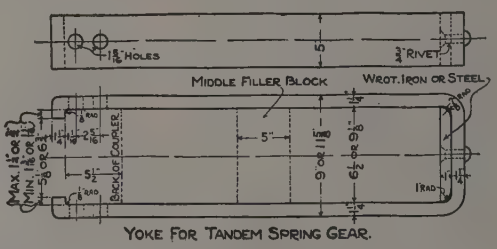


FIG. 1085—A. R. A. STANDARD DIMENSIONS FOR COUPLER YOKES FOR FRICTION AND SPRING DRAFT GEARS.

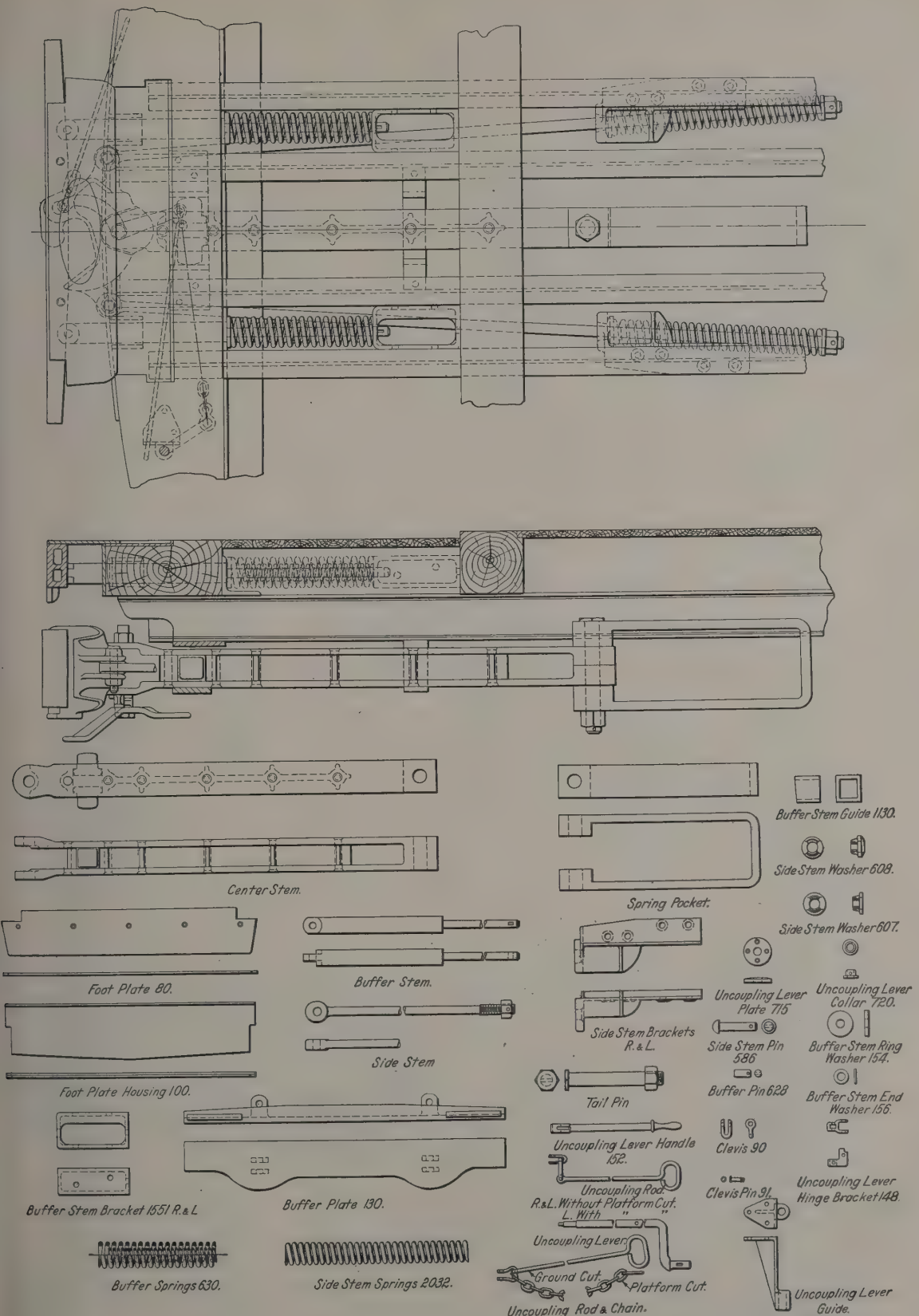


Fig. 1086—Buhoup Three-Stem Buffer Equipment and Parts for Passenger Train Car Platforms.

The McConway & Torley Company

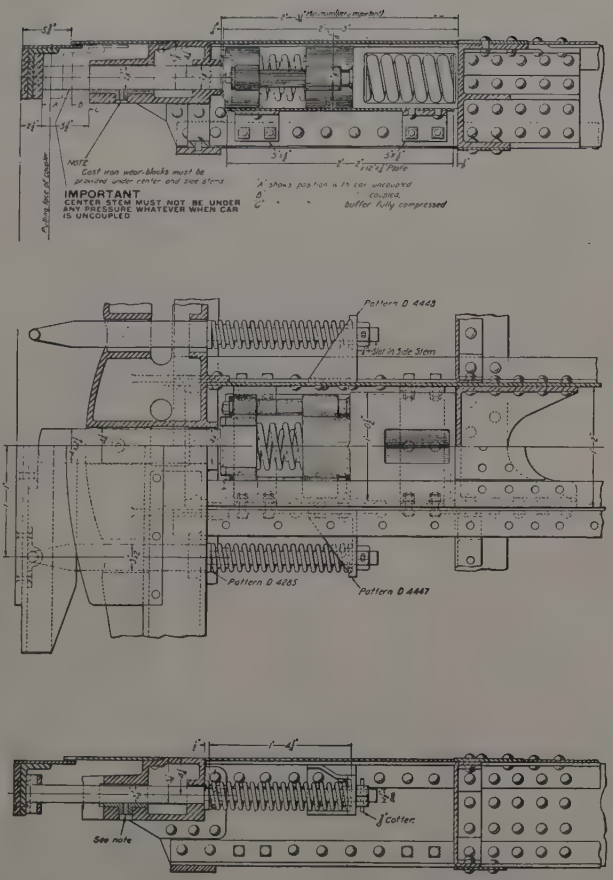

NOTE
Cast iron wear-blocks must be provided under center and side stems
IMPORTANT
CENTER STEM MUST NOT BE UNDER ANY PRESSURE WHATEVER WHEN CAR IS UNCOUPLED
Pattern D 4449
Pattern D 4485
Pattern D 4447
See note
Cotter

Fig. 1087—Miner Friction Buffer Class B-10 for Passenger Equipment with Built Up Steel Platforms.

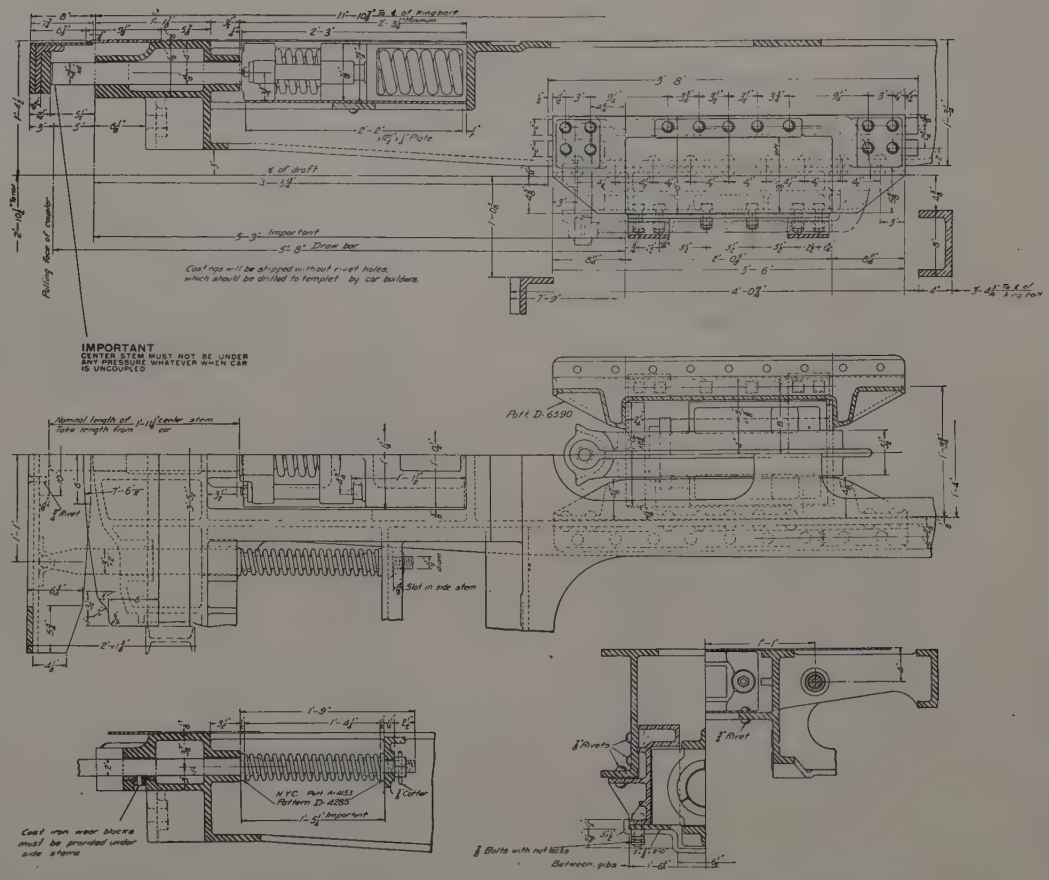

IMPORTANT
CENTER STEM MUST NOT BE UNDER ANY PRESSURE WHATEVER WHEN CAR IS UNCOUPLED
Pattern D-6390
Slot in side stem
Rivet
Cotter
Cast iron wear blocks must be provided under side sterns
Bolts with nut locks

Fig. 1087A—Miner Friction Buffer Class B-10 Showing Application to New York Central Passenger Equipment with Vestibule End.

W. H. Miner.

(See also Page 501)

Miner A-5-P-X Draft Gear and B-10 Buffer

The combined installation of the Miner Friction Draft Gear, Class A-5-P-X, and the Friction Buffer Class B-10, positively prevents severe passenger car shock and ensures the maximum comfort to the traveling public.

The Class A-5-P-X gear introduces a most necessary improvement in the equipment of passenger cars as it eliminates the necessity for backing and jerking trains in order to get under way. The free and independent spring action provided in the cylinder ensures non-slack, high capacity, live resilient movement which is sufficient to enable the engineer to start his train properly without any rough handling and at the same time to employ the full tractive power of the locomotive.

The cushioning power of the preliminary springs blends smoothly into the travel of the friction elements of the gear without shock, these friction elements finally co-acting with the main springs which are initially employed for the preliminary travel. This arrangement provides high ultimate resilient capacity, the total of which is employed only under the more severe conditions of train operation.

The Class B-10 buffer materially supplements the action of the draft gear and protects long shank couplers in the absorption of the heavy buffing shocks resulting from careless coupling and inequalities of air brake action.

The preliminary spring travel of this buffer co-acts with the side stem springs in maintaining contact between the vestibule face plates of opposing cars.

The total travel of the device is 5½ in., all of which is available when cars are uncoupled. A compression of 3 inches occurs when cars are in normal coupled position, which leaves 2½ inches for final movement synchronized with the full 2½ inches travel of the draft gear.

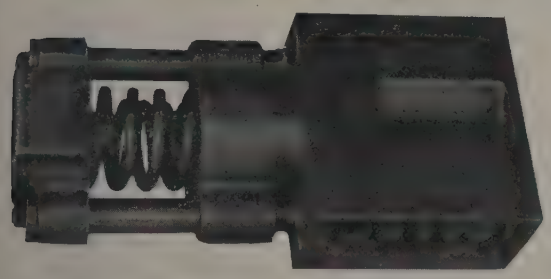


Fig. 1088—Miner Class B-10 Buffer

The high resilience supplied by the combined action of the draft gear and buffer not only protects the structure and attachments of passenger cars from the heavy impacts to which they are often subjected when trains are being made up in the yards, but also ensures smooth control of the train when running at or stopping from high speed. The violent surges throughout the length of the train tending to result from careless or emergency handling, and also non-uniform air brake action, are ideally accommodated by this gear and buffer.

Fig. 1089—Miner Class A-5-P-X Draft Gear

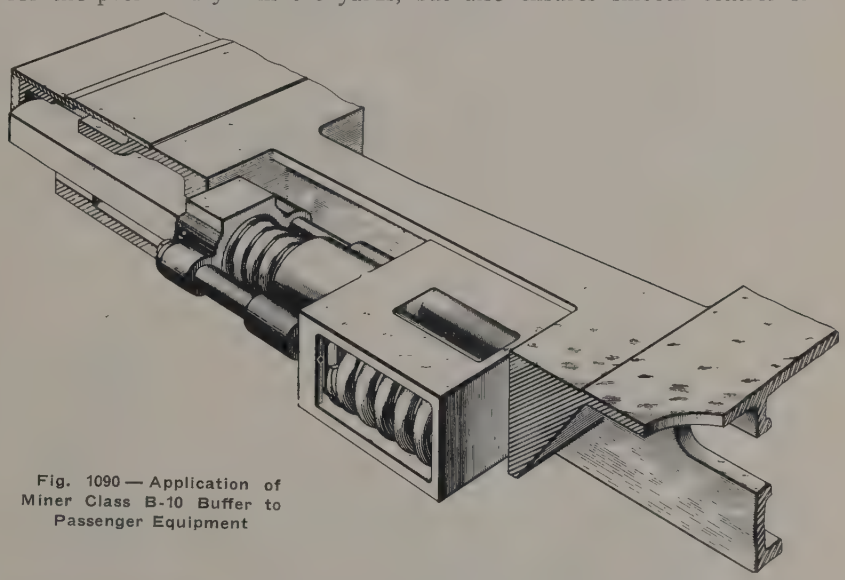


Fig. 1090 — Application of Miner Class B-10 Buffer to Passenger Equipment

The principal dimensions of the Miner Class A-5-P-X Draft Gear and the Class B-10 Buffer are given in the following table:

Item	*A-5-P-X Gear*	*B-10 Buffer*
Length	22¾ inches	27 inches
Width	12¾ inches	12½ inches
Depth	9 inches	7⅛ inches
Travel	2½ inches	5½ inches

Both of these devices embody important developments of earlier designs which are being used with unqualified success on many thousands of passenger and baggage cars in the United States and Canada.

For other products and branch offices, see classified and alphabetical indexes.

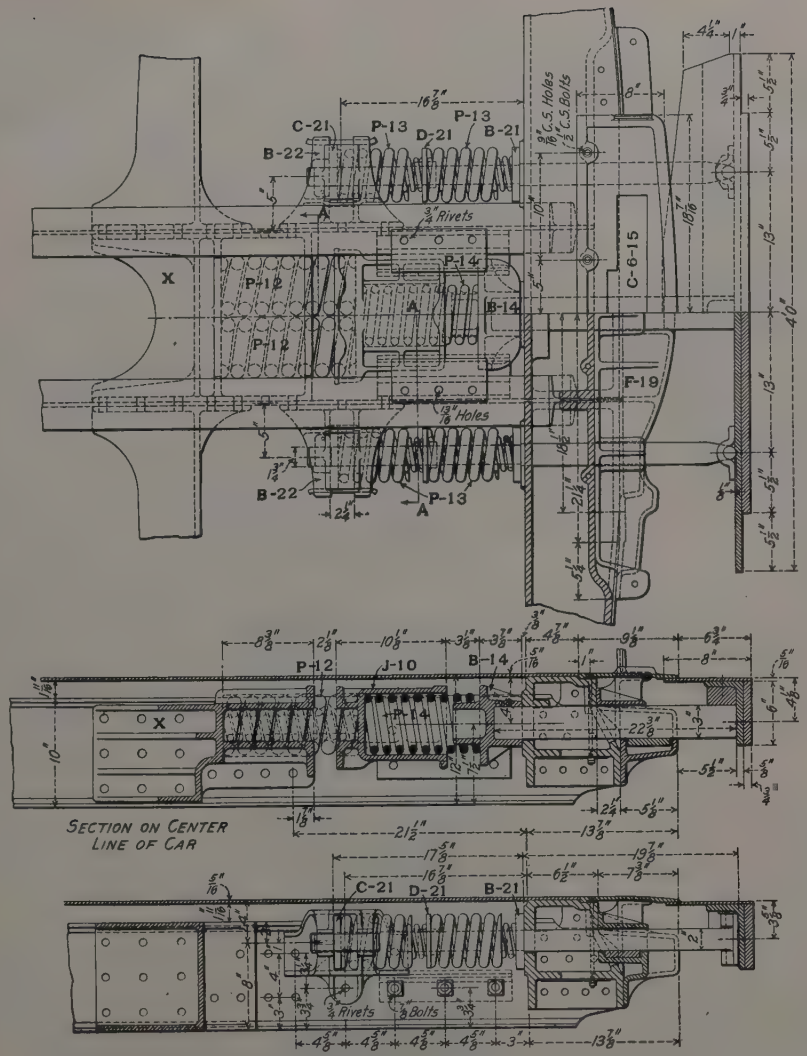
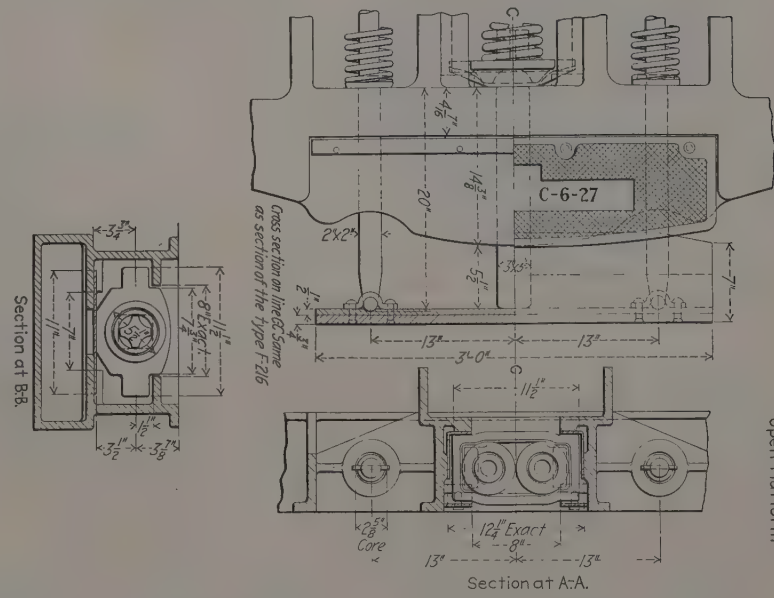


Fig. 1091—Standard Steel Platform Buffers for Steel Cars.

Parts of Standard Steel Buffers, Type F-216 and F-217.

2 *Buffer Face Angles*
2 *Buffer Face Plates*
2 *Buffer Tread Plates*
4 *Buffer Stems (side)*
4 *Buffer Stem Keys and Cotters*
4 *Buffer Stem Hinge Plates*
2 *Buffer Stems (center)*
2 *Front Followers D-14*
2 *Back Followers A-18*
2 *Front Spring Cups M-10*
2 *Back Spring Cups M-13*
4 *Washers F-21*
4 *Washers H-21*
2 *Name Plates C-6-27, C-6-28, or to suit*
2 *Chafing Plates*
4 *Cover Plates*
4 *Angle Plates*
4 *Buffer Springs D.C. P-23*
2 *Buffer Springs D.C. P-24*
4 *Buffer Springs D.C. P-25*
2 *Buffer Springs P-26*



Parts of Buffers Type D-126 as in Fig. 1091, Adapted to Steel Cars.

2 *Beam Extensions with Inserts, F-19*
2 *Name Plates, C-6-15*
2 *Buffer Spring Followers, B-14*
2 *Buffer Spring Casings, J-10*
4 *Side Stem Brackets—Keys F-22*
4 *Side Stem Washers, C-21*
4 *Side Stem Washers, B-21*
4 *Side Stem Washers, D-21*
2 *Buffer Center Stems*
"X" Back Spring Cups
4 *Buffer Center Stems*
2 *Buffer Face Angles*
2 *Buffer Face Plates*
2 *Buffer Tread Plates*
4 *Buffer Side Stems*
4 *Side Stem Keys and Cotters*
4 *Hinge Plates*
2 *Single Coil Buffer Springs, P-14*
4 *Double Coil Buffer Springs, P-12*
8 *Double Coil Buffer Springs, P-13*

Fig. 1091-A—Plan and Transverse Sections of Type F Buffer Shown in Fig. 1092.

Standard Coupler Company.

(See also Page 503.)

"Standard" Steel Buffers

The service demanded of the buffer in performing its function of protecting passenger cars, requires that this device combine strength, simplicity, and efficiency in operation, and it is these qualities which have been incorporated in the various designs of "Standard" Steel Buffers.

The older types are spring-actuated only and their capacity is limited to 45,000 lb. They have proved very satisfactory for the lighter and wooden types of cars, which have comprised their field of application. These types of buffers are also used very efficiently on steel underframe cars, with either built-up or cast steel platform construction.

The type "F" Buffer—shown in Fig. 1091 A and Fig. 1092—is a device of high capacity and is designed to meet the requirements demanded by modern heavy steel cars. This buffer provides resistance by means of both friction and springs, which gives it high reserve capacity, yet makes simplicity of construction a distinguishing feature.

In operation, the springs receive all minor shocks and take care of buffing loads up to approximately 50,000 lb. For shocks which exceed this amount, the friction plates come into action and, together with the springs provide capacity up to 350,000 lb. The general construction of this buffer is such that it is adaptable to built-up as well as to cast steel platforms.

All "Standard" Steel Buffers have three stems, an arrangement which provides for keeping the outer faces in proper alinement and at the proper contact pressure under all conditions of track and operation. This feature is also effective in reducing and absorbing shocks that would otherwise have to be taken up entirely by the draft gear or the sills of the car.

Buffer face plates are furnished in designs which are suitable for application to cars having either vestibule or open platforms.

The large number of these buffers, which are in extensive use throughout the United States and Canada, is evidence that they efficiently meet all practical railway requirements.

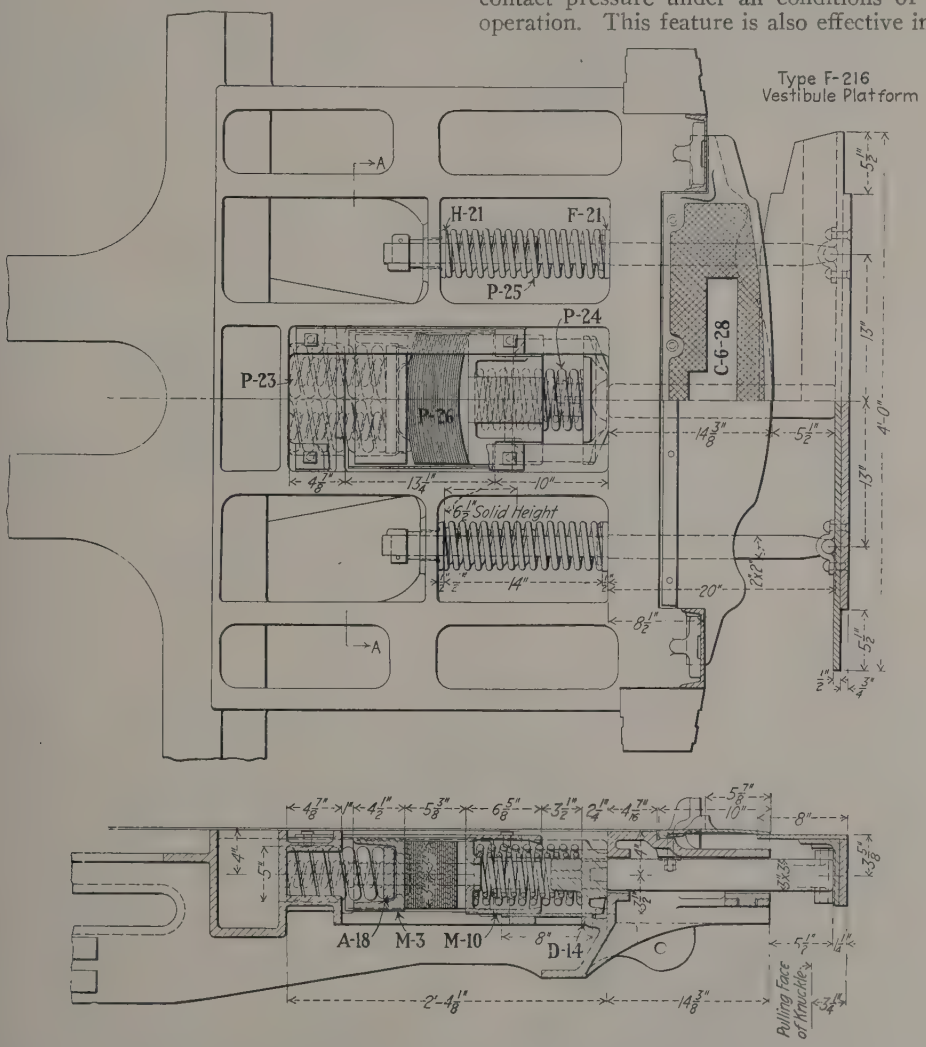
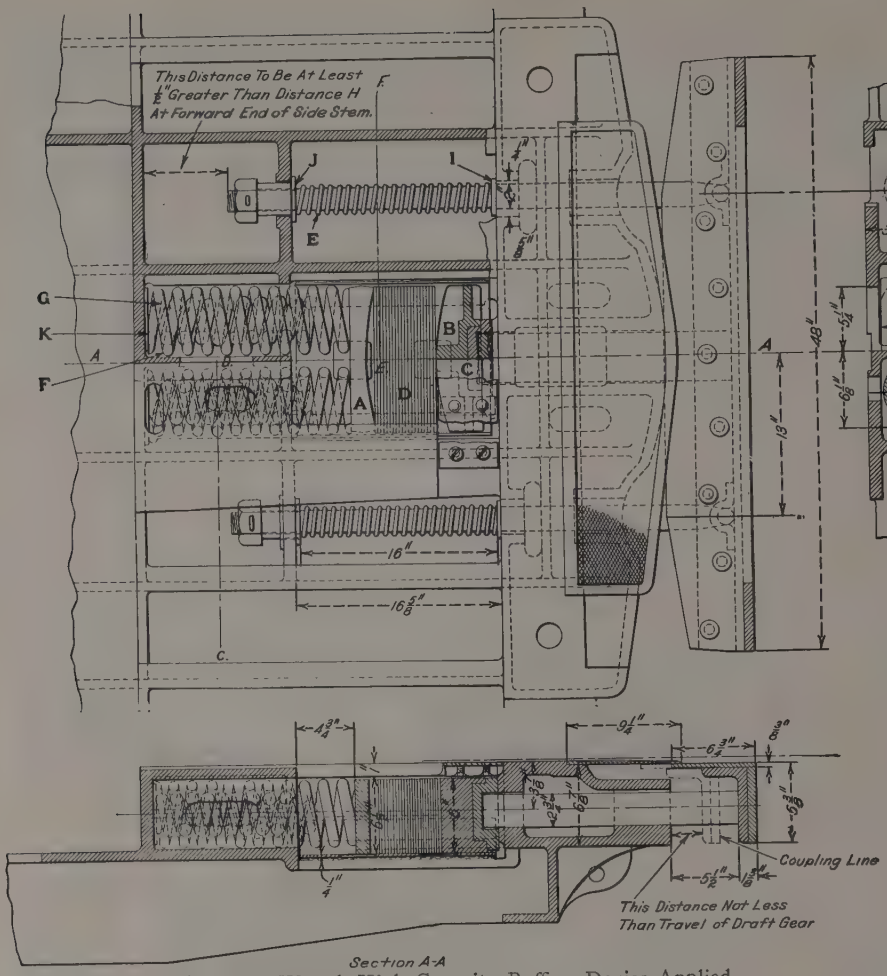


Fig. 1092—Application of Standard Steel Type F Buffers to Cast Steel Platforms

For other products and branch offices, see classified and alphabetical indexes.

STANDARD COUPLER COMPANY, NEW YORK, N. Y.


This Distance To Be At Least 1" Greater Than Distance H At Forward End of Side Stem.
Section E-F
Section C-D.
6" Plates
Coupling Line
This Distance Not Less Than Travel of Draft Gear
Section A-A

A *Concave Followers*
B *Convex Followers*
C *Interlock Followers*
D *2 Complete Sets of Friction Plates*
E *Side Stem Spring No. 53*
F *Outside Springs No. 50*
G *Inside Springs No. 51*
H *Bottom Wear Plates*
I *Side Stem Spring Washer*
J *Side Stem Spring Thimble*
K *Main Spring Washers*

Fig. 1093—Waugh High Capacity Buffing Device Applied to Cast Steel Platform. Waugh Draft Gear Company.

(*See also Page* 505)

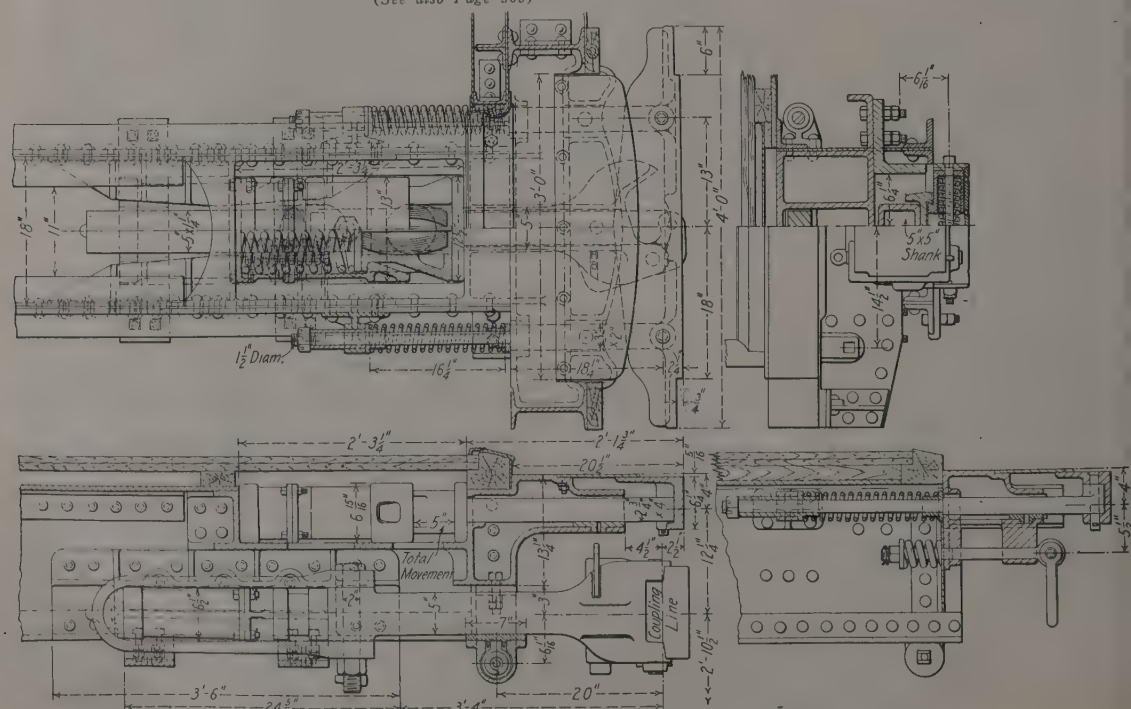


Fig. 1094—Cast Steel End Sill Buffer, Centering Device and Draft Gear. Gould Coupler Company.

Waugh Platform Buffer

The circumstances which surround the switching of passenger cars and their movement in trains, make it necessary to provide other cushioning equipment in addition to that provided by the draft gear. Shocks which are common in making up freight trains and in their movement, are not to be tolerated in the case of passenger trains. Very often it is necessary to switch passenger cars containing passengers, who are asleep, as in the case of sleeping cars; the presence of dining cars in a train introduces another condition; and further, as it is often necessary to "take the slack" when starting a passenger train, this must be done with as little discomfort as possible to the passengers. The practically universal use of vestibuled equipment also requires some provision for keeping the adjacent platforms always in contact. The Waugh Platform Buffer, combined in a single piece of apparatus is an equipment which meets the requirements incident to the above conditions of passenger service.

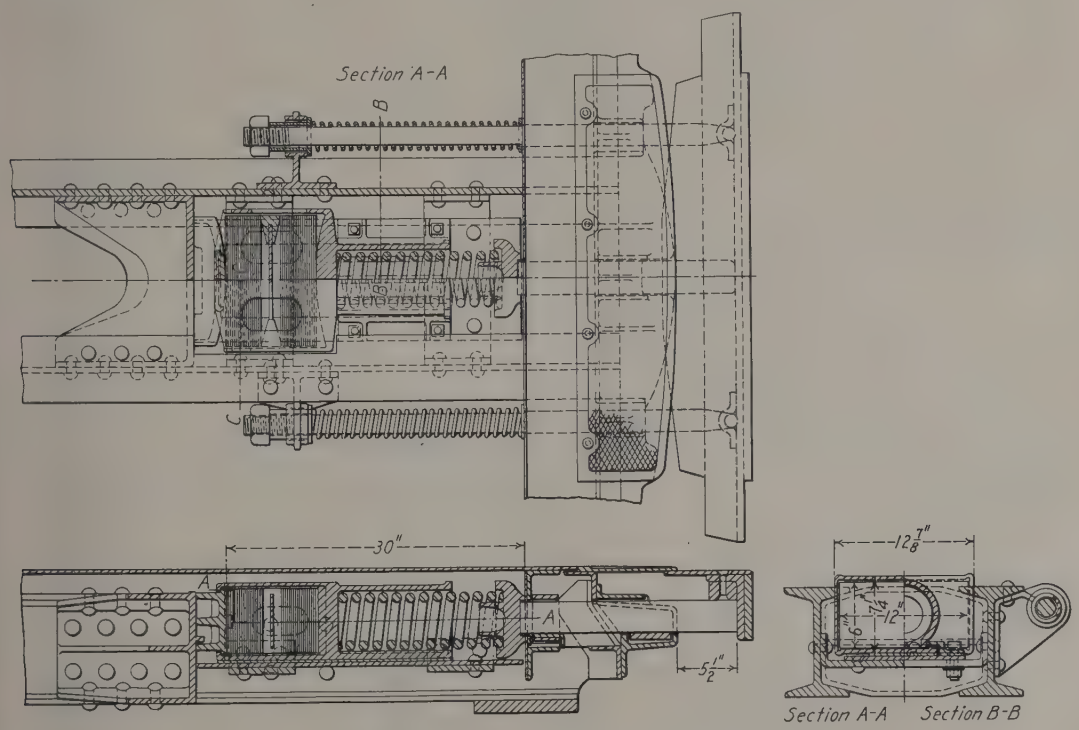


Fig. 1095—Waugh Buffing Device Arranged for Steel Passenger Train Cars

The complete Type H Buffer consists of a chafing casting, three sets of springs and a back-stop arrangement. The springs which absorb the heavy buffing stresses consist of two groups of steel plates in an arrangement which has the same design and action as have been described on another page, in connection with the Waugh Draft Gear. These springs are carried in a cast steel housing with which is also cast integral a tube containing the tension and initial compression springs. These are helical springs, carefully designed and manufactured to suit the purpose for which they are employed. The buffing stresses are transmitted to and from the spring assembly by a column which extends through the end sill of the car to the chafing plate. The initial compression is obtained by means of two rods which are threaded on one end, the other ends being attached to the chafing plate at points about half way between the center and each end. These rods pass through lugs riveted to the center sills and also carry springs which serve to maintain the position of the chafing plate at right angles with the center line of the car. Nuts are screwed on the threaded ends of the rods and tightened against the lugs until initial compression of the desired degree is obtained.

The capacity of this buffer is about 300,000 lb. Half of the travel of the draft gear under compression is accompanied by the action of the two groups of plates contained in the buffer mechanism. The housings that enclose the operating parts and conduct the buffing shocks which exceed the capacity of the cushion mechanism are of sufficient strength to eliminate all breakage or damage to the cushioning elements in service.

Another type of Waugh Platform Buffer—Fig. 1093—has practically the same capacity as the type H but has only one group of plates.

For other products and branch offices, see classified and alphabetical indexes.

WAUGH DRAFT GEAR COMPANY, CHICAGO, ILL.

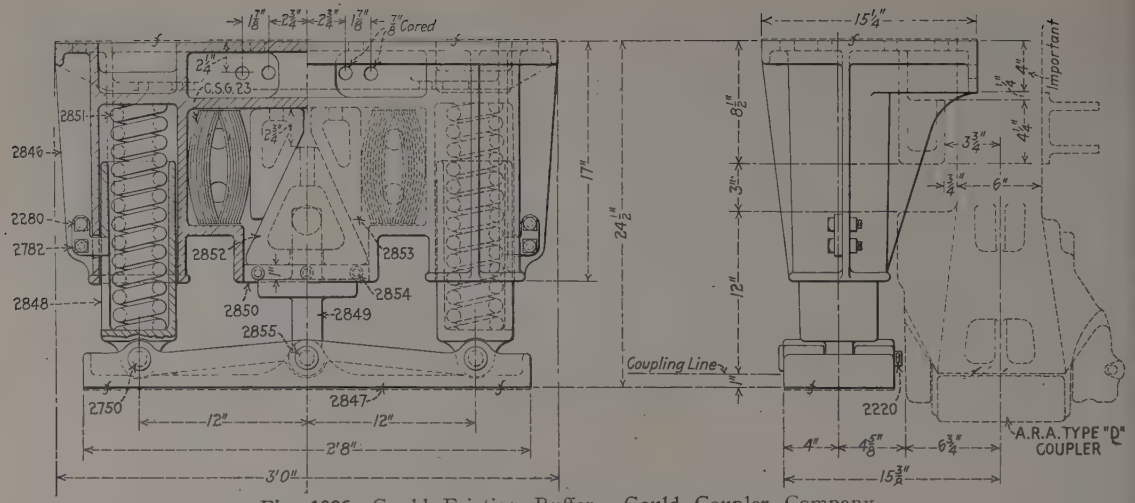


Fig. 1096—Gould Friction Buffer. Gould Coupler Company.

Parts of Waugh Buffing Devices Shown in Fig. 1097.

A *Housing Casting*
B *Convex Follower*
C *Concave Follower*
D *Side Stem Brackets*
E *Bottom Wear Plates*
F *Chafing Plates, Center Stem*
G *No. 50 Spring*
H *No. 51 Spring*
I *No. 53 Spring*
J *Spring Friction Plates*
K *Tread Plates*
L *Side Stem Spring Washer*
M *Buffer Face Casting with Inserts—Vestibule End Only*
N *Buffers*
O *Buffer Tread Plate*
P *Buffer Angle*
Q *Buffer Face Plate*
R *Hinge Plate*
S *Center Stem Chafing Block*
T *Side Stem Chafing Block*
U *Vestibule End Side Stems*
V *Vestibule End Center Stems*
W 1¾-inch Hexagon Nut
X ¼-inch Cotter Pin

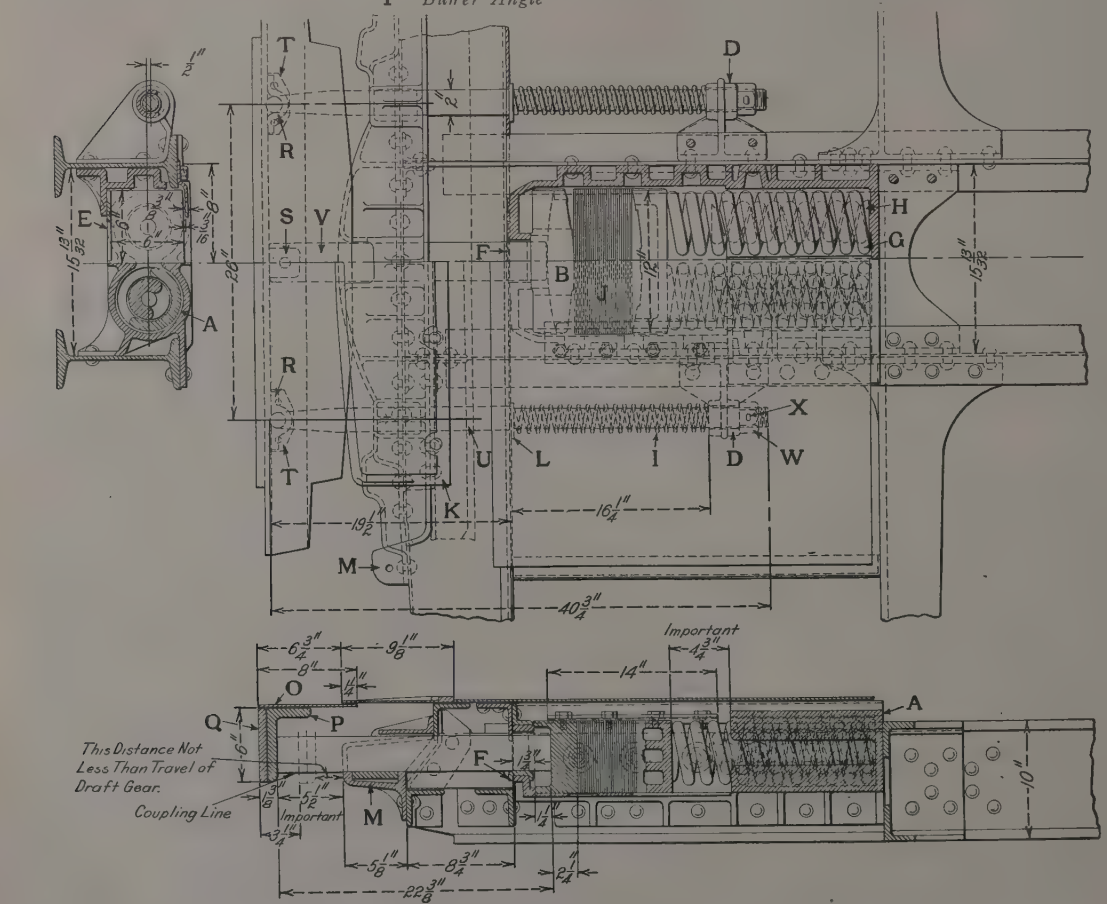


Fig. 1097—Waugh High Capacity Buffing Device Applied to Built Up Steel Platform. Waugh Draft Gear Company.

(See also Page 505)

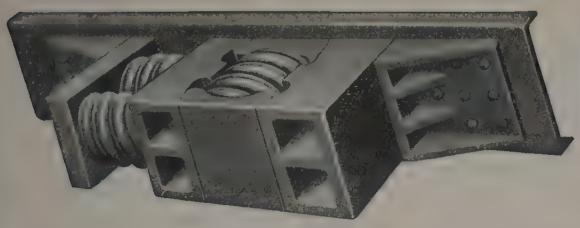


Fig. 1098—Butler Friction Draft Gear No. 370 with One Draft Sill Removed.

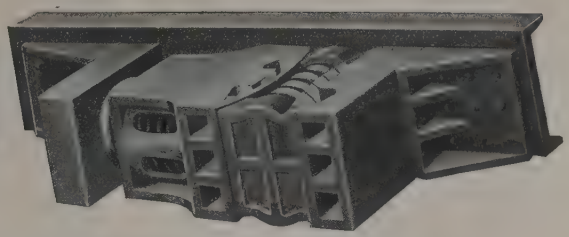


Fig. 1099—Butler Friction Draft Gear with One Sill Removed.

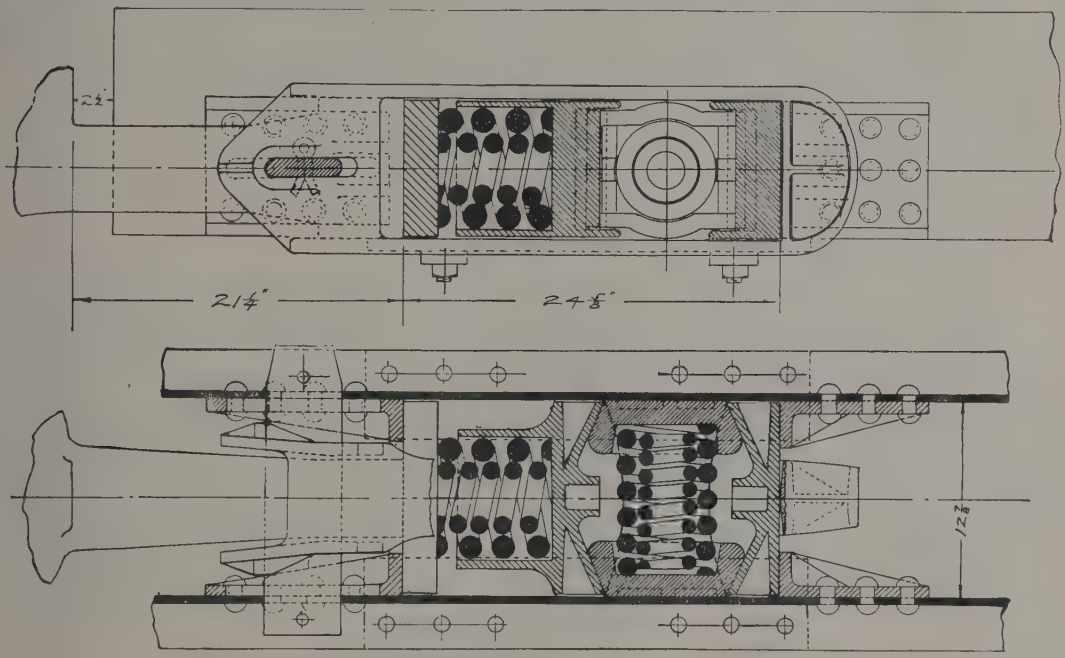


Fig. 1100—Butler Friction Draft Gear No. 350 Applied to Freight Car.

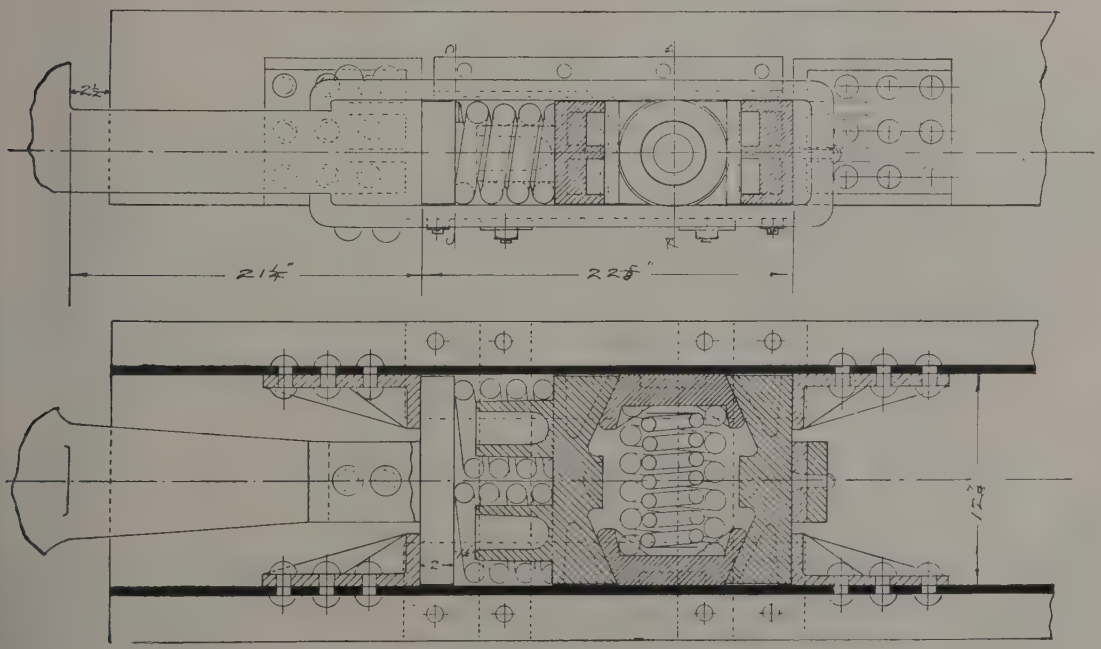


Fig. 1101—Butler Friction Draft Gear No. 370 Applied to Freight Car.

National Malleable Castings Company.

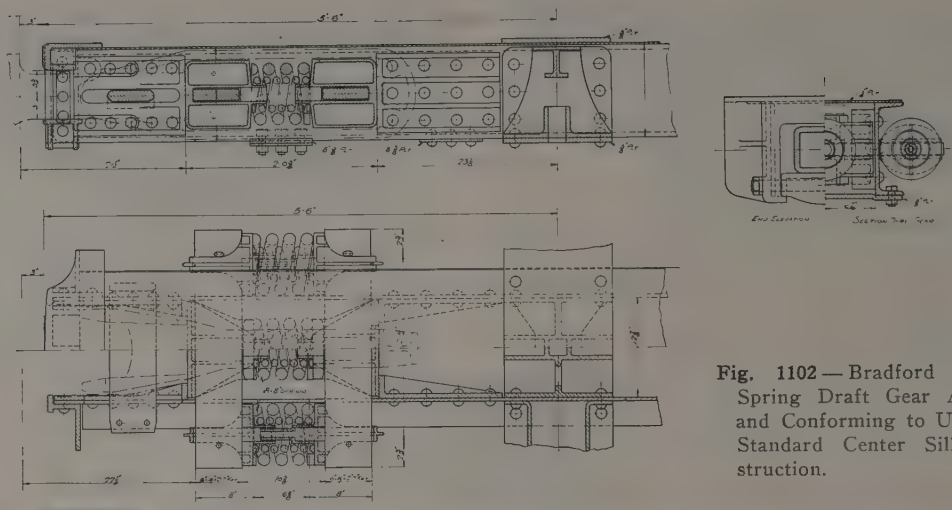


Fig. 1102 — Bradford Three-Spring Draft Gear Applied and Conforming to U.S.R.A. Standard Center Sill Construction.

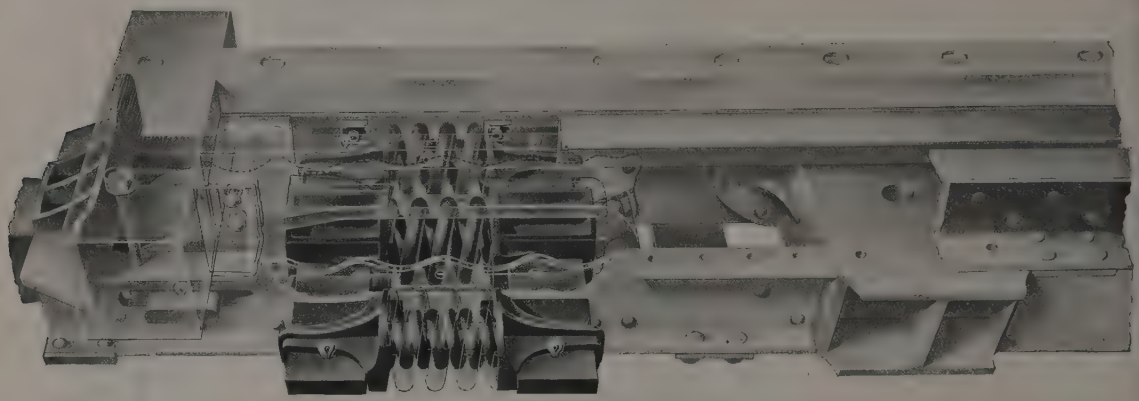


Fig. 1103—Bradford Three-Spring Draft Gear.

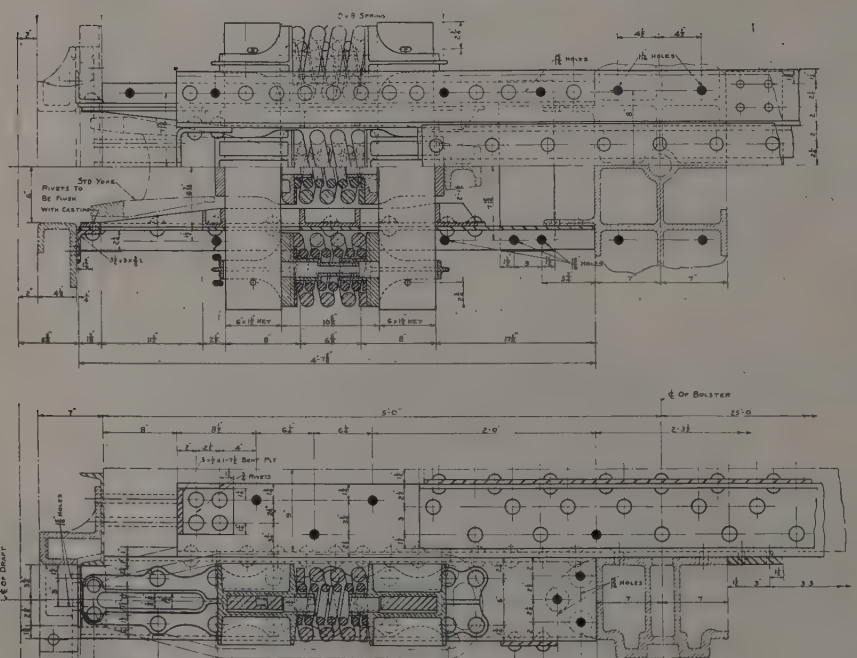


Fig. 1104—Detail of Bradford Three-Spring Draft Gear and Structural Center Sills for Central Railroad of New Jersey.

Bradford Draft Gear Company.

(*See also Page* 509)

Commonwealth Transom Draft Gear

One of the important problems which has arisen with the increase of freight trains to lengths of 100 cars and more, has been to discover a means for reducing the drag at curves, which not only subjects the car structure to excessive stresses but also causes needless rail wear.

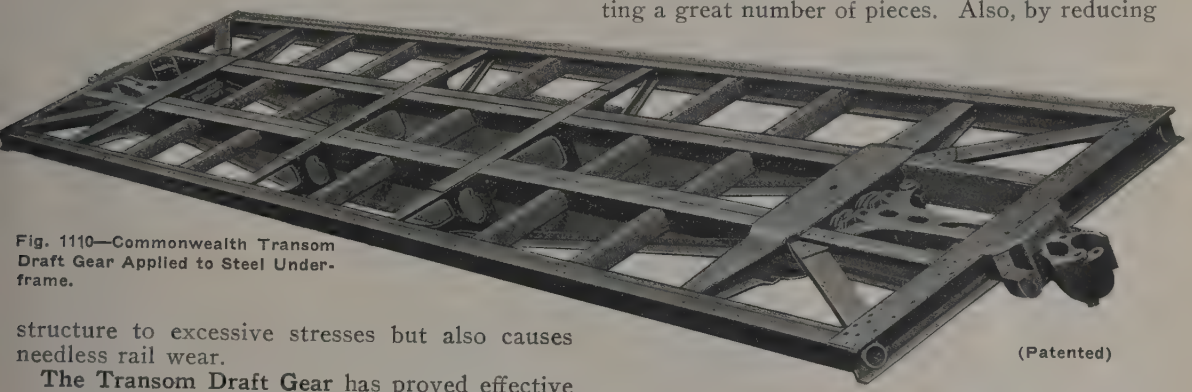


Fig. 1110—Commonwealth Transom Draft Gear Applied to Steel Underframe.

(Patented)

The Transom Draft Gear has proved effective in combating these destructive forces, and, at the same time, the car is strengthened. This device makes possible the location of the pulling points of the car on the vertical center lines of the truck center pins, while the reactions to buffing and pulling stresses are provided by a strong and specially designed cast steel body bolster through which all shocks are evenly distributed over all the sills.

In addition to the body bolster the Transom Draft Gear also includes a yoke arrangement—for connecting the coupler to the bolster—and four coil springs—for absorbing any shocks which may accompany tension and compression stresses.

All types of cars can be adapted to the use of this device, whether they are of all-steel, of composite, or of wooden construction. Its application is especially desirable in the case of cars with wooden underframes when in combination with the wooden sills, it forms an unusually powerful buffing and pulling column. The economy and permanence of this type of construction has been proved by instances where the wooden car-bodies have been demolished; yet this reinforcement has been removed unharmed, and applied to other cars for further use. For ballast cars, the Transom Draft Gear solves the problem of reinforcing their light sill construction.

Maintenance costs and train operation are improved by the installation of this device. Its use simplifies ordinary car construction by eliminating a great number of pieces. Also, by reducing the pulling length of cars, the drag at curves is lessened which results in decreased rail wear, reduced stresses in the car structure, and an increase in the hauling capacity of locomotives.

(Patented)

Fig. 1111—Commonwealth Transom Draft Gear for Wooden Cars.

Any friction draft gear can be used with the harness which the Commonwealth Transom Draft Gear provides, or any special construction requirements can be met by special designs.

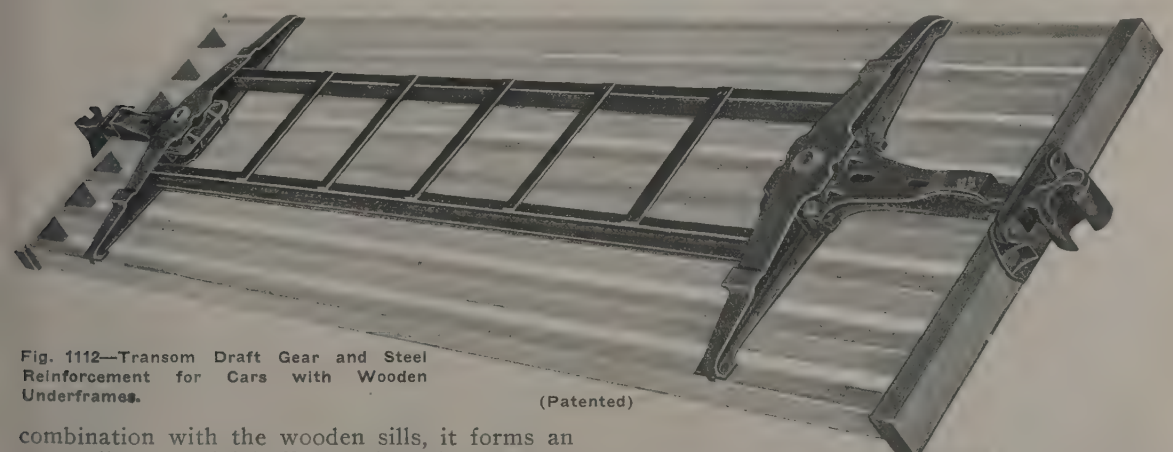
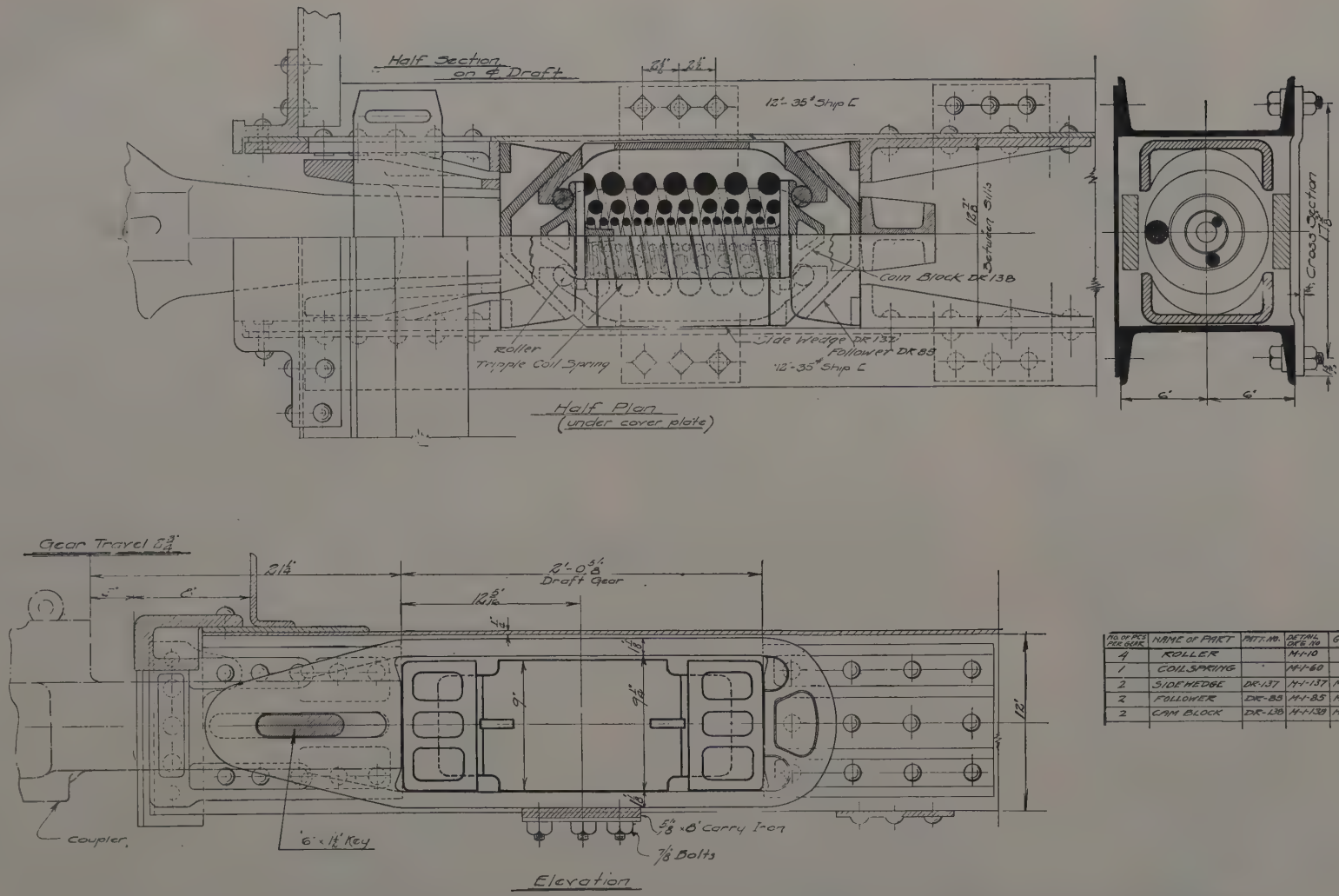


Fig. 1112—Transom Draft Gear and Steel Reinforcement for Cars with Wooden Underframes.

(Patented)

For other products and branch offices, see classified and alphabetical indexes.

COMMONWEALTH STEEL COMPANY, ST. LOUIS, MISSOURI



No. of Pcs per Gear	Name of Part	Patt. No.	Detail Dr'g No.	Gauge
4	ROLLER		M-1-10	
1	COIL SPRING		M-1-60	
2	SIDE WEDGE	DR-137	M-1-137	M-1-139
2	FOLLOWER	DR-83	M-1-83	M-2-115
2	CAM BLOCK	DR-138	M-1-138	M-1-140

Fig. 1113—Murray Type H Friction Draft Gear as Applied to U. S. R. A. Standard Cars. Keyoke Railway Equipment Company.

(See also Page 513 and Figs. 1115-1117)

The Murray Cast Steel Friction Draft Gear

The importance of the design of draft gear cannot be overestimated in regard to the relation which it bears to satisfactory train operation, and to the cost of maintaining equipment in serviceable condition. At the same time, it is indisputable that the service which draft gears must endure is the most severe to which any part or collection of parts, of a car is subjected.

The basic principles which underlie the design of the Murray friction draft gear give it the necessary stamina to meet the most severe conditions of service at a cost of practically nothing for maintenance.

The component parts of this draft gear include 2 heads or followers, 2 side wedges, 1 triple-coil spring, 4 rollers and 2 cam blocks, making a total of 13 parts in all.

The frictional surfaces act upon each other in wedge-like fashion, the pressure between the surfaces being controlled by the pre-determined force of the coil springs. Any longitudinal movement of the heads or followers produces a corresponding inward movement of the side wedges, and this latter movement actuates the spring by means of the four rollers and the two cam blocks. These rollers are made of standard spring steel and actually rotate. They are not anti-friction rollers, but are the equivalent of floating levers, on account of the change of angle of the surfaces between which they are located.

Fig. 1114—Murray Cast Steel Friction Draft Gear Ready for Application

Provision against lost motion or slack, as well as spring failures, has been made in the design of this gear. Slack is avoided by applying the gear under an initial compression of about ⅜ in., which automatically prevents, for a few years, any slack due to wear on the friction surfaces. Murray gears are also manufactured with an adjustable wear-block feature, by which provision is made for restoring the gear to its original length and travel after it has worn sufficiently by many years of service to have slack in the draft gear pocket. This wear can be compensated by the insertion of rolled steel shims—which may be made from scrap plates—behind or between the wear block and follower proper. The Murray Gear is designed so that the springs are never compressed solid, thus they are protected against the most severe service. This is accomplished by causing the followers to seat on the shoulders of the side wedges before the springs are entirely closed.

The release of the Murray Gear is positive and smooth, as in all tests conducted by the manufacturer as well as disinterested parties never has this gear been known to stick on release.

These features insure uniform wear and long life of the parts. The work done is evenly distributed; the initial resistance is moderately low and increases smoothly to an ultimate high capacity, so that light and heavy shocks are absorbed with equal efficiency.

Murray Draft Gears are interchangeable with all standard length friction draft gears and are furnished complete with followers and springs, assembled and held compressed with bolts shorter than the pocket, so that the gears may be readily placed in the yokes and half-way entered between the draft sills without sledging, after which the bolts must be removed.

Simplicity of construction is combined with strength and durability in the Murray Draft Gear. It is composed of only a few parts and there are no rods, bolts, nuts, or rivets, to bend, shear, break or work loose. Except for the material composing the rollers and springs, only a high grade of acid cast steel is used which renders the design strong and substantial, and makes the net cost of the Murray Gear low when considered in reference to the total life of the gear and the character of the service rendered.

The vital functions performed by the draft gear equipment of freight and passenger trains have far reaching consequences as regards car and locomotive tender construction. It is at the draft gear that the severe shocks concentrate when trains are started or stopped under difficult circumstances, and when trains are in motion other buffing and surging stresses are generated. The extent to which these forces affect the structure of cars and locomotives depends in a large measure upon the draft gear. This problem is rendered more complex by the fact that calculations at best are uncertain. However, many of the difficulties encountered can be overcome or neutralized by the installation of Murray Draft Gears. The principles embodied in the design of this gear make possible the adoption of a type of construction, which is economical in first cost and maintenance.

For other products and branch offices, see classified and alphabetical indexes.

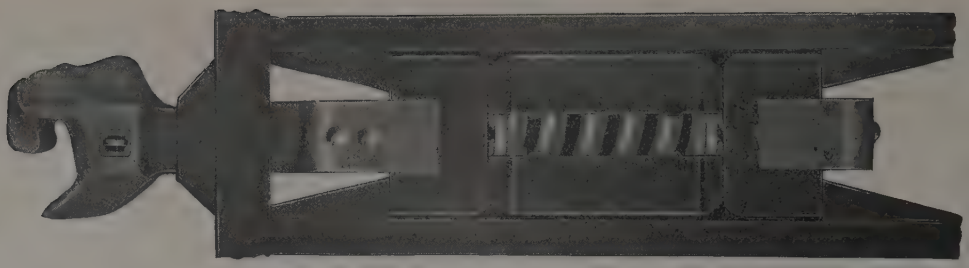


Fig. 1115—Murray Cast Steel Friction Draft Gear Applied with A. R. A. Riveted Yoke.

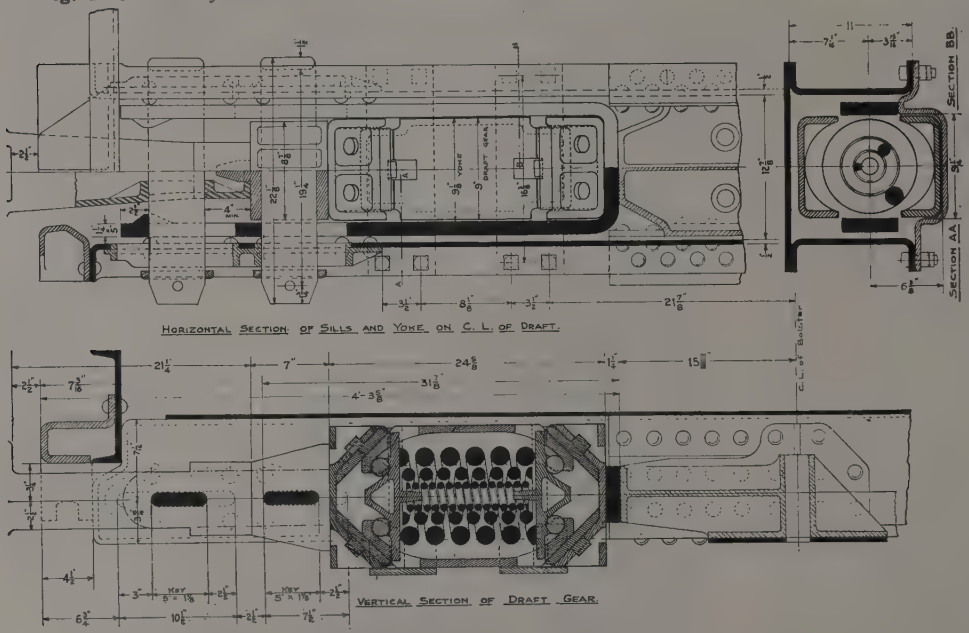


Fig. 1116—Murray Draft Gear, Type H, Class 8.

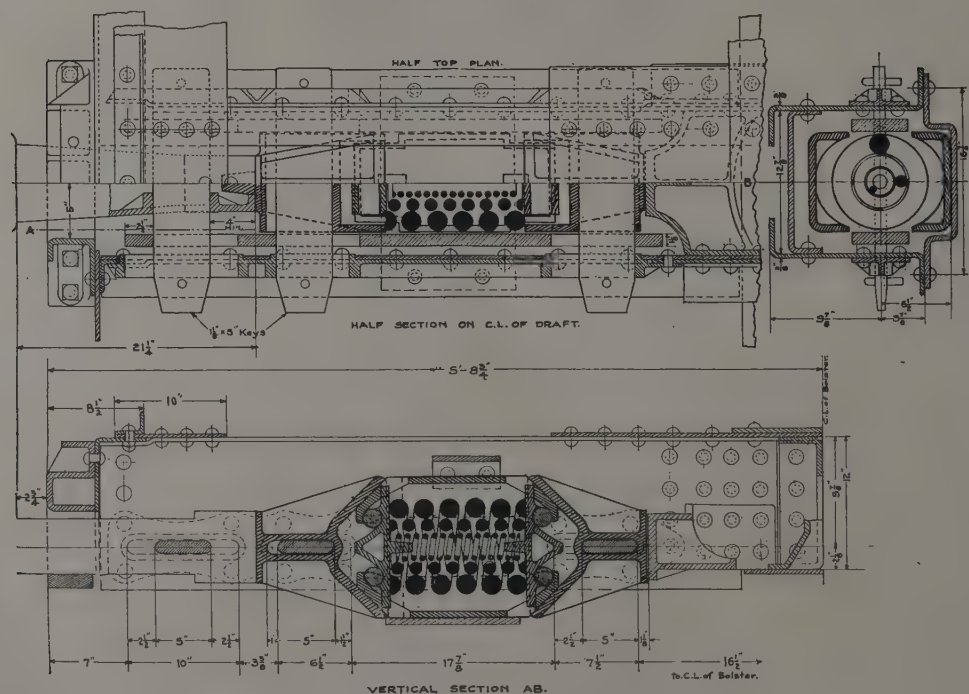


Fig. 1117—Murray-Farlow Draft Gear, Type H.

Keyoke Railway Equipment Company.

(*See also Page* 513)

Fig. 1118—Hall Friction Draft Gear, Class H. Assembled with Two-Key Attachment.

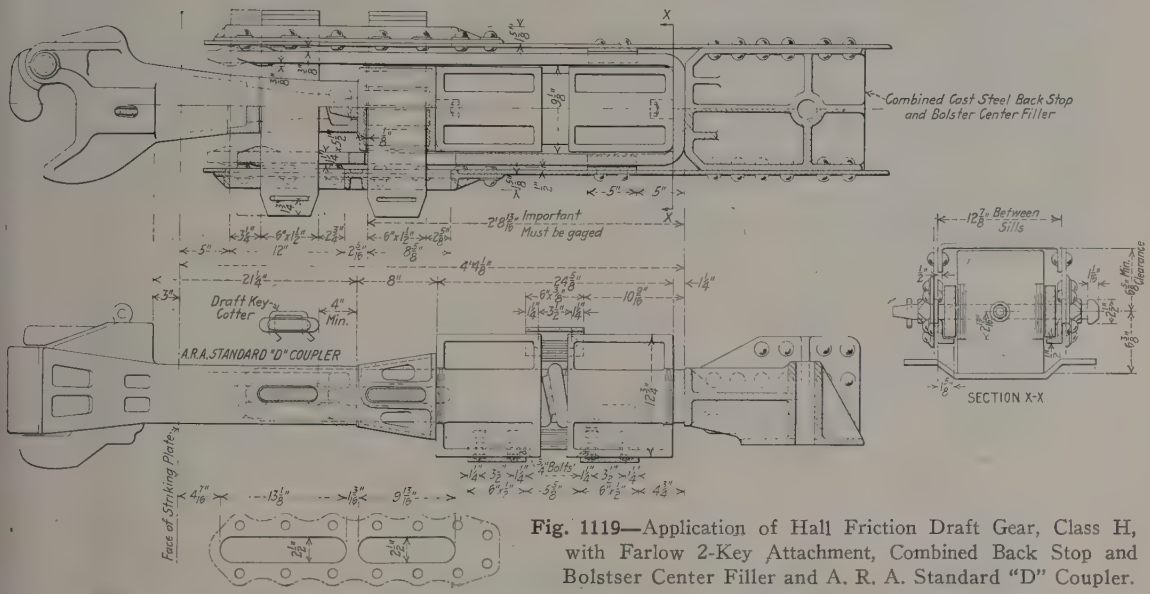


Fig. 1119—Application of Hall Friction Draft Gear, Class H, with Farlow 2-Key Attachment, Combined Back Stop and Bolstser Center Filler and A. R. A. Standard "D" Coupler.

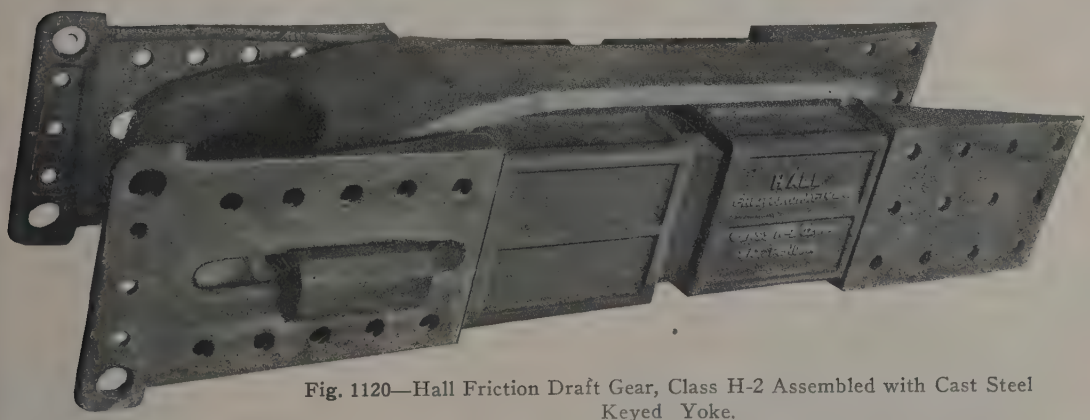


Fig. 1120—Hall Friction Draft Gear, Class H-2 Assembled with Cast Steel Keyed Yoke.

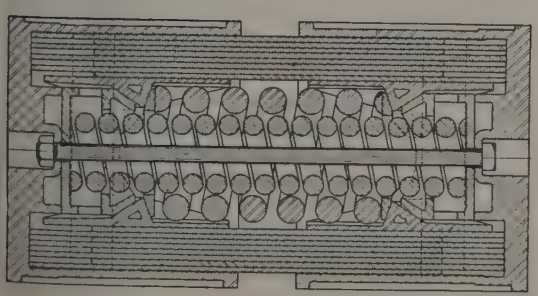


Fig. 1121—Section of Hall Friction Draft Gear.

Fig. 1122—Hall Friction Draft Gear.

Hall Draft Gear Corporation.

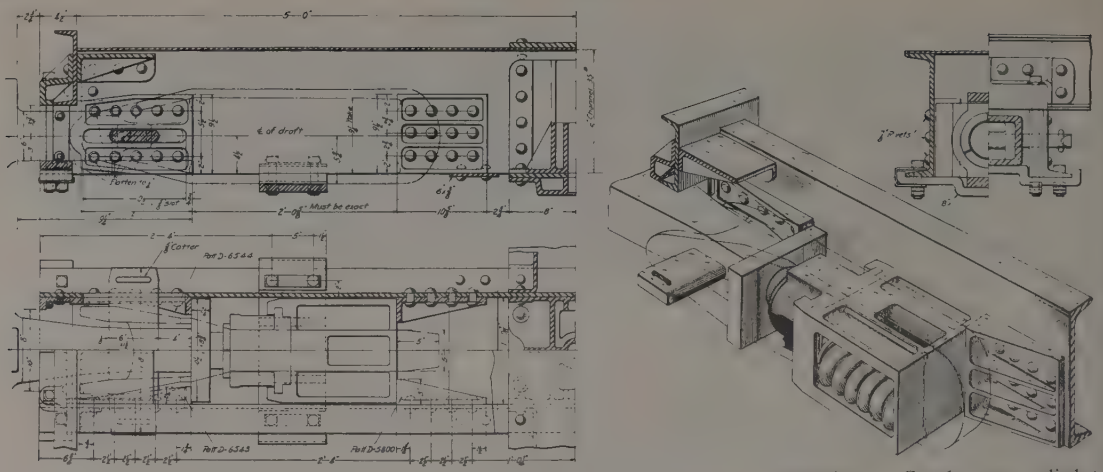


Fig. 1123—Miner Friction Draft Gear, Class A-18-S2, Cast Steel Yoke with Key Connection to Coupler, as applied to Freight Equipment.

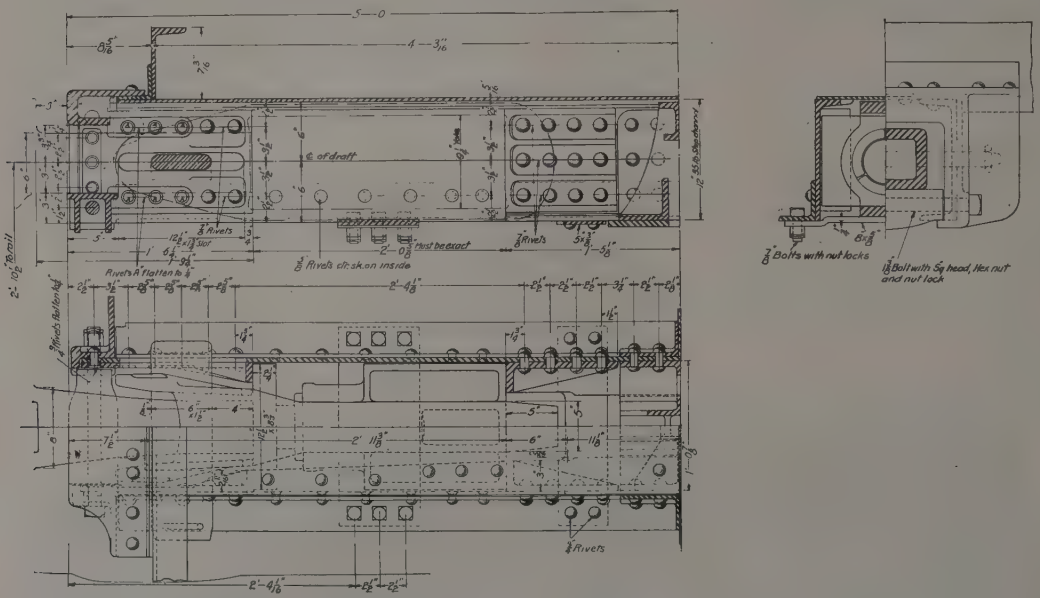


Fig. 1124—Miner Friction Draft Gear, Class A-18-S, Cast Steel Yoke with Key Connection to Coupler, as applied to New York Central 55-Ton Hopper Cars

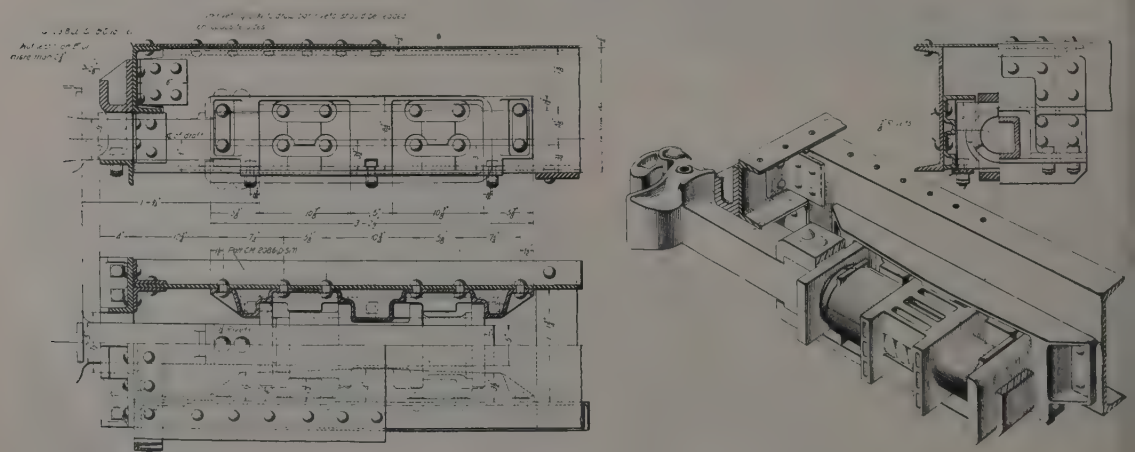


Fig. 1125—Miner Friction Draft Gear, Class A-19-B, as applied to Atchison, Topeka & Santa Fe Railway Ore Cars.

W. H. Miner.

(See also Page 517.)

Miner Friction Draft Gear Class A-18-S

The Miner Class A-18-S device embodies the highest development in the art of friction gear design and is guaranteed to render satisfactory service under all modern traffic conditions. The use of this superior shock absorber ensures greatest economy in relation to costs of operation and maintenance of equipment. Therefore, from an economic viewpoint, the A-18-S design is an important item in the construction of the modern freight car.

The excellence of this device is also vitally related to the efficiency of the car. Maximum earnings can only be obtained when cars are equipped with this type of gear which is well qualified to absorb the shocks resultant from train operation and hump yard switching. Any car properly equipped with this gear is certain to remain continuously in productive service for a long period of years.

The A-18-S gear provides a yielding resistance or cushion of initial sensitiveness for the complete

Fig. 1127—Miner Friction Draft Gear Class A-18-S

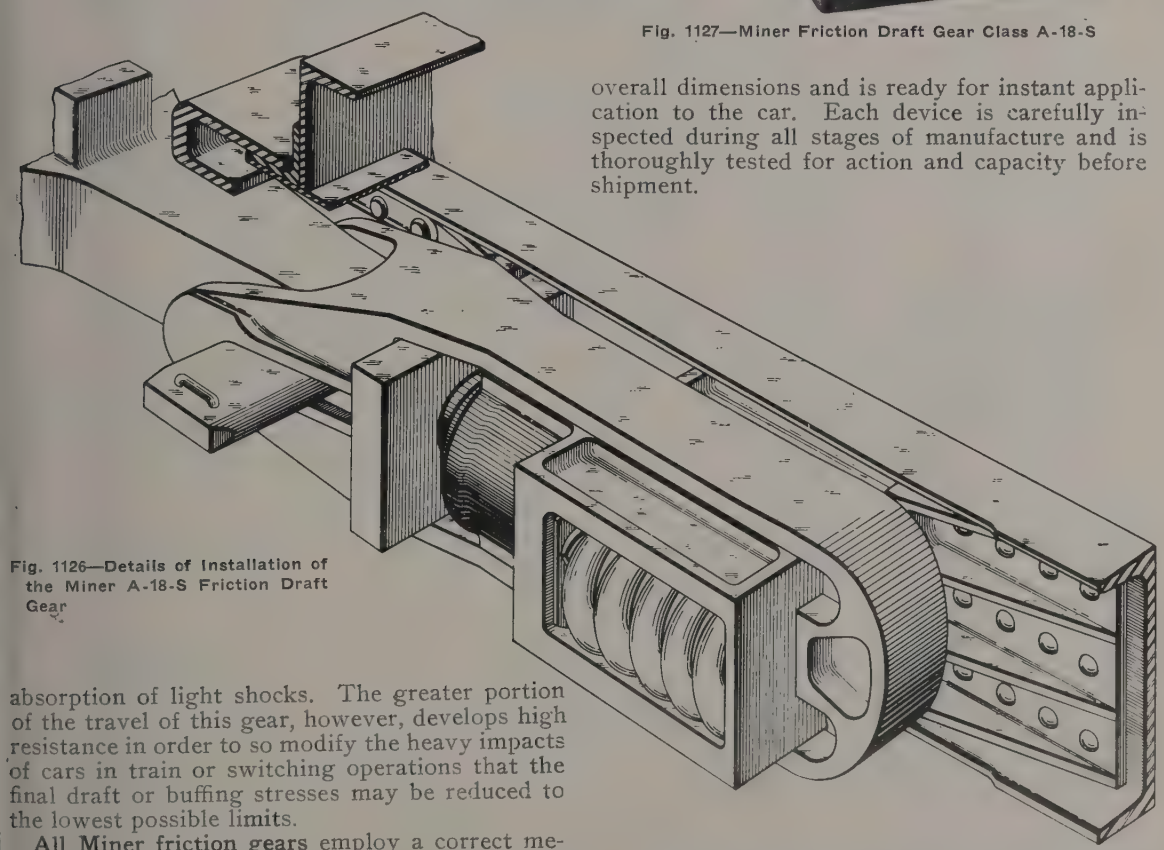


Fig. 1126—Details of Installation of the Miner A-18-S Friction Draft Gear

absorption of light shocks. The greater portion of the travel of this gear, however, develops high resistance in order to so modify the heavy impacts of cars in train or switching operations that the final draft or buffing stresses may be reduced to the lowest possible limits.

All Miner friction gears employ a correct mechanical principle in transmitting forces to the frictional surfaces. These surfaces are of such ample area that wear is reduced to an absolute minimum. The adjustment of the parts to compensate for wear is automatic, positive and completely eliminates any development of slack.

Each component part of the A-18-S device has a massiveness, contour and quality of metal based upon many years of aggressive scientific research and practical experience derived from the study of actual performance of these devices on many thousands of cars. Only materials of the best possible composition are used.

The gear as forwarded from the factory is a completely assembled unit structure of standard overall dimensions and is ready for instant application to the car. Each device is carefully inspected during all stages of manufacture and is thoroughly tested for action and capacity before shipment.

The principal dimensions of the Miner Class A-18-S gear are as follows:

Length	22¾ inches	Depth	9 inches
Width	12¾ inches	Travel	2½ inches

The installation of this gear is always carefully planned and is inspected during construction of the cars.

For other products and branch offices, see classified and alphabetical indexes.

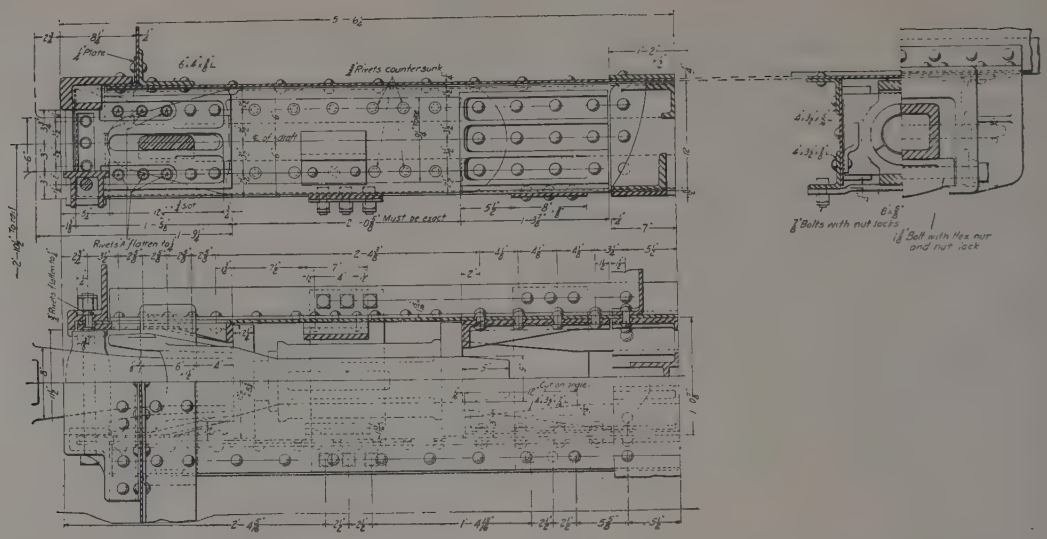


Fig. 1128—Miner Friction Draft Gear, Class A-2-S, Cast Steel Yoke with Key Connection to Coupler, as applied to U. S. Government Freight Equipment.

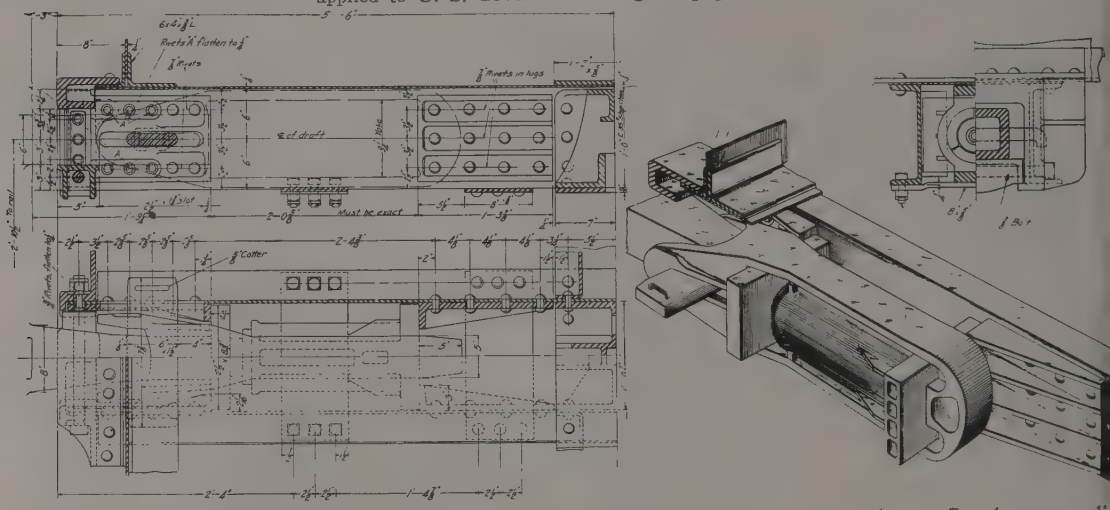


Fig. 1129—Miner Friction Draft Gear, Class A-24-S, Cast Steel Yoke with Key Connection to Coupler, as appli to New York Central 50-ton Box Cars.

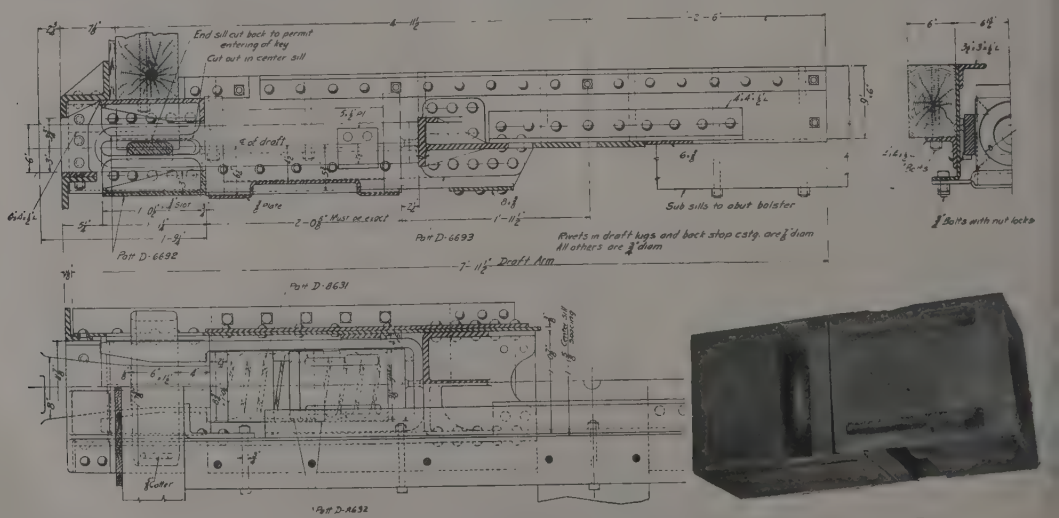

End sill cut back to permit entering of key
Cut out in center sill
Must be exact
Sub sills to abut bolster
Bolts with nut locks
Draft Arm
Cotter

Fig. 1130—Miner Draft Gear, Class "H," as applied to Great Northern 40 ft. Refrigerator Cars.

W. H. Miner.

(*See also Page* 519.)

Miner Friction Draft Gear Class A-2-S

Miner Class A-2-S Friction Draft Gear is an especially desirable shock absorber because of its relatively high capacity, great column strength, endurance and moderate cost. This device, although lighter than the Class A-18-S design, described on page 517, embodies exactly the same principle of mechanical action, and is also guaranteed to render satisfactory service under modern traffic conditions.

The capacity of this gear is high in relation to its comparatively light weight and the device is adequate to accommodate severe service on account of its sturdy construction. Excessive overloads can be repeatedly delivered to this gear without causing any permanent set in the cylinder or column and consequently the contained parts are thoroughly protected.

The endurance value of the Class A-2-S gear is remarkable and results from the employment of a correct mechanical principle in transmitting forces to the friction surfaces. These surfaces are of such ample area that wear is reduced to an absolute minimum. The friction elements of this device are made of drop-forged casehardened steel burnished. These important facts further contribute to a high standard of efficiency.

Each component part of the A-2-S gear has a massiveness, contour and quality of metal based upon many years of aggressive scientific research and practical experience derived from the study of actual performance of these devices on many thousands of cars. Only material of the best possible composition and refinement is used.

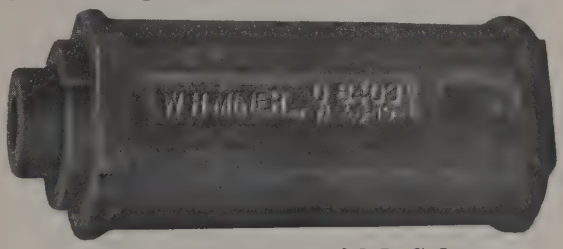


Fig. 1132—Miner Class A-2-S Draft Gear

The springs used in the A-2-S gear are assembled under considerable initial compression which is maintained by means of a substantial retainer bolt. This feature ensures against lost motion.

The gear as forwarded from the factory is a completely assembled unit structure of standard overall dimensions and is ready for instant application to the car. Each device is carefully inspected during all stages of manufacture and is thoroughly tested for action and capacity before shipment.

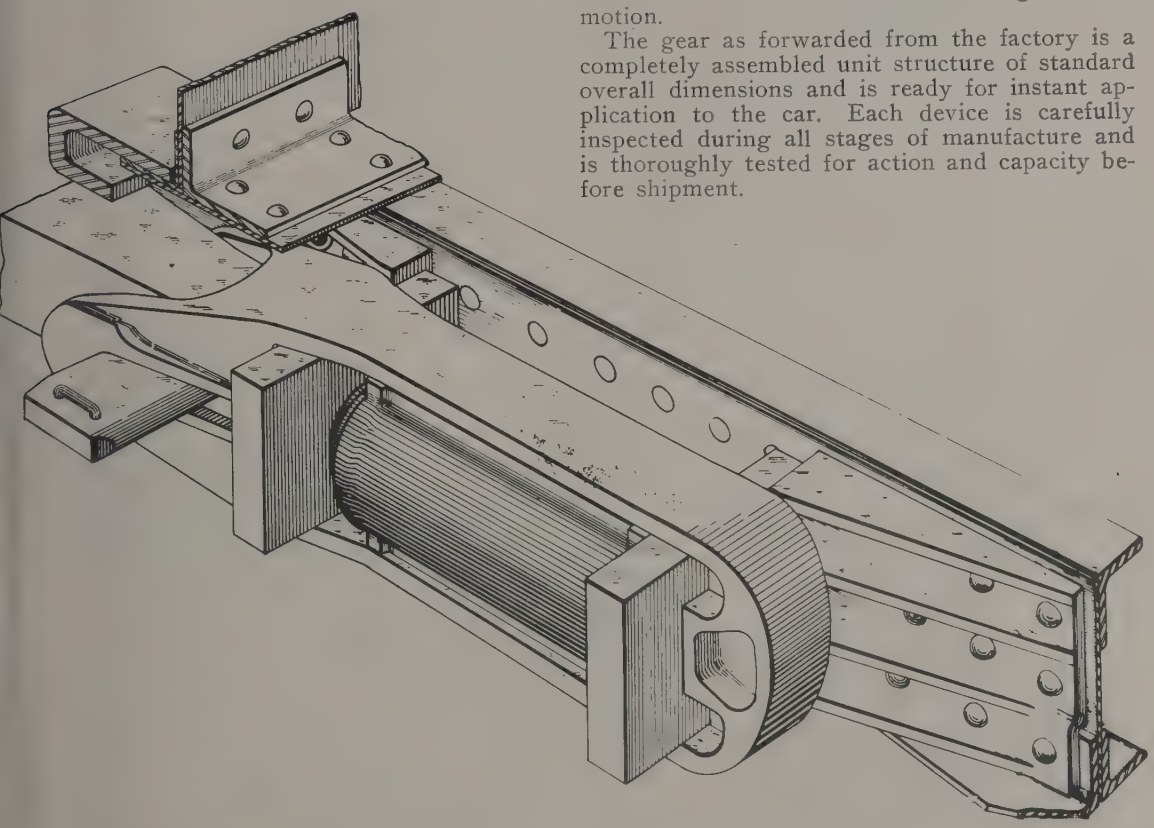


Fig. 1131—Application of Miner Class A-2-S Draft Gear

The principal dimensions of the Miner Class A-2-S gear are as follows:

Length	20⅛ inches	Depth	9 inches
Width	9 inches	Travel	2½ inches

The installation of this gear is always carefully planned and is inspected during the construction of the cars at the car builder's plant.

For other products and branch offices, see classified and alphabetical indexes.

W. H. MINER, CHICAGO, ILL.

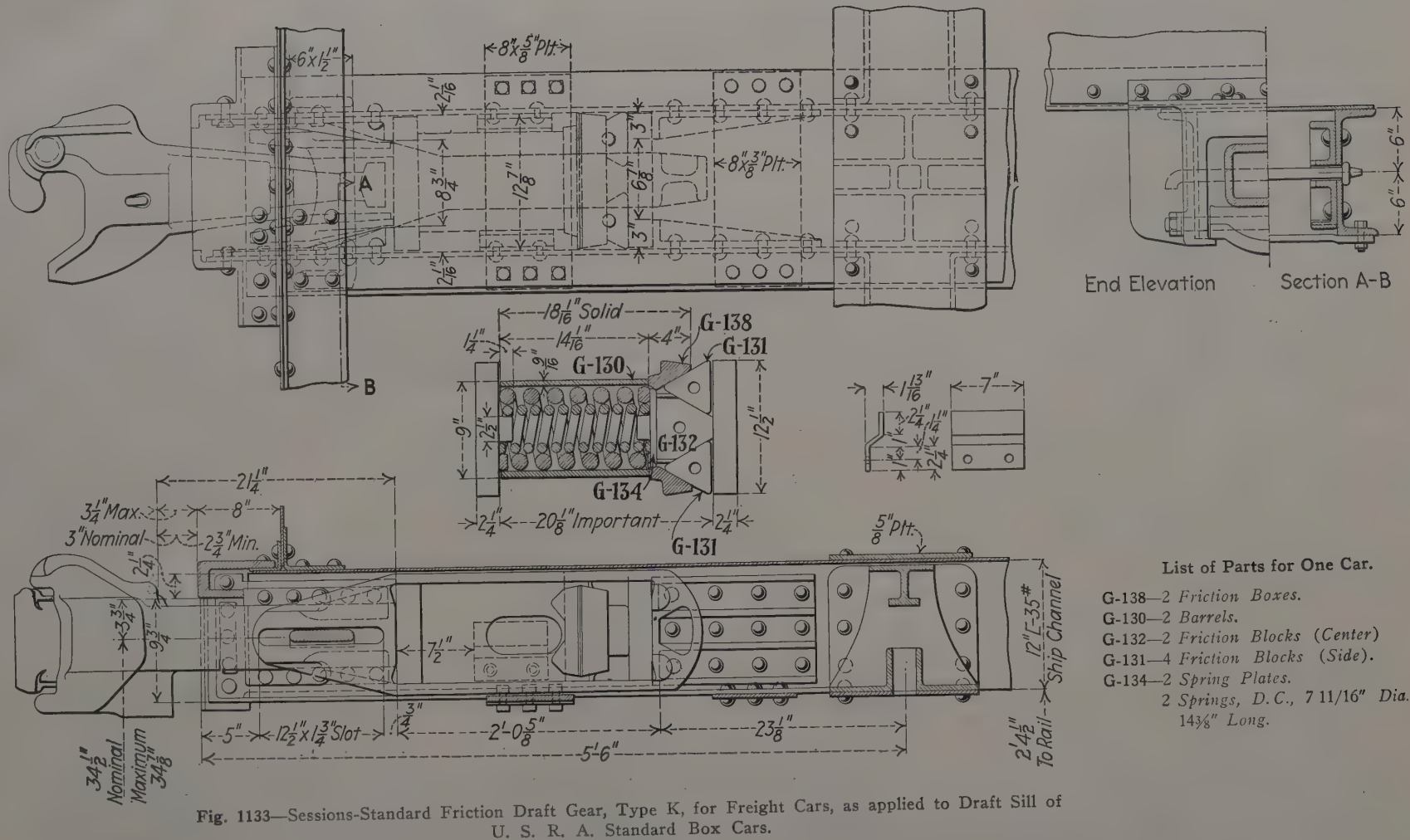


Fig. 1133—Sessions-Standard Friction Draft Gear, Type K, for Freight Cars, as applied to Draft Sill of U. S. R. A. Standard Box Cars.

Standard Coupler Company.

(*See also Page 521*)

List of Parts for One Car.

G-138—2 *Friction Boxes.*
G-130—2 *Barrels.*
G-132—2 *Friction Blocks (Center)*
G-131—4 *Friction Blocks (Side).*
G-134—2 *Spring Plates.*
2 *Springs, D.C.,* 7 11/16" *Dia.,* 14⅜" *Long.*

Sessions-Standard Friction Draft Gears

The Sessions-Standard Friction Draft Gears are particularly designed to meet the severe requirements imposed upon draft appliances, under modern traffic conditions. Every possible effort has been made to incorporate in the various designs all the desirable features and details of construction which have demonstrated their value during many years of heavy duty service.

The use of heat treated forged steel, in constructing these gears combined with a special wear resisting mixture in the friction blocks and careful manufacturing methods, have resulted in highly efficient draft mechanisms, well adapted to absorb the violent impacts incidental to present day traffic movement.

The type K Sessions—Standard Friction Draft Gear is illustrated in Fig. 1133. This draft gear was selected by the United States Railroad Administration for application to 50,000 of the 100,000 cars purchased during the year 1918, and which has now been applied to approximately a total of 190,000 cars.

As at present manufactured, this gear is equipped with a forged steel friction box of an improved and heavier design. It has also a steel center friction block made integral with the spring plate which reduces the number of separate parts to six, and avoids the possibility of incorrect assembly.

In addition to its heat treated, forged steel friction box, and its combined spring plate and center friction block, the type *K* draft gear has two equilateral triangular friction blocks made of a special wear resisting mixture, together with a double coil spring and a steel barrel or housing.

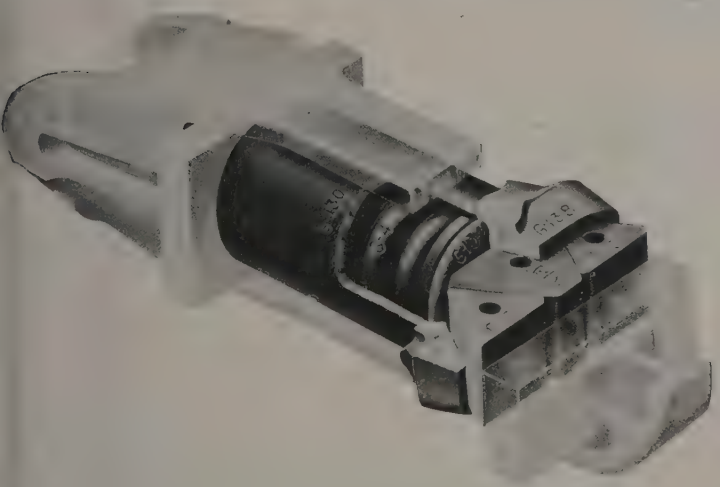


Fig. 1134—Assembly of Sessions-Standard Draft Gear, Type K

The energy absorbing capacity of the Sessions type *K* gear is high, its resistance varies in proportion to the gear travel and the recoil is only sufficient to insure positive release with readiness to operate at any point in the stroke. It is applicable to any form of attachment in standard pockets.

Type K4—Fig. 1135—is a new Sessions-Standard draft gear of very sturdy construction, designed to meet the exigencies of modern railway service and the incessant demands for a gear of increased strength. The travel, closing capacity, outside dimensions and facility of application to standard attachments, are identical with that of the improved type *K* equipment described above; the weight, however, is greater. All parts of the new gear, with the exception of the spring barrel are interchangeable with corresponding parts of the older design.

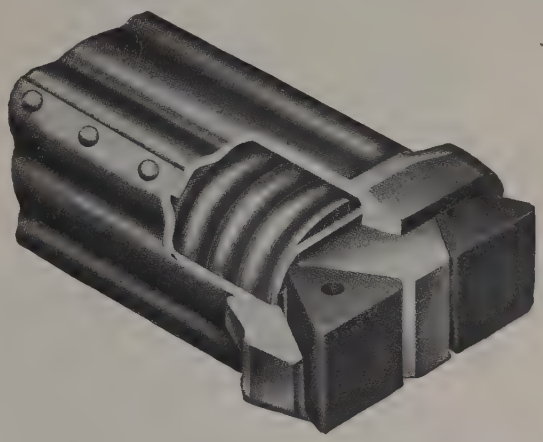


Fig. 1135—Sessions-Standard Draft Gear, Type K4

The oversolid strength of a type K4 draft gear, as a column, is 35 per cent greater than that of the standard type *D* coupler. This has been accomplished by corrugating the spring barrel, in such a manner as to increase its cross sectional area more than 30 per cent, compared with the barrel of a type *K* gear, and without encroaching upon the space provided to accommodate the draft spring. These corrugations afford excellent spring guides and add greatly to the longitudinal strength of the barrel when it is called upon to act as a column. In addition, the design is so arranged that the spring barrel contacts the friction box over its entire face, thus preventing any local upsetting tendency; with the still further advantage that an increased support is provided near the ends of the friction box, thereby keeping the friction surfaces from spreading and insuring their permanent disposition at a proper angle. To provide for still greater interchangeability the corrugations are designed so that the friction box retaining lugs will fit them accurately and will also encircle the cylindrical barrel used on a type *K* gear.

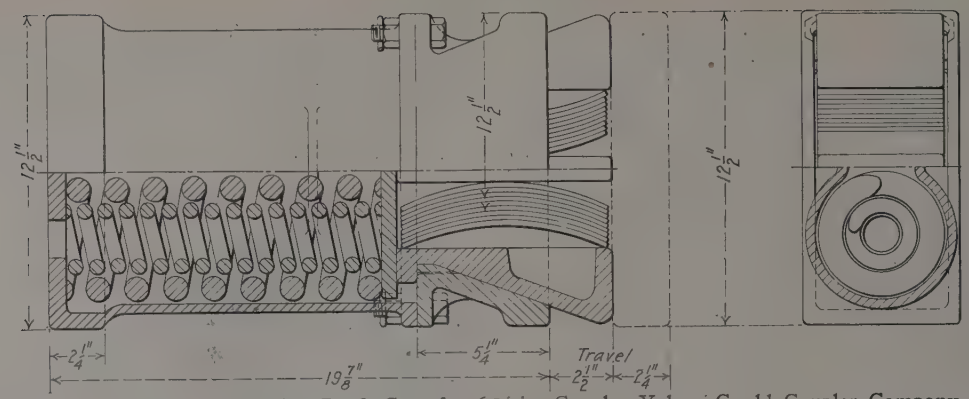


Fig. 1136—Passenger Friction Draft Gear for 6 ½-in. Coupler Yoke. Gould Coupler Company.
(See also Page 955.)

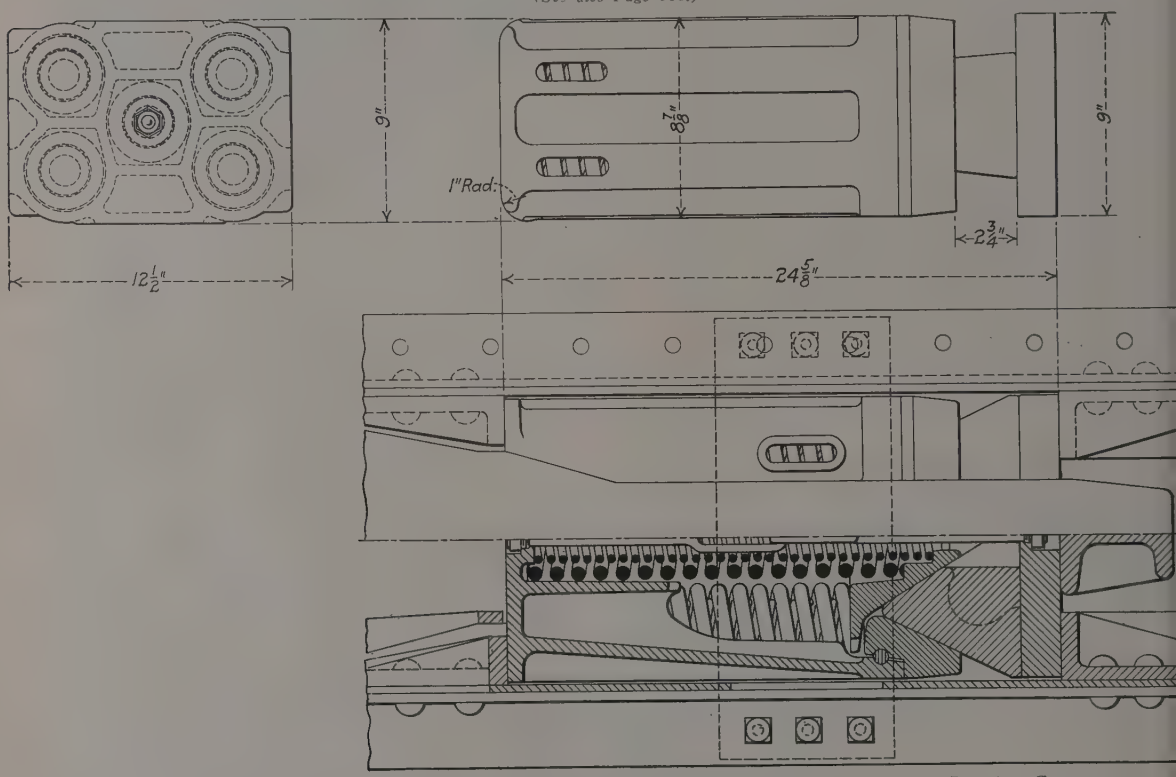


Fig. 1137—Sessions-Standard Friction Draft Gear, Type Jumbo No. 2. Standard Coupler Company.
(See also Page 523.)

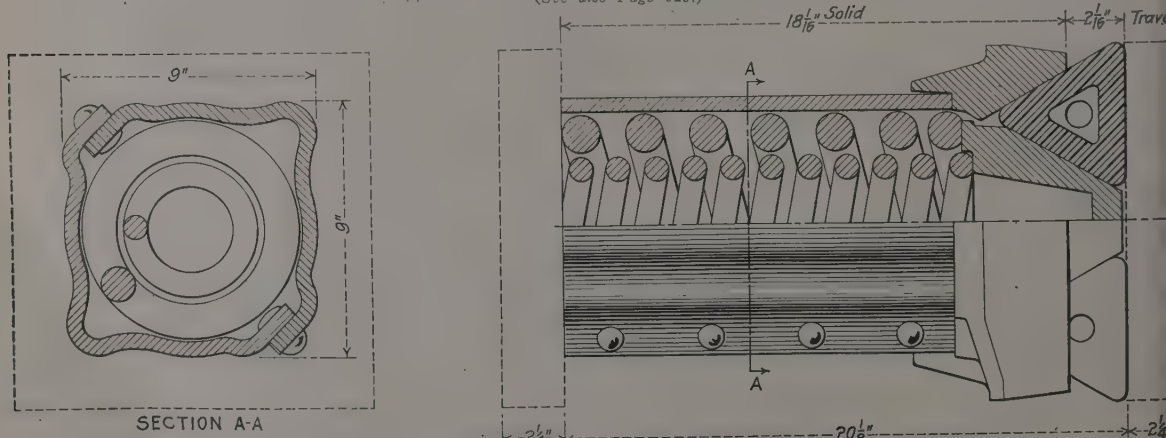


Fig. 1138—Sessions-Standard Friction Draft Gear Type K4. Standard Coupler Company.
(See also Page 521.)

Sessions-Standard Friction Draft Gears *Cont'd.*

The above advantageous features of the type K4 draft gear may be briefly summarized as follows: Ample cross sectional area and column strength; uniform cross section throughout; interchangeability; a thoroughly supported forged steel friction box; complete contact between barrel and friction box.

The Sessions-Standard Jumbo No. 2 type—Fig. 1137—is an exceptionally strong gear of high capacity and when fitted with standard heavy springs, is suitable for 70, 100 and 120 ton cars. When equipped with lighter springs this gear is especially adapted for freight equipment of ordinary weight and for all classes of passenger cars.

Fig. 1139—Sessions-Standard Draft Gear, Type Jumbo No. 2

It has a travel of 2¾ in. all of which is friction travel and in addition is assembled and installed under a ¼ in. friction compression which prevents any accumulation of slack for a long period, thereby maintaining its original high capacity. As the gear is built and assembled under a high initial spring compression it is very effective in the early part of its stroke and incidentally eliminates wear of the friction elements during minor impacts which the resiliency of car construction is entirely able to absorb without damage. This self-contained gear is shipped and applied as a unit to cars with any type of attachments that provide a standard draft gear pocket.

No additional coupler followers or yoke fillers are required as the barrel corners are made rounded for the purpose of accommodating the bend in the forged yokes.

The gear is smooth in its action which makes it suitable for passenger equipment and, while the capacity may be lowered at will by the use of lighter springs, the oversolid strength remains high, higher in fact, than any gear tested under the draft gear test of the United States Railroad Administration, and about 45 per cent stronger than the Type *D* Coupler. This means that the coupler must fail first in heavy, well-built freight equipment and that the gear is practically indestructible in passenger car service.

The drop capacity with standard springs is 33 in. total fall under the 9,000 lb. drop which is exceedingly high as was partially demonstrated in the United States Railroad administration test with the original Jumbo. This draft gear differs from the original Jumbo in the following respects: The travel is reduced to 2¾ in; the gear is self-contained; it has an improved design of spring barrel with re-inforced bottom and round corners; the spring barrel is made of cast steel instead of malleable iron; the spring plate and key are eliminated; forged steel instead of cast iron is used for the center friction block; the gear has 100 per cent friction travel with high initial spring and friction compression.

Unlike the older type *K* design this gear has a cast spring barrel with closed bottom and is firmly attached to the drop forged friction box with all necessary followers included. The triangular side friction blocks, cast of special mixture, contact forged steel parts on all sides as in the newer type *K* and *K*4 gears. There are five double coil springs arranged to take advantage of all available spring space and so located as to allow numerous re-inforcing webs or ribs immediately opposite the coupler butt, thereby preventing any possibility of piercing the bottom of the spring barrel. In part these ribs extend the length of the barrel giving ample strength to the side walls.

The total weight of the Jumbo No. 2 draft gears per car as furnished by the Standard Coupler Company. This figure includes the weight of the draft gear follower plates.

For other products and branch offices, see classified and alphabetical indexes.

STANDARD COUPLER CO., NEW YORK, N. Y.

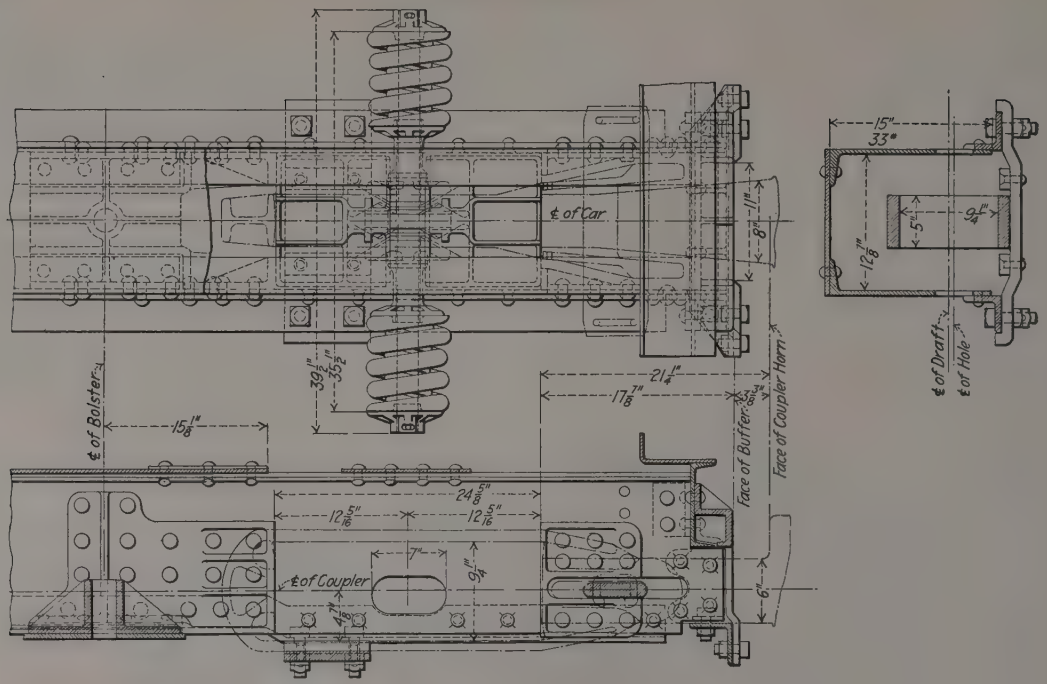
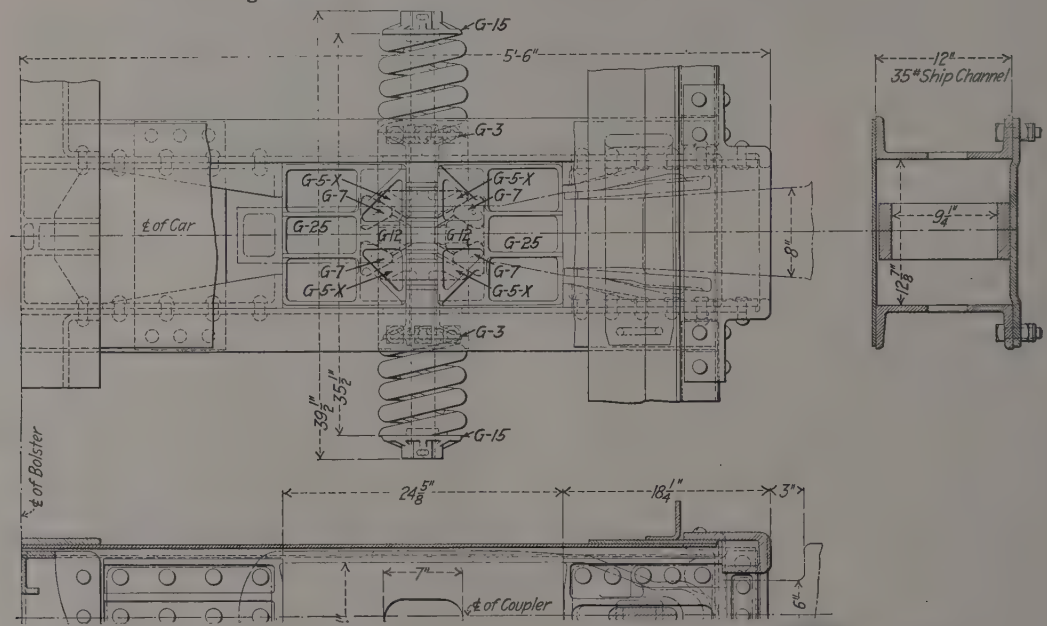


Fig. 1140—Cardwell Friction Draft Gear Type G Class 18-A.



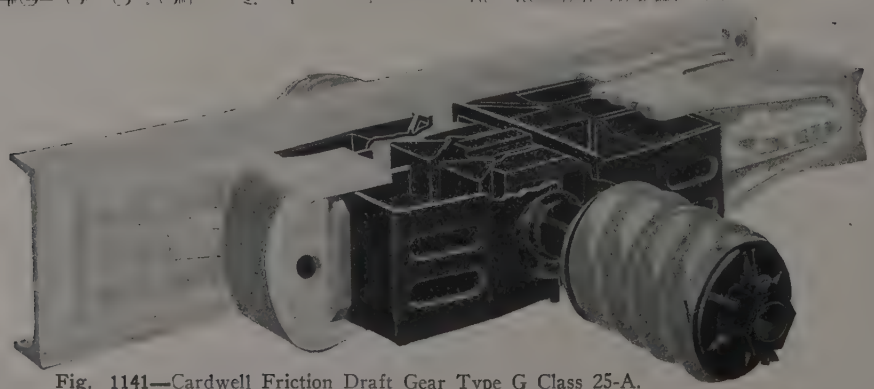


Fig. 1141—Cardwell Friction Draft Gear Type G Class 25-A.

Union Draft Gear Company.

(*See also Pages* 525-527)

Cardwell Friction Draft Gear

There is no part of railway equipment that has a greater effect upon the revenue service obtainable from a freight car than the draft gear. While good workmanship and the careful design of all other car details are absolutely essential, it is of still greater importance that a draft gear of proper type and adequate capacity shall be selected. The truth of this statement will be apparent when it is realized that regardless of the effort and expense devoted to other car parts, all are exposed to the shocks and impact of service conditions, and all will deteriorate or completely fail if unprotected by a suitable energy dissipating device.

It is universally admitted that the use of springs, without any controlling feature, has been entirely unsatisfactory as a means to effect the dispersion of impact energy, because although springs will undoubtedly absorb a blow, they do not fully dissipate the energy, consequently there is an immediate recoil, of a violence directly proportional to the force involved. The effect of this is to merely transfer the greater part of the shock to other parts of the car structure, without materially reducing its destructiveness.

To obtain a draft gear mechanism, that will have a properly regulated shock absorbing action it has been found necessary to interpose a frictional resistance. The use of friction appears to be the only practical means whereby the energy of suddenly applied forces, as encountered in railway train service, can be rapidly dissipated.

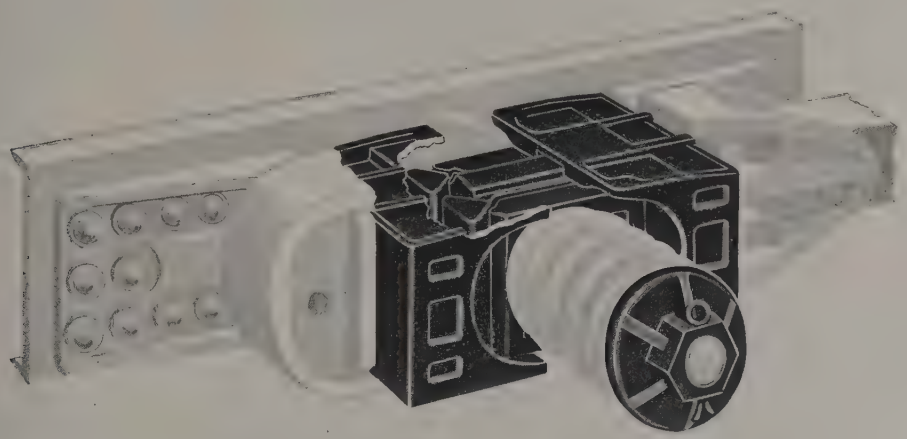


Fig. 1142—Cardwell Friction Draft Gear, Type G, Class 17

In the Cardwell draft gear there has been developed a reliable and simple shock absorbing device. Its successful operation is obtained because of the ability of suitably arranged contacting surfaces to interpose an entirely adequate frictional resistance, which acts to completely dissipate the objectionable kinetic energy.

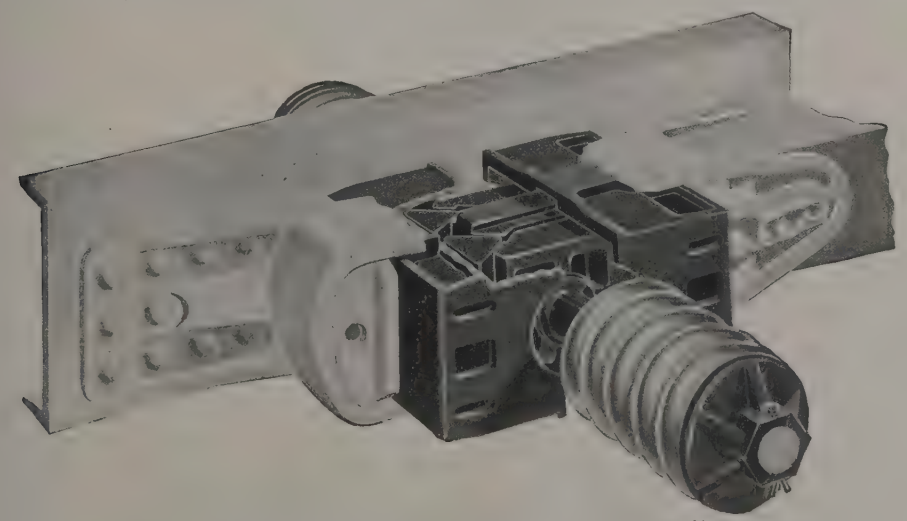


Fig. 1143—Cardwell Friction Draft Gear, Type G, Class 11-A

In the type G. Class 11-A and Class 17 Cardwell Friction Draft Gears, there are two side friction members, one center friction member and four triangular friction members incased in two friction casings, as shown in Figs. 1142 and 1143. The

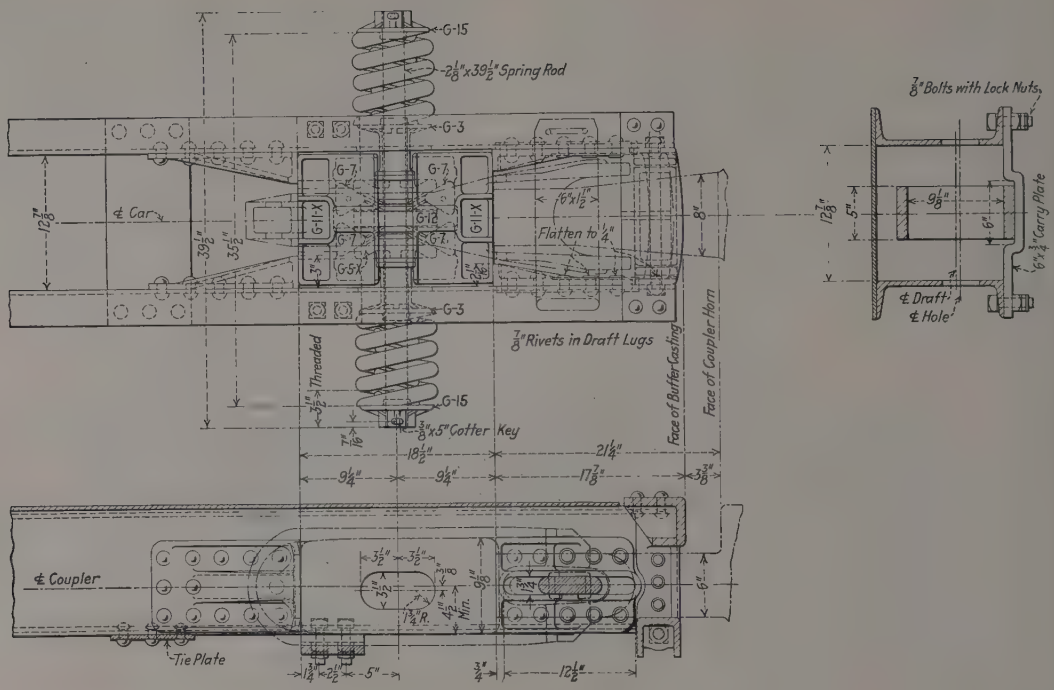


Fig. 1144—Cardwell Friction Draft Gear, Type G, Class 11-A.
(*See also Page* 525.)

Names of Parts of Fig. 1144-1145.

G-11-X, G-11-D *Friction Casing*	**G-5-X** *Side Friction Member*
G-3 *Inside Spring Seat*	**G-12** *Center Friction Member*
G-15 *Nut Spring Seat*	**G-7** *Triangular Member*

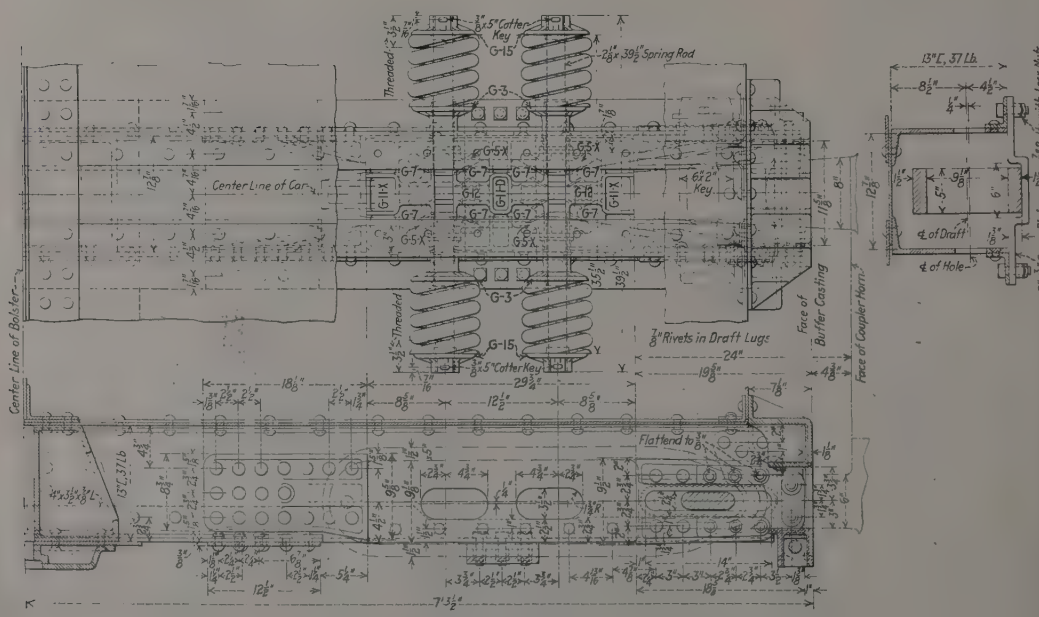


Fig. 1145—Cardwell Friction Draft Gear Type G, Class 11-A Duplex.
(*See also Page* 527.)

Union Draft Gear Company.

Cardwell Friction Draft Gear *Cont'd.*

spring rod holds the two side and one center friction members together under the pressure of a coiled spring on either side. The coupler yoke encircles the two friction casings and its side motion is restricted by the channels used on each side of the draft gear.

In the type G, Class 11-A, Duplex Cardwell Friction draft gear, there are four side friction members, two center friction members and eight triangular friction members incased in three friction casings as shown in Fig. 1146. There are two spring rods through two sets of friction members, and therefore four springs, giving nearly double the capacity of the type G. class 11-A draft gear. This draft gear requires a longer coupler yoke in order to encircle the friction casings.

The design of the Cardwell Friction Draft Gear is distinctive in that it is the only gear with

Two successive adjustments are possible. The first adjustment is made by turning one outside spring seat up on the spring rod until the cotter, which is shown in the illustrations as passing through both the spring seat and the spring rod, will pass through the hole in the spring rod, just clearing the outside end of the outside spring seat. A second adjustment can be made after further continued service by turning up and keying the outside spring seat on the opposite end of the rod in the same manner.

Thus, the distinguishing features of this gear are high capacity, simplicity and a long efficient life. Its prolonged life is obtained by virtue of the unique adjustment feature mentioned above, which functions in such a way that the original efficiency of the gear can be restored twice, thus giving a working life three times as long as would be possible if not possessing this valuable characteristic.

The only maintenance required with a Cardwell

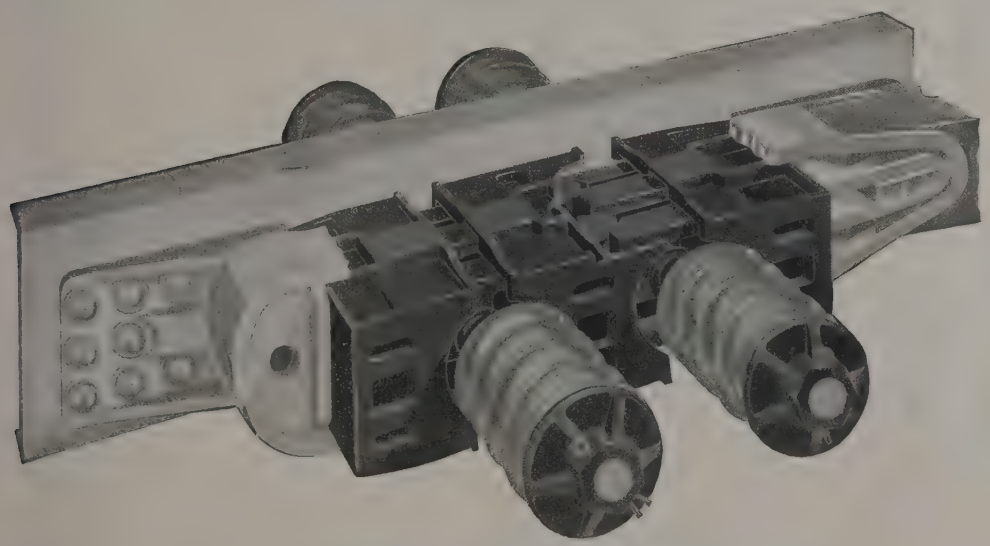


Fig. 1146—Cardwell Friction Draft Gear, Type G, Class 11-A Duplex

springs arranged crosswise of the sills and having its working mechanism so disposed that its condition may be determined in an instant. This arrangement of springs allows the gear to be made longitudinally compact, which is a decided advantage in nearly all cases and particularly so in short cars.

Friction implies wear, which means reduction in the size of working parts with consequent lost motion, unless some method of compensating for wear is provided. In the Cardwell gear a simple adjustment may be made when, after considerable service, the inevitable slack gradually develops.

Inspection is made by measuring the distance between the inside and outside spring seats on each side of the spring rod. If it is found that this distance exceeds by a certain amount—which varies with the different type of gears—the distance originally established, an adjustment should be made.

gear is an adjustment for wear and, as previously mentioned, this is only necessary after a period of service which would usually be considered the normal life of an ordinary draft gear. An inspector may readily determine whether or not this period has been reached by simply grasping the end of the spring rod and trying to move it. If this rod is tight the gear needs no attention.

The Cardwell Duplex Draft Gear has been developed to give still greater protection than is possible with any single gear. While especially adapted to the heaviest type of equipment, it is also very successful in providing maximum protection for light capacity cars where service is particularly severe.

The distinguishing features of the Cardwell Friction Draft Gear are high work capacity, simplicity and long efficient life. The latter is obtained by a property original with and peculiar to these gears—that of adjustment.

Fig. 1147–One Draft Sill Removed, Showing National Friction Draft Gear in Combination with U. S. R. A Cast Steel Yoke.

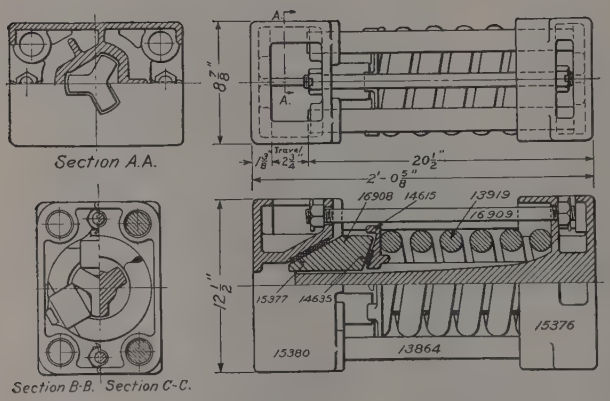


Fig. 1148—National Friction Draft Gear, Type M-4-A.

List of Parts

Number	Name	No. Per Gear
13864	*Compression Column*	4
13919	*Draft Spring*	1
14615	*Friction Segment Seat*	1
14635	*Segment Bearing Pad*	3
15376	*Friction Member*	1
15377	*Follower Bearing Pad*	3
15380	*Follower Wedge*	1
16908	*Friction Segment*	3
16909	*Retaining Rod and Nut*	2

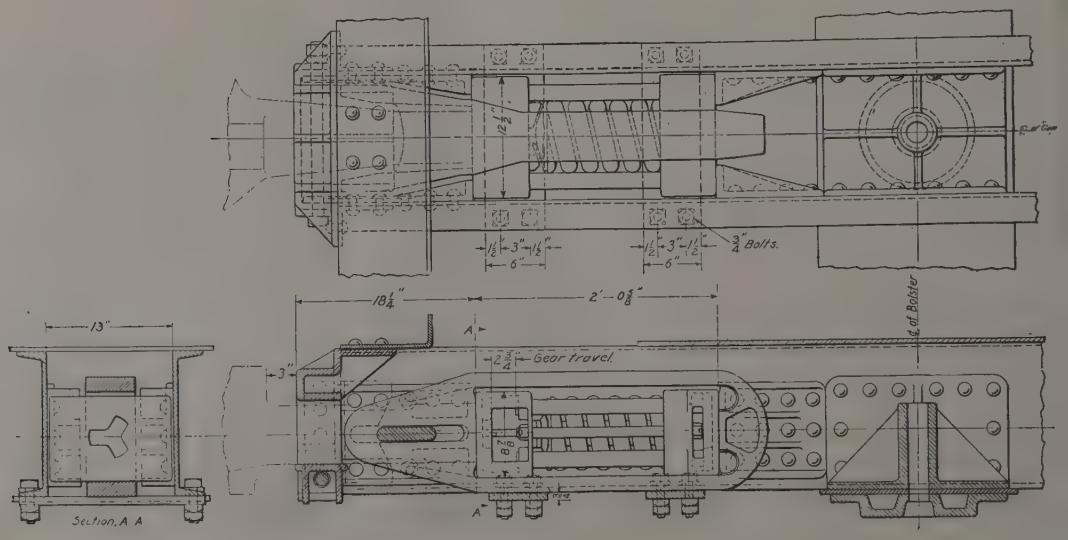


Fig. 1149—National Friction Draft Gear, Type M-4-A, Applied to Car in Combination with U. S. R. A. Cast Steel Yoke.

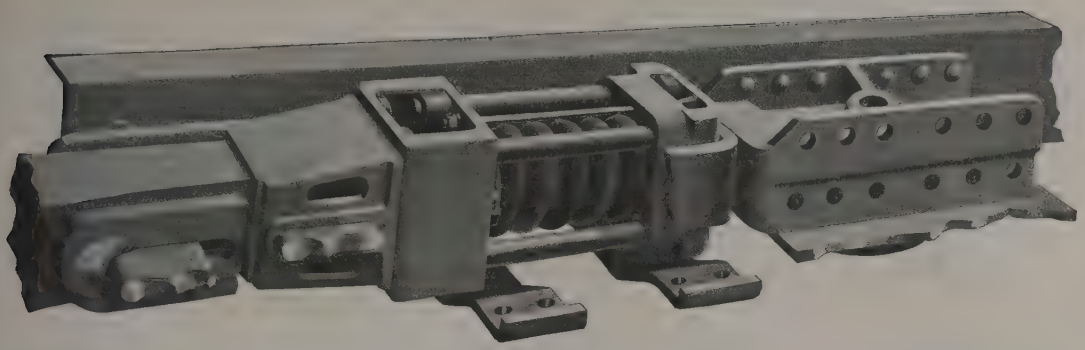


Fig. 1150—One Draft Sill Removed, Showing National Friction Draft Gear in Combination with Farlow Two-Key Draft Attachments.

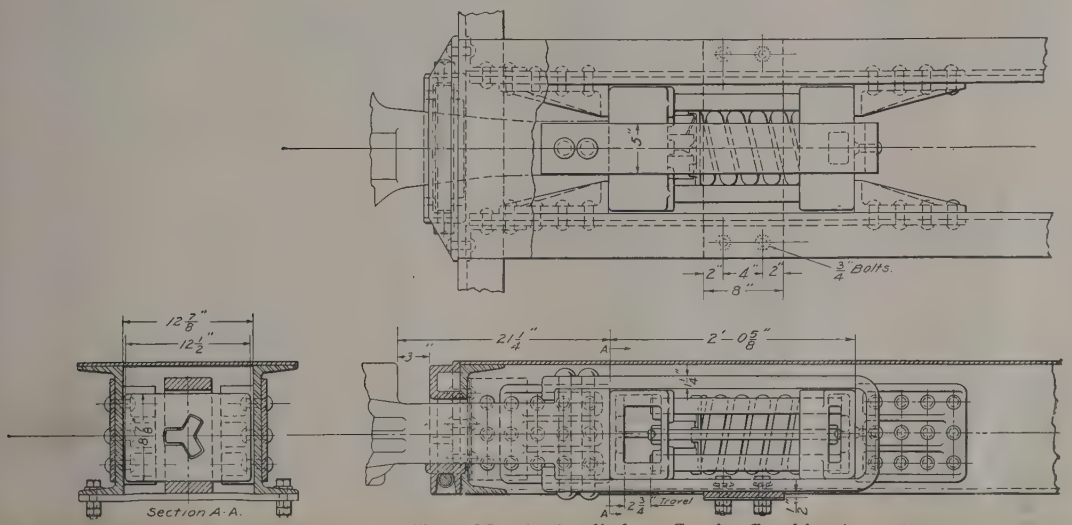


Fig. 1151—National Friction Draft Gear, Type M-4-A, Applied to Car in Combination with 1¼" x 5" Wrought Iron Yoke.

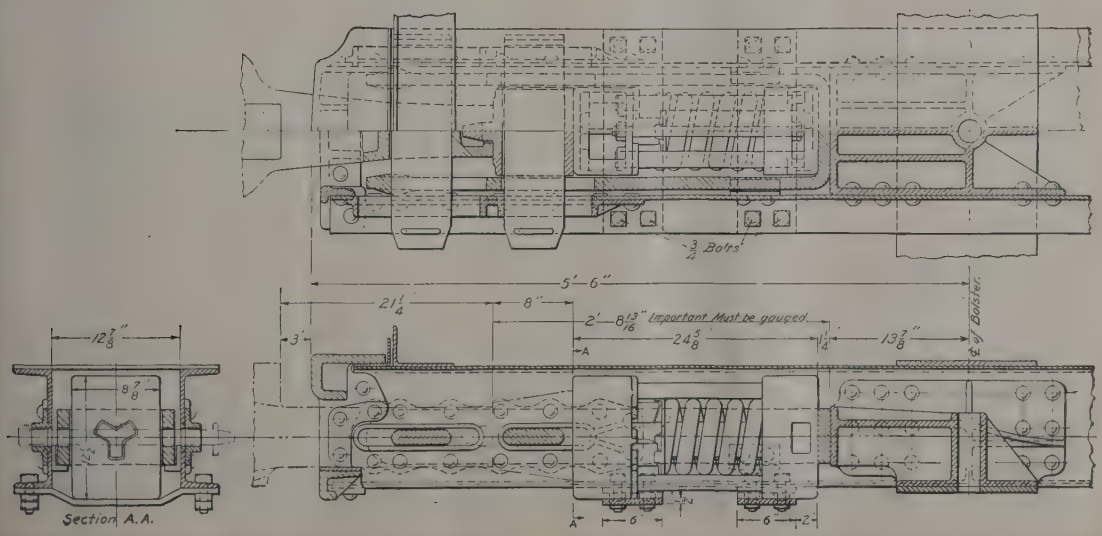


Fig. 1152—National Friction Draft Gear, Type M-4-A, Applied to Car, in Combination with Farlow Two-Key Draft Attachments.

The National Malleable Castings Company.

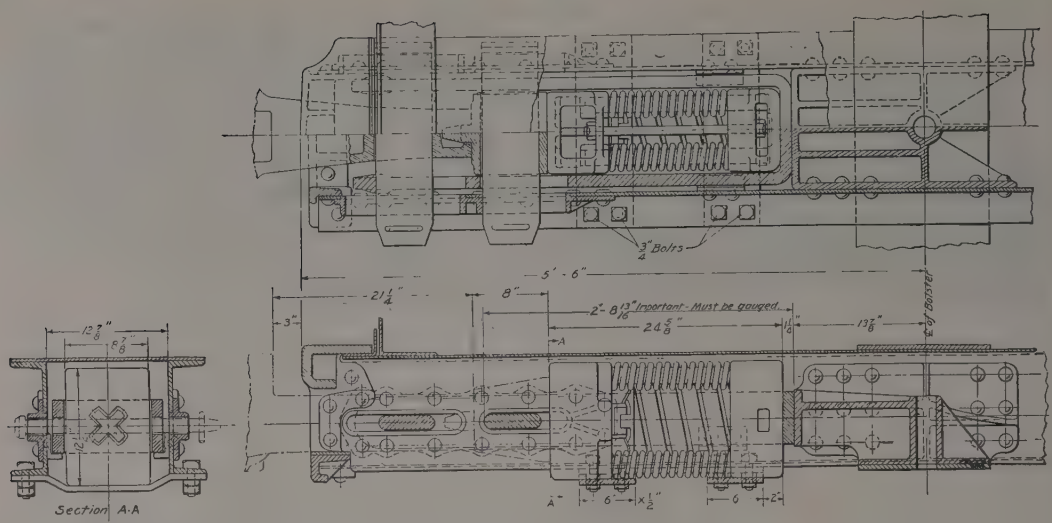
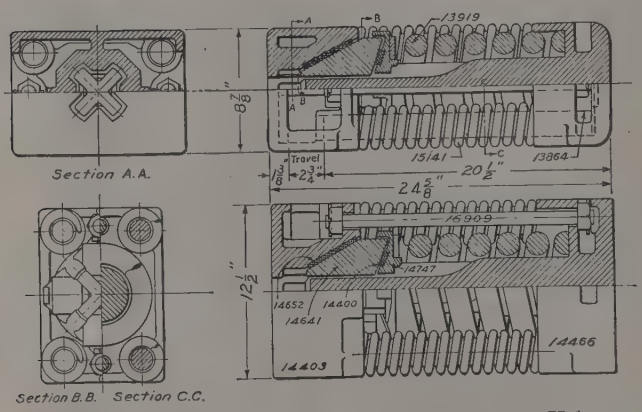


Fig. 1153—National Friction Draft Gear, Type H-1, Applied to Car in Combination with Farlow Two-Key Draft Attachments.



List of Parts

Number	Name	No. Per Gear
13864	*Compression Column*	4
13919	*Draft Spring*	1
14400	*Segment Bearing Pad*	4
14403	*Follower Wedge*	1
14466	*Friction Member*	1
14641	*Friction Segment*	4
14652	*Follower Bearing Pad*	4
14747	*Friction Segment Seat*	1
15141	*Release Spring*	4
16909	*Retaining Rod and Nut*	2

Fig. 1154—National Friction Draft Gear, Type H-1.

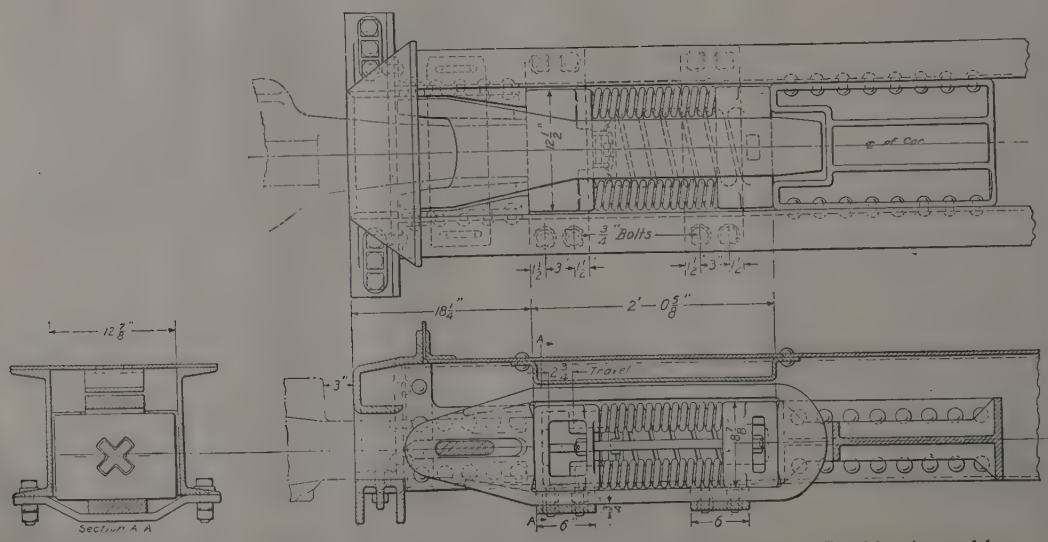


Fig. 1155—National Friction Draft Gear, Type H-1, Applied to Car in Combination with U. S. R. A. Cast Steel Yoke.

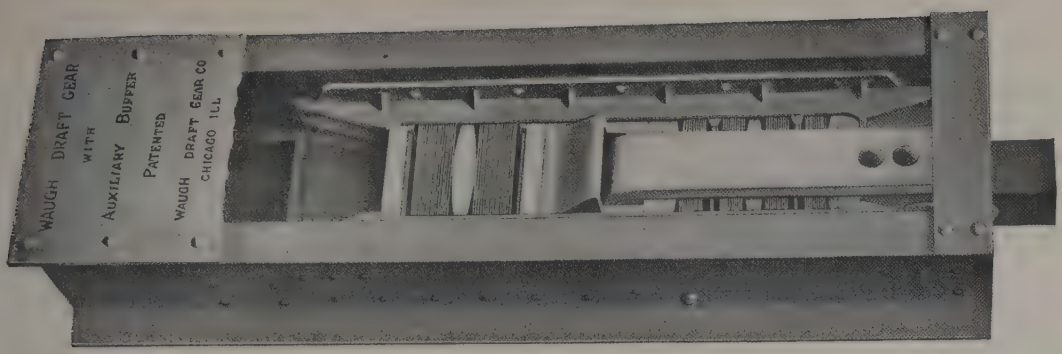


Fig. 1156—Waugh Draft Gear with Auxiliary Buffer.

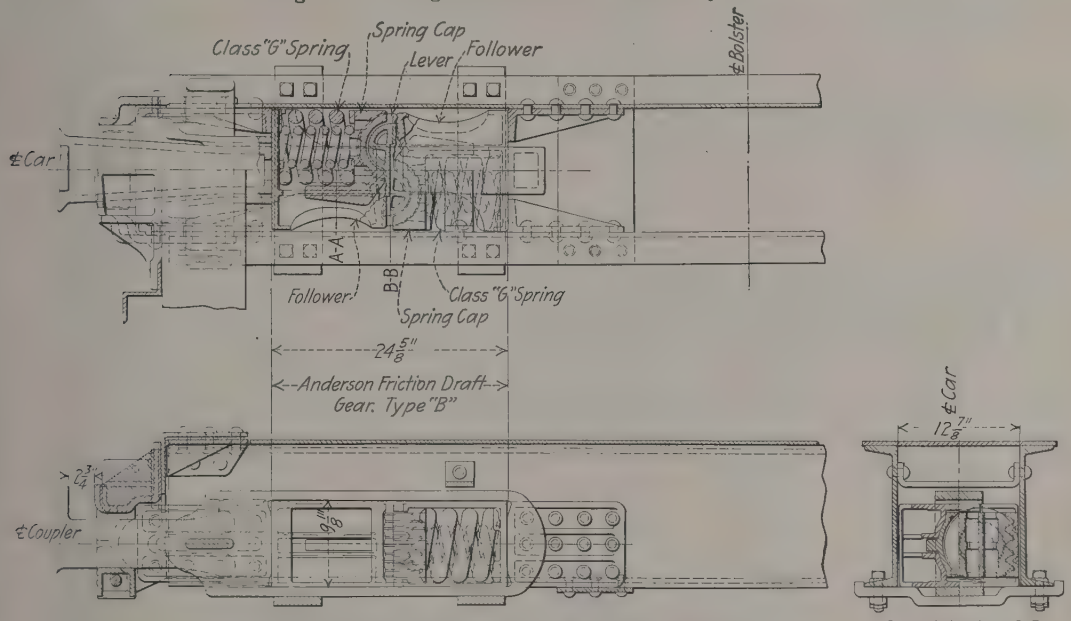


Fig. 1157—Anderson Type B Friction Draft Gear.

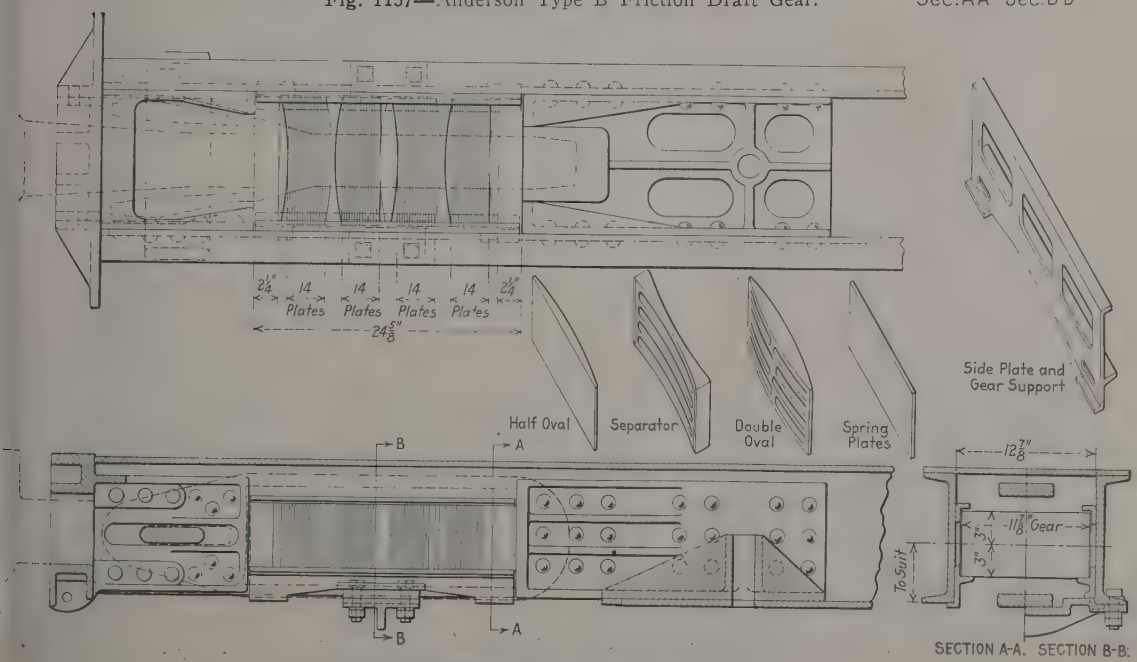


Fig. 1158—Waugh Draft Gear for Freight Cars.

Waugh Draft Gear Company.

(*See also Page* 533)

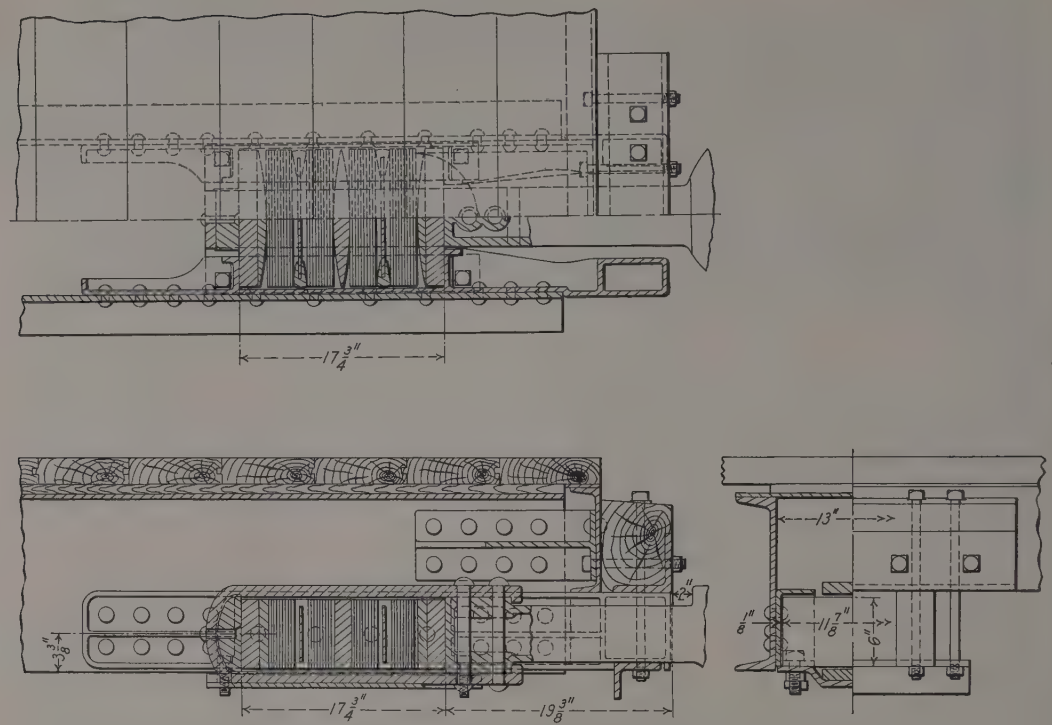


Fig. 1159—Waugh Draft Gear as Applied to Chicago & North Western Freight Cars.

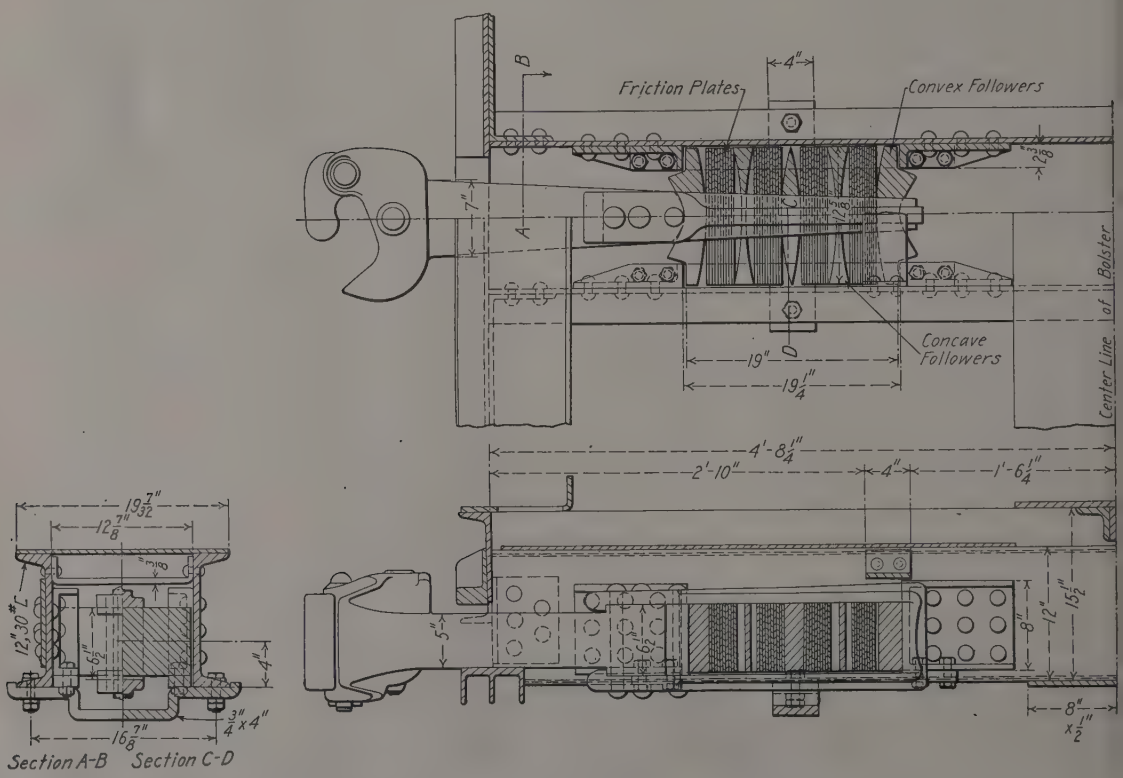


Fig. 1160—Application of Waugh High Capacity Radial Draft Gear to Southern Railway Freight Cars.

Waugh Draft Gear Company.

(*See also Page 533.*)

Waugh Friction Spring Draft Gear

Protection for the equipment in which it is installed and the stamina to withstand the severe shocks and surging encountered in train and car movements—these are the requirements of the modern draft gear. Upon analysis of the device, it is at once evident that the design of the Waugh Draft Gear has features which amply provide for the absorption of large amounts of energy in such a manner that a minimum effect upon the gear itself results from the continued performance of this function.

Simplicity of construction is a prominent characteristic, as there are no complicated parts. Four units, each consisting of a number of steel plates, provide both the spring and friction elements of the gear. At the middle of the gear an oval separator block is placed and in the other spaces between the units are other special separators. At each end of the gear is a half-oval follower plate. In addition, two guide plates or wear plates are supplied for each gear.

The capacity of the gear may be varied to provide from 250,000 lb. to 400,000 lb. in the normal length of drawbar travel, which is 2¼ in. Any standard measurements are suitable for the application of this gear; it may be designed to occupy pocket lengths varying from 18½ in. to 24⅝ in. The side plates protect the sills from abrasion and carry the gear independently of the yoke, through bearings supported by the crossties and are not attached to the draft sills.

A friction area of great extent is provided in this gear and this in turn reduces the unit abrasive to such an extent that it is practically impossible for wear to materially reduce the travel or capacity of the gear. The adhesive friction which adds to the capacity under compression, tends to retard the return of the plates to their normal position, so that the recoil is uniform and of such limited strength that it is never damaging, yet the gear always releases and returns to normal position. The action of the gear is such that there is no tendency to buckle the sills when these are tied in the ordinary way underneath the gear.

An auxiliary cushion can be used in combination with the standard form of the Waugh Draft Gear. This auxiliary gear is placed in the rear of the regular draft gear, and in its construction more plates are used in the group, which greatly increases its capacity. The floating block, or stops, at the rear of the regular gear hold the auxiliary back in position in its operation. The yoke enclosing the regular gear pulls the rear follower of the regular gear away from the floating block and only the regular draft gear is used in pulling, while in buffing both the auxiliary and the regular gear act in conjunction and compress relative to their individual capacities.

This combination, as will readily be seen, is capable of being constructed to produce a capacity of several hundred thousand pounds, thereby cushioning the blows which the cars may receive in service other than collision blows, yet providing a resilient cushion in pulling, and for normal shocks in buffing.

At no place in the anatomy of freight and passenger equipment has the effect of increases in weight and capacity been felt more strongly than in the draft gear. This fact has not been overlooked in the manufacture of the Waugh Draft Gear, which today is designed to meet efficiently the most severe conditions encountered in all classes of service.

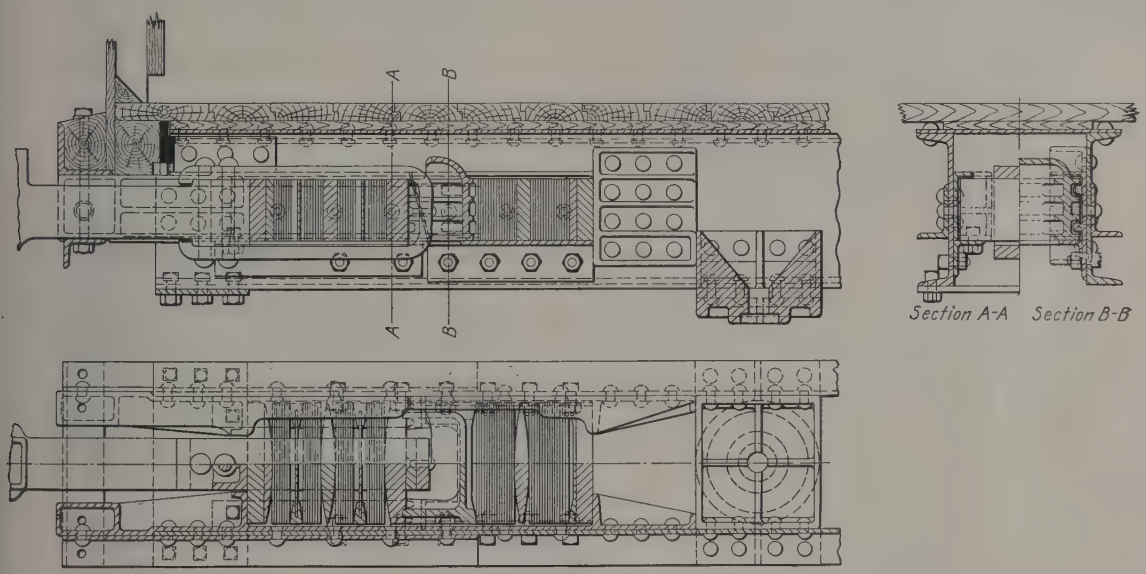


Fig. 1161—Waugh Auxiliary Buffer in Combination with Waugh Draft Gear

For other products and branch offices, see classified and alphabetical indexes.

WAUGH DRAFT GEAR COMPANY, CHICAGO, ILL.

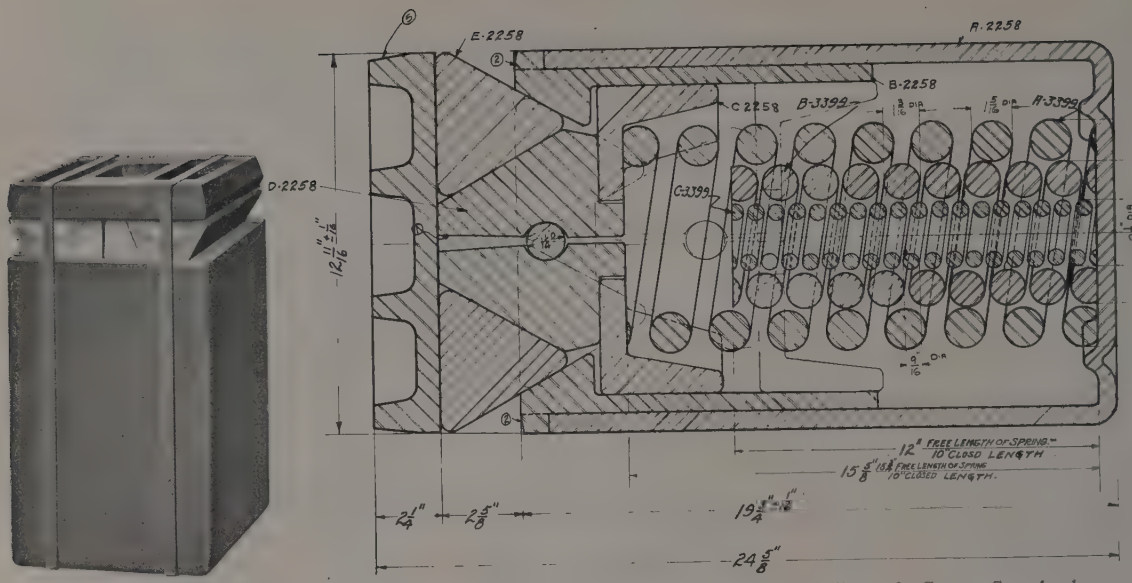


Fig. 1162—Assembled Gear and Longitudinal Section of "Stanforge" Draft Gear. Standard Forgings Company.
(See also page 535.)

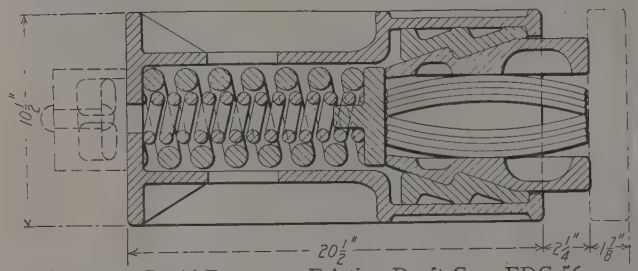


Fig. 1163—Gould Passenger Friction Draft Gear FDG-56. Gould Coupler Company.
(See also Page 955.)

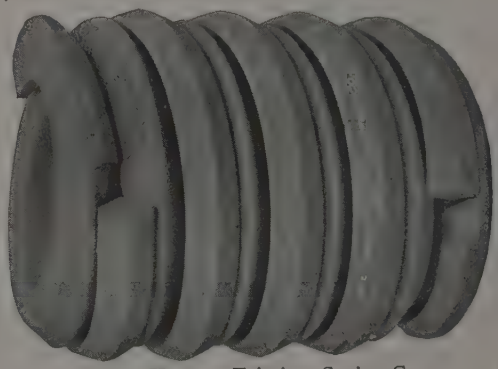


Fig. 1164—Harvey Friction Spring Gear. Frost Railway Supply Company.

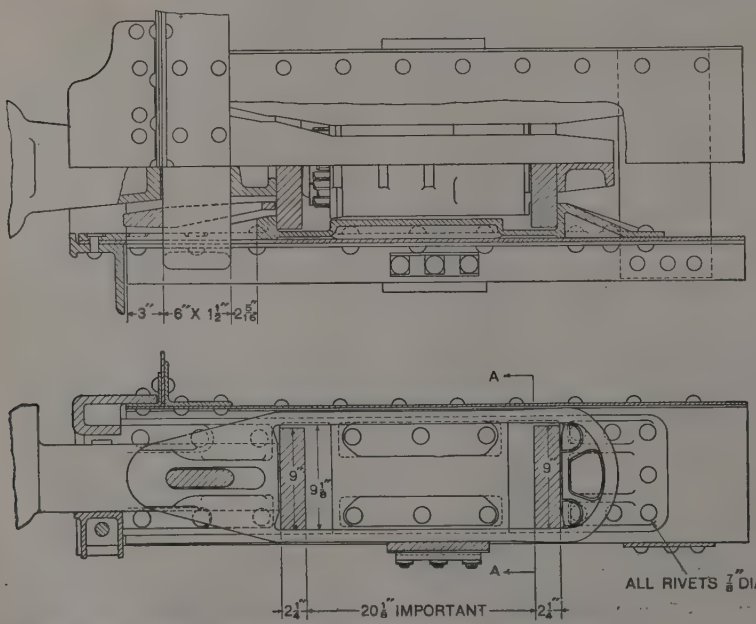


Fig. 1165—Typical Installation Westinghouse D-3 Friction Draft Gear. Westinghouse Air Brake Company.
(See also Page 537.)

The Stanforge Draft Gear

The desirable features of draft gear are high draft capacity, constant efficiency in service, and durable construction. Before attempting the design of the Stanforge Draft Gear equipment, the Standard Forgings Company made an exhaustive study of railroad requirements, in connection with the high speed movement of traffic under modern conditions. This resulted in the development of

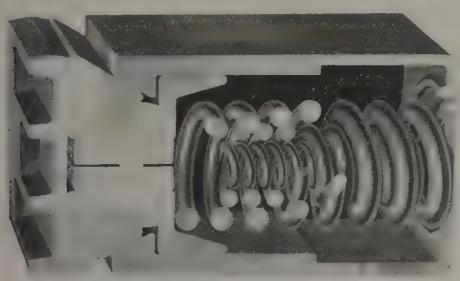


Fig. 1166—Sectional View Showing Stanforge Gear in the Free State

a draft gear equipment of high capacity, one that would maintain its efficiency and at the same time be of such construction as to withstand indefinitely the shock and abuse of heavy service.

Only drop forged steel is used in the construction of the Stanforge draft gear. The use of this material makes possible the full realization of draft gear requirements and permits of a compact design.

Aside from the unquestioned strength and wearing quality of forged steel, a further advantage is secured in that the various details can be made with an accuracy that is very desirable in such equipment. This accuracy of detail results in a perfectly fitted gear with close uniform bearing between frictional surfaces, that insures long the initial compressions and after the gear has moved to one-half of its travel, the two inner springs start to compress in conjunction with the outer coil, thereby offering an increasing resistance as the coils approach their solid height.

The action of the gear is the same under buff or pull; that is, the triangular blocks slide transversely on the follower plate toward one another and at the same time move longitudinally into the barrel, producing a resultant force at a 60 deg. angle. This causes a pinching action on the scissors blocks which, in turn, rotate about a toggle pin and open up inside the barrel so as to exert a powerful transverse pressure upon each of the integral spring seat and side blocks. The latter, together with the scissors blocks move

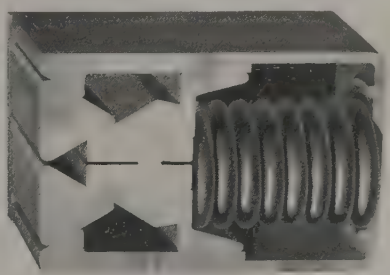


Fig. 1167—Sectional View Showing Stanforge Gear in Compressed Position

twice as fast as the triangular blocks and in consequence they have double the travel. As a result of this increased travel, the wear on the longitudinal friction plates is distributed over double the area, as compared with draft gears which do not possess this differential movement in the frictional members.

This method of construction provides many surfaces of frictional contact; a cumulative capacity is gained by use of the scissors blocks and

Fig. 1168—Sectional View of the Stanforge Draft Gear Showing Its Application to the Draft Sills

wear and a smooth, sensitive action under all conditions.

The parts are housed in a forged steel barrel—shown in the illustrations—which is never subjected to wear as it is protected on each side by the friction plates. The triple coil spring with which this draft gear is equipped—see Fig. 1166—is made with one long outside coil to receive toggle pin. Through this latter part, any wear in the gear may be taken up, by substituting a pin of larger diameter, thereby restoring the parts to their original positions.

A detailed illustration of the Stanforge draft gear on which are indicated the principal dimensions, is shown in Fig. 1162. This clearly illustrates the compactness of the design.

For other products and branch offices, see classified and alphabetical indexes.

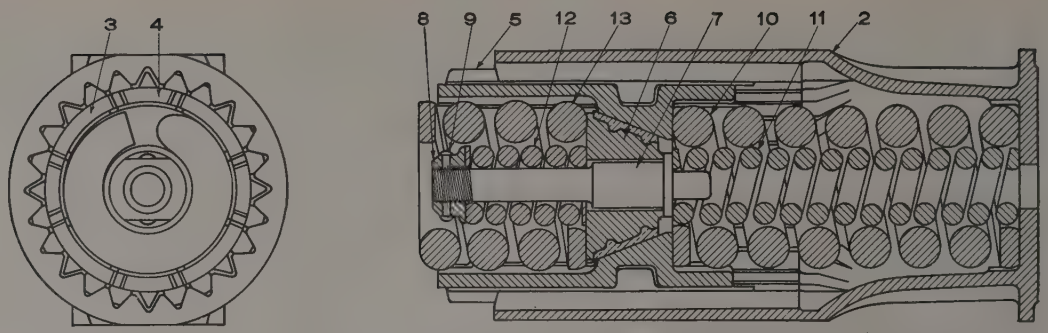


Fig. 1169—Westinghouse Type D-3 Friction Draft Gear—2 9/16" Travel.

2 *Cylinder*
3 *Male Segment*
4 *Female Segment*
5 *Friction Strip*
6 *Wedge*
7 *Release Pin*
8 *Release Pin Nut*
9 *Button Head Rivet*
10 *Release Spring*
11 *Aux. Release Spring*
12 *Aux. Prel. Spring*
13 *Preliminary Spring*

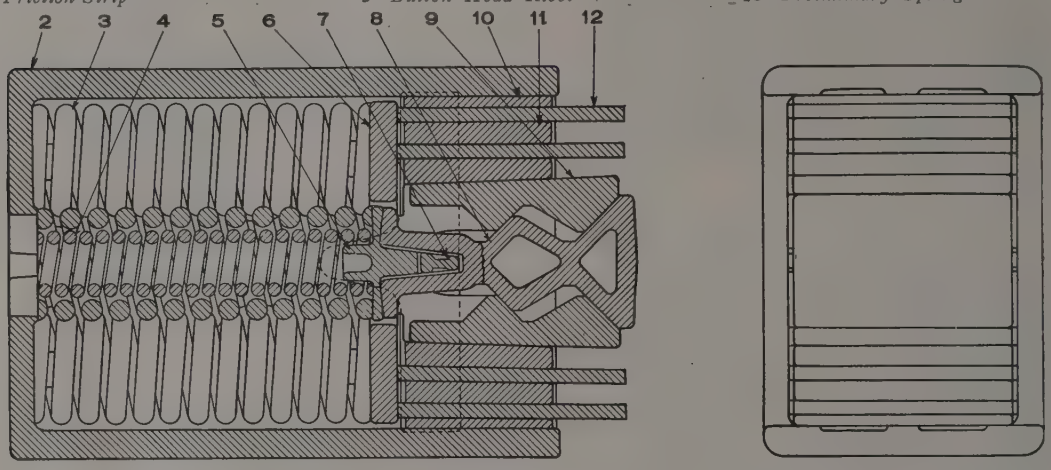


Fig. 1170—Westinghouse Type N Friction Draft Gear—N-10-F, 2 7/16" Travel; N-12-A, 3" Travel.

2 *Housing*
3 *Outside Spring*
4 *Inside Spring*
5 *Release Spring Seat*
6 *Follower Plate*
7 *Key*
8 *Wedge*
9 *Wedge Plate*
10 *Outside Stationary Friction Plate*
11 *Inside Stationary Friction Plate*
12 *Movable Friction Plate*
13 *Spring Separator*

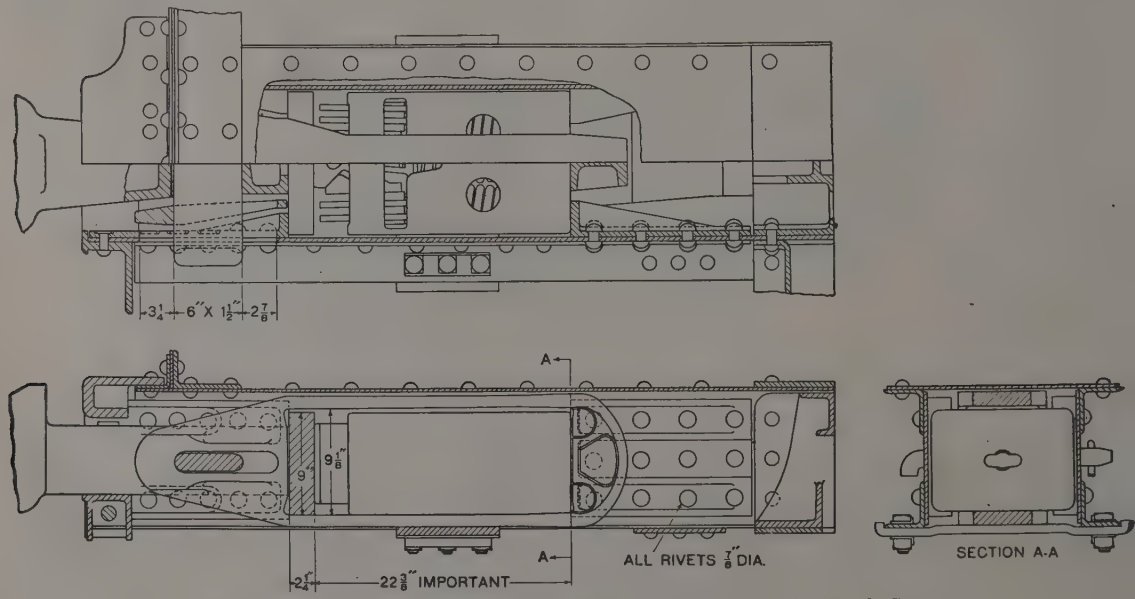


Fig. 1171—Typical Installation of Westinghouse Type N Friction Draft Gear.

Westinghouse Air Brake Company.

(See also Fig. 1165 and Page 537)

Type "N" and Type "D" Friction Gears.

Powerful locomotives, high capacity cars, long trains, and high speeds, with high rates of acceleration and retardation, have intensified all factors involved in train operation and created a demand for a draft gear commensurate with service requirements. Not only have physical conditions become more severe, but economic conditions are now such as to demand careful consideration.

Fig. 1172—Type "N" Draft Gear

The Westinghouse Type N Friction Draft Gear because of its heavy duty characteristics, its important installation advantages, and its low maintenance cost, fully meets these conditions.

The construction of the gear consists essentially of a multiple arrangement of friction members in combination with springs which furnish the necessary highly elastic resistance, and the means for releasing the gear. It is self-contained, with its movable parts encased in a housing of rectangular cross section, and held together under initial compression by a key. The construction throughout is substantial and of the best materials. The housing is a high grade steel casting. The friction members are of malleable iron and case hardened soft steel, a combination which offers high resistance with minimum wear.

The operating advantages include a low initial resistance to provide the necessary slack, which insures that long trains can be started easily.

High capacity is obtained by making the design and construction amply sufficient for the heavy duty required under modern conditions.

Positive release is obtained by so constructing the gear as to insure its prompt and certain return to normal position in readiness for subsequent duty up to its full capacity.

A minimum practicable reaction is effected by release of the gear and return of the parts to their normal position with the least possible reactive effect consistent with the other functions to be performed. The apparatus is therefore free from the possibility of dangerous recoil.

The installation advantages include the use of only one follower plate to effect satisfactory operation although two may be used if desired.

Any keyed draft gear attachment may be used when installing this gear.

A long travel with a consequent increase in capacity is secured without requiring any increase in the draft lug spacing.

It is self contained, the various members of the gear being held together under initial compression by a key. This insures, first, that all parts are always in their proper relation regardless of any discrepancy that might exist in the spacing of draft lugs, and second, the gear is handled as a unit and may be transported from place to place with no fear of it becoming disassembled.

The maintenance advantages include extreme simplicity as the parts are relatively few.

Stresses in the springs are kept low under full load. This is accomplished by providing proper design of the gear, and insures long life.

The housing is strong enough to safely withstand blows far in excess of the capacity of the gear, without possibility of distortion.

No wear on the housing, which insures that no repairs will be required from this source,—the most expensive single part to replace—is achieved by so designing the gear that the wear affects the removable elements only.

Exceptionally large frictional surfaces are provided, which distribute the work over a large area, consequently the rate of wear is low.

Wear is compensated by unlimited adjustment of the frictional surfaces, as the gear can be returned to initial condition by inserting liners between the housing and the outside friction plates, thus prolonging its life indefinitely.

Two sizes of the Type N gear are regularly manufactured, the N-10-F which has a travel of 2 7/16 in. with an impact capacity which requires a 9,000 lb. weight to fall from an average free height of 21 inches to close the gear; and the N-12-A which has a travel of 3 in. with an impact capacity which requires a 9,000 lb. weight to fall from an average free height of 25 inches to close the gear. The gear is shown in detail on page 536, together with a typical installation.

Fig. 1173—Type "D" Draft Gear

The Westinghouse D-3 Friction Draft Gear has been in general service so long and with such satisfactory results as to become generally known. It has proved a remarkably effective device for preventing damage to car equipment and lading, by dissipating the stresses set up between cars during normal train movements. This gear has a travel of 2 9/16 in. with an impact capacity which requires a 9,000 lb. weight to fall from an average free height of 17 inches to close the gear. It is shown in detail on page 536, while a typical installation is shown on page 534.

For other products and branch offices, see classified and alphabetical indexes.

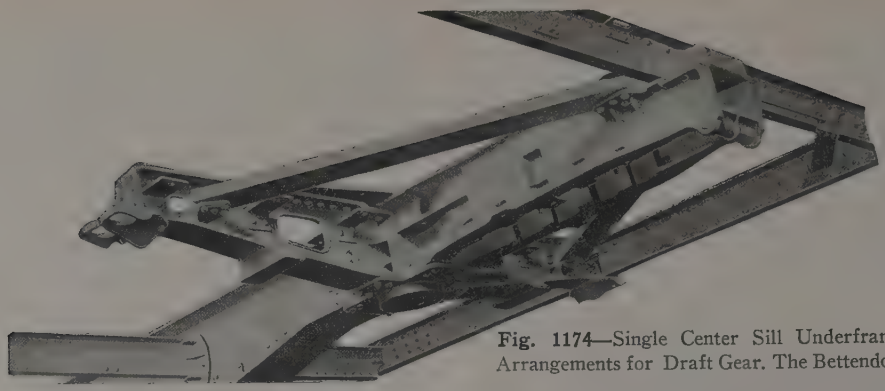


Fig. 1174—Single Center Sill Underframe, Showing Arrangements for Draft Gear. The Bettendorf Company.

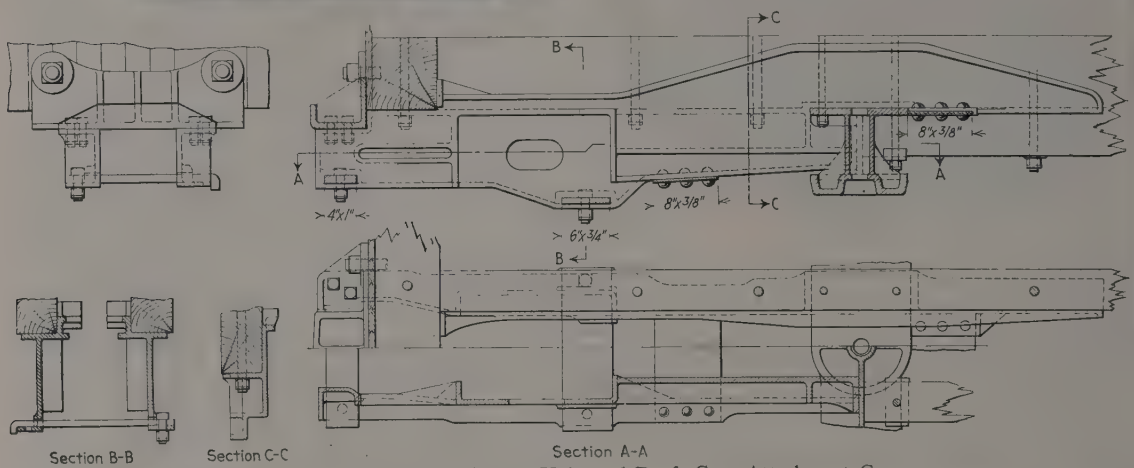


Fig. 1175—Cast Steel Draft Arms. Universal Draft Gear Attachment Company.

For Wooden Freight Cars.

For Wooden Freight Cars.

General Arrangement.

Fig. 1176—Economy Draft Arms. American Steel Foundries.

(*See also Pages* 542-543.)

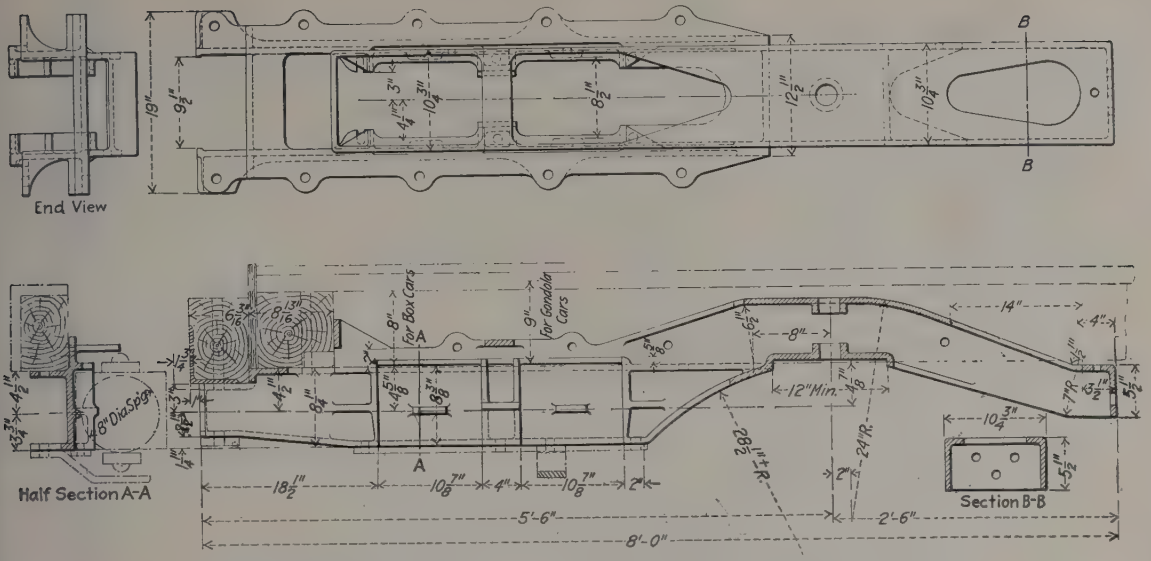


Fig. 1177—Cast Steel Draft Arm. Pittsburgh Steel Foundry Company.

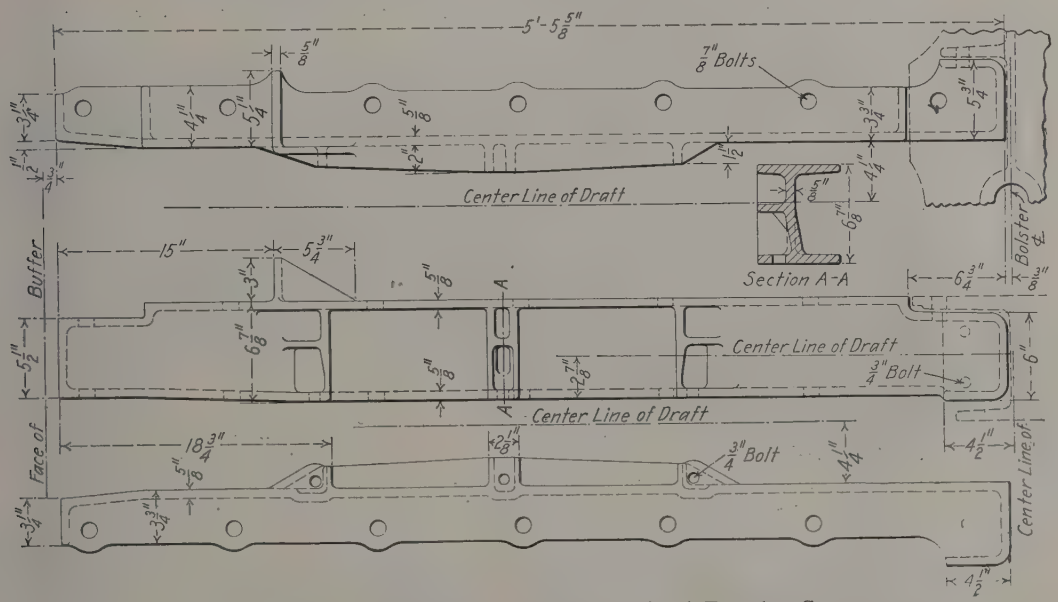


Fig. 1178—Cast Steel Draft Arm. Pittsburgh Steel Foundry Company.

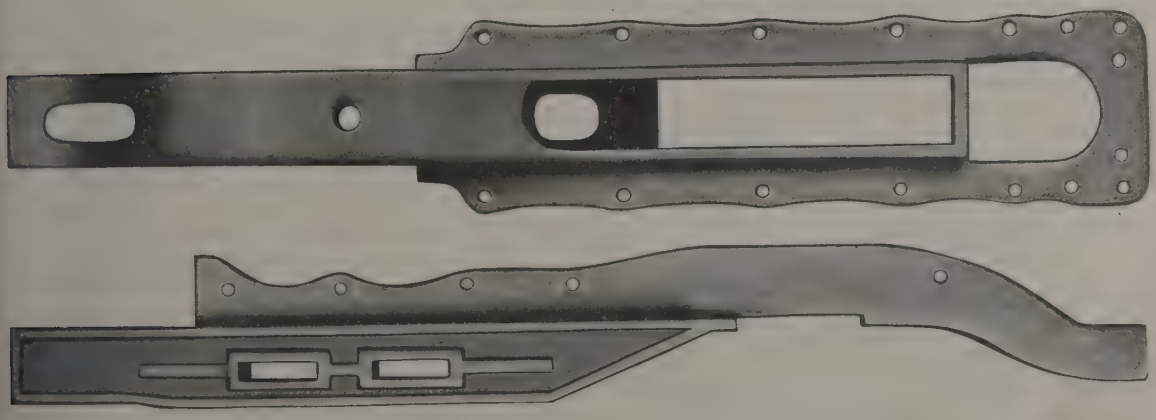


Fig. 1179—Cast Steel Draft Arms. Chicago Steel Car Company.

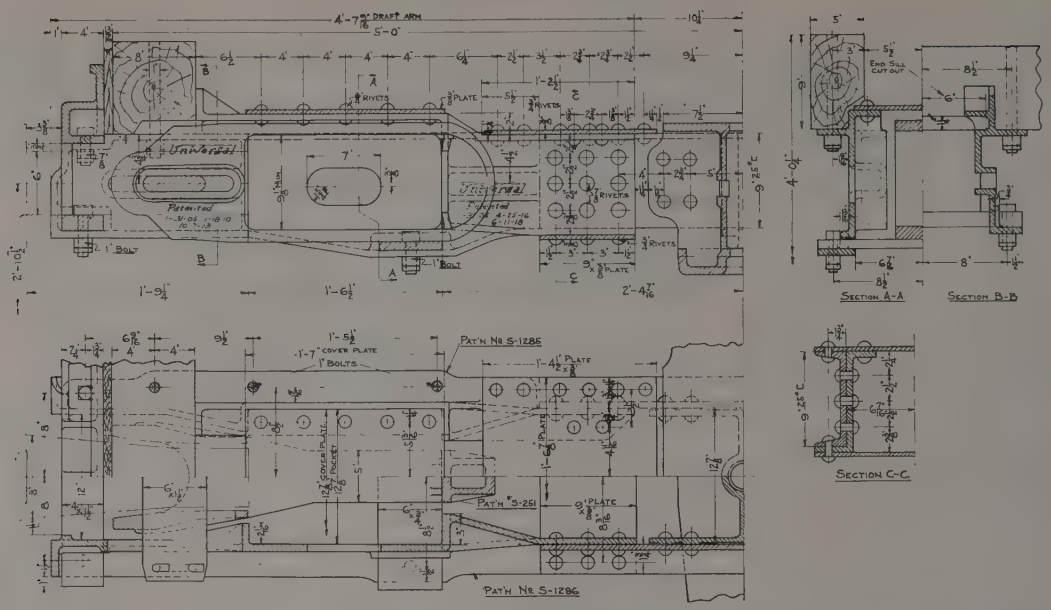


Fig. 1180—Universal Type "G" Cast Steel Draft Arms and Keyed Yokes for Cardwell Draft Gear with Steel Center Sills

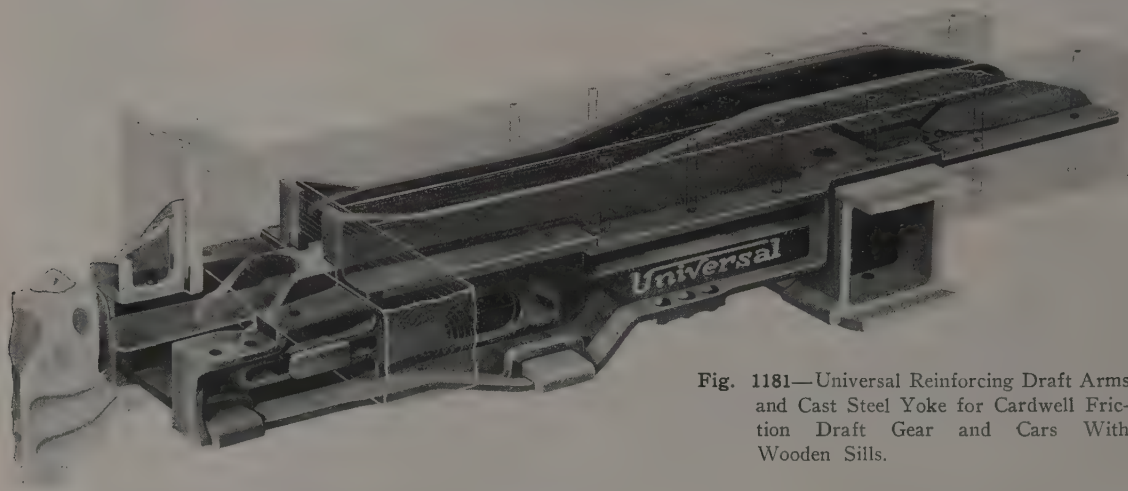


Fig. 1181—Universal Reinforcing Draft Arms and Cast Steel Yoke for Cardwell Friction Draft Gear and Cars With Wooden Sills.

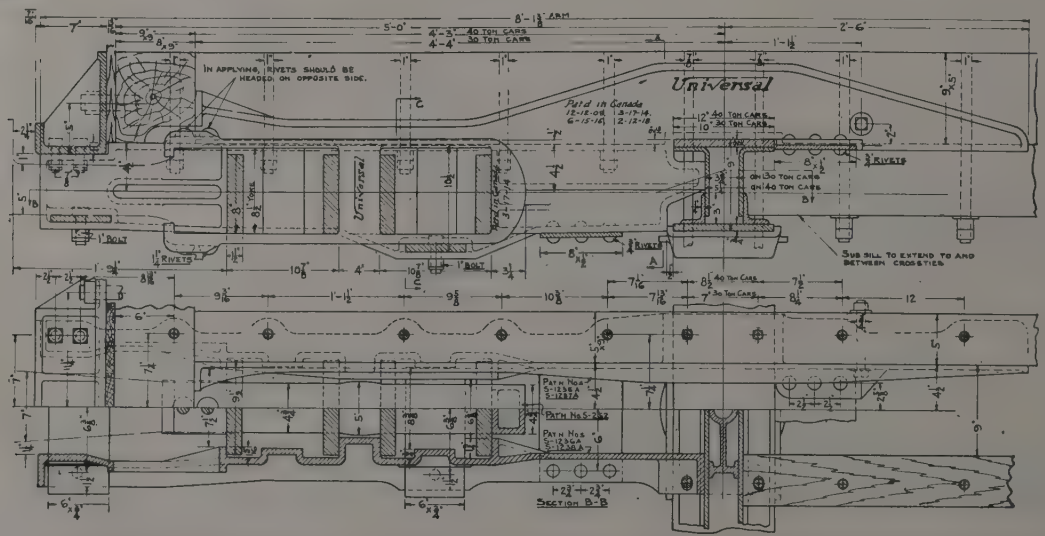


Fig. 1182—Universal Reinforcing Draft Arms and Cast Steel Yoke for Tandem "G" Springs and Cars with Wooden Sills.

Universal Draft Gear Attachment Company

(See also Page 541.)

Universal Draft Arms

The cost of maintaining draft rigging in good condition is an important factor in the upkeep of rolling stock. On wooden cars the weak point of the draft rigging is the attachment or connection between the draft gear and the car. Not only do the wooden sills and bolster need reinforcement but the connection between draft gear and sills must be strengthened.

The use of structural steel in securing the present day draft gear to the car is usually of little more value than wooden timbers; a rigid casting forming a connection between the draft gear, the car sills and the bolster, thereby utilizing the compression strength of the members in both buffing and pulling, is the logical answer. On all wood or steel underframe equipment the use of a rigid casting renders draft lugs unnecessary and adds greatly to the strength of the draft gear rigging when the car is in buff.

Fig. 1183—Universal Reinforcing Draft Arms with Gusset Plates and Keyed Yokes as used with Cardwell Friction Draft Gear for Cars with Wooden Center Sills

The Universal Draft Arm is a one piece steel casting designed to form an indestructible connection between the draft gear, the car sills, and the bolster. The draft arm may be made for any standard type of draft gear and does not require draft lugs, plates, or straps, with the usual bolts or rivets. It is cast of sufficient section to withstand violent abuse in buffing as well as strain in pulling and, by the use of a shoulder against the end sill and on both sides of the body bolster, always transmits the shocks to the car by compression.

Special features of design in the Universal Draft Arm which should be noted are: the section back of the rear abutting shoulder is Z-shaped, giving surplus strength at a vital point without depending on rivets, possible only by the use of a casting.

The coupler and the draft gear carrier plates are carried in openings of the draft arm casting above the lower flange, making unnecessary the use of bolts under tension and preventing any possible sagging or loss of these parts. By using a shoulder on either side and an additional riveted plate at the rear of the bolster a tight fit is assured at this most important point of connection.

In some cases Universal gussets are used to connect the two draft arms and bolster in one compact unit thus preventing any movement of the arms with reference to the bolster or the turning of the bolster due to shock in starting or stopping. This reinforcement also stiffens the center sills very materially and is very desirable from every point of view.

The replacement of couplers, yokes, or draft gears becomes an easy task as the coupler and draft gear carrier plates can be quickly removed without disturbing the draft arms or sills.

The revenue producing life of cars in service may be considerably lengthened by the installation of Universal Draft Arms and the future cost of maintenance of which the draft rigging is such a large percentage, will be reduced.

Actual service has demonstrated that in the case of old wooden cars the installation of Universal Draft Arms has not only made the car stronger than when new but has more than doubled its life.

The economic value of the Universal Draft Arms—a device which keeps cars off the repair tracks—is only appreciated when a survey of repair costs is made. The cost of maintenance of the ordinary draft rigging found on many cars is greater than any other part of the car and in a large number of cases—on wooden cars—greater than the cost of all the other repairs put together. The Universal Draft Arm insures low maintenance costs and—which many times is of greater importance—continuous service of the car to which it is attached.

Universal Draft Arms are adaptable to any type of car, wooden, composite or steel, new and old and can be made to accommodate any type of draft gear.

For other products and branch offices, see classified and alphabetical indexes.

UNIVERSAL DRAFT GEAR ATTACHMENT COMPANY, CHICAGO, ILL.

Economy Draft Arms and Janney Vertical Key Yoke

The underframe, which is the foundation of a car and the principal member of its structure from the standpoint of strength, must be substantially constructed. It is subjected to very heavy shocks incident to present day service conditions and unless this part of the car's structure is sufficiently strong to withstand these shocks the superstructure and, in the case of box cars, the roofs are sure to suffer and the car lading along with them. Cars with wooden or light steel underframes give the greatest amount of trouble. There is but one real remedy for such equipment—the application of steel draft arms.

The advantage of the steel draft arm over the continuous steel center sill—for strengthening underframes of old cars—lies in the fact that equal strength can be obtained by using the metal draft arm at less cost and without adding as much weight to the car as in the case of the continuous steel center sill. In the case of the latter some form of metal crosstie would be required to support it.

The Economy Cast Steel Draft Arm—a standard product of the American Steel Foundries—is an economical and efficient device for strengthening wooden underframe and light steel underframe cars so that they may be fit for service in the heavy trains used in present day traffic.

The Economy Draft Arm is an integral steel casting which combines draft arms, steel reinforcements, body truss-rod plates, draft lugs, etc. It is designed in accordance with the requirements of the Mechanical Division of the American Railway Association. It passes alongside and underneath the center sill and laps over and extends 30 in. back of the body bolster. This extension back of the bolsters is an important feature for in practically all cases weak center sills break over the bolster, the point of maximum intensity of center sill stress. Furthermore, by bringing the draft arm back of the bolster it is possible to make a substantial connection with the center sills. The Economy Draft Arm can be designed to accommodate any style of draft gear. Two typical designs are shown, but special designs are worked out in many instances to suit conditions.

Being an integral steel casting, the Economy Draft Arm eliminates all loose pieces, built up plates, angles, etc., for holding the draft gear. It is of course much stronger than the old wooden draft arm. As it extends underneath the center sills and back of the bolster, it withstands the coupler blows which tend to break the center sills at the bolster; coupler blows are absorbed without damage because their force is distributed uniformly along the center sills and through the body bolster to the underframe.

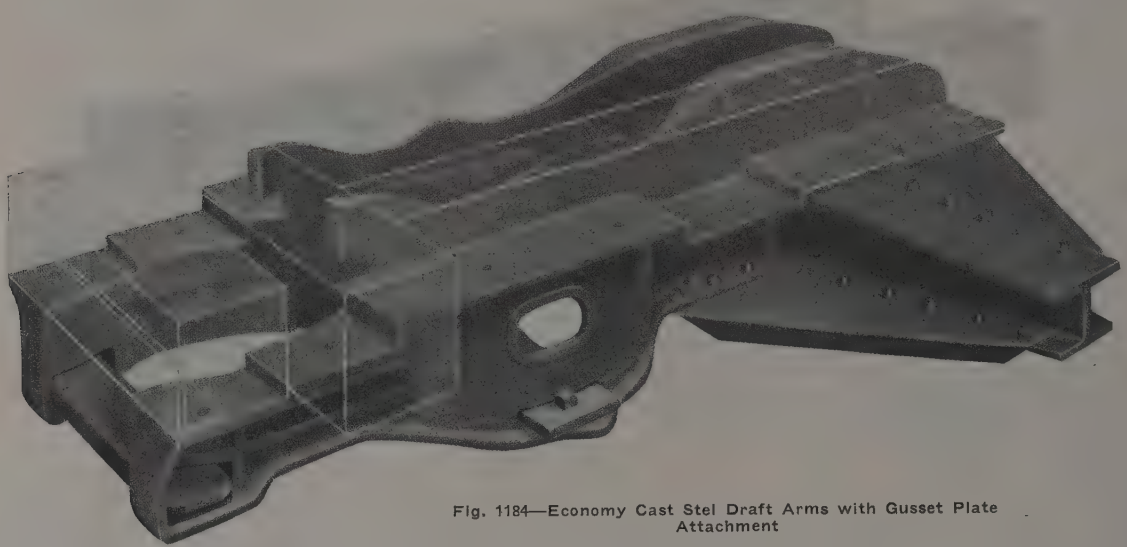


Fig. 1184—Economy Cast Stel Draft Arms with Gusset Plate Attachment

Economy Draft Arms are applied readily and quickly, and the cost of application is low for there is no assembling to be done. The application of Economy Cast Steel Draft Arms gives additional strength at the point where it is most needed and the proof of its value lies in the fact that there are now hundreds of thousands in service. The engineers of the American Steel Foundries have had long experience in draft arm design and their knowledge of what has been done is at the service of all roads to assist in solving their draft arm problems.

The Janney Vertical Coupler Key Yoke, shown in Figs. 1186 and 1187, which has been developed recently by the American Steel Foundries, serves the purpose of a universal joint between the draft gear and the coupler, thus providing a freedom of motion which relieves the yoke of any unnecessary strains. It makes possible a central pull on the coupler yoke and at the same time gives lateral, vertical and torsional play to the coupler

Economy Draft Arms and Janney Vertical Key Yoke *Cont'd.*

shank, the combination of which can not be secured in the riveted or other keyed types of yokes.

A feature of this yoke is the heat treated vertical key which is in double shear and transmits the stresses in a direct line with the straps of the yoke at all times. The key is held in the coupler

wise would have been scrapped. The flexibility of angling through the use of the Janney Vertical Key Yoke increases the efficiency of the centering device.

The elimination of rivets reduces the labor and delays incident to coupler replacements and the compact design of the yoke readily lends itself to use with any type of car construction without change. It can be adapted to the tandem draft

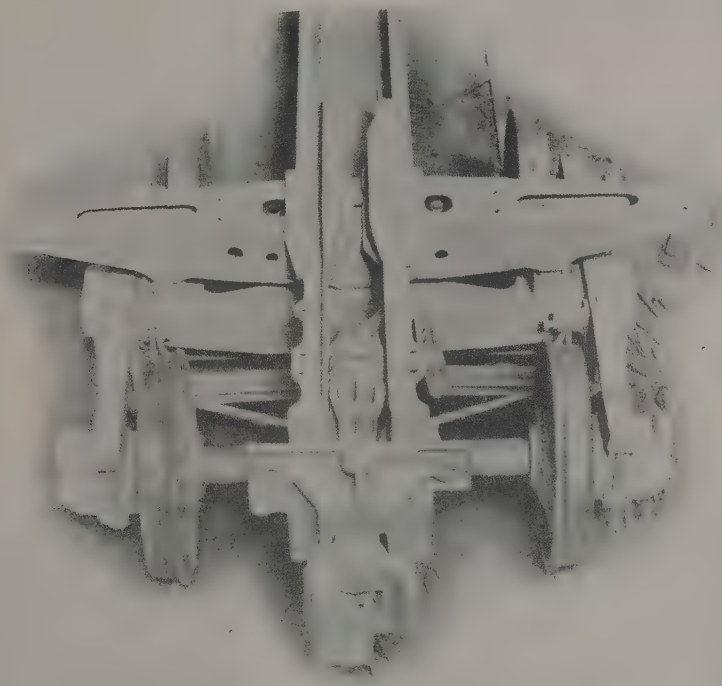


Fig. 1185—Typical Economy Draft Arm Application

end of the yoke by means of a track bolt, underneath the yoke, which is provided with a cotter in addition to the standard nut and lock washer. Thus the key may be removed easily and it is possible to replace couplers, when it is necessary, without disturbing the draft gears.

The Janney Vertical Key Yoke can be used with old couplers by burning out the partition between the rivet holes in the butt end of the coup-

springs and practically all sill construction without change to the car.

The Eclipse Cast Steel Coupler Yoke requires no rivets; it is provided with substantial lips which fit over the lug on the end of the coupler shank. It is held in place by a cast steel binder which is locked to the yoke by a cotter. The coupler shank pulls directly on a bearing surface of the yoke. To remove the coupler from the yoke it is only necessary to slide off the binder

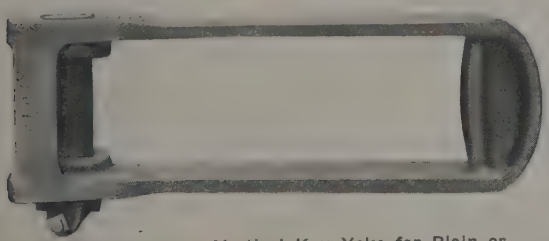


Fig. 1186—Janney Vertical Key Yoke for Plain or Friction Gear

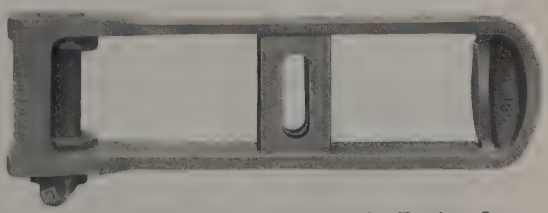


Fig. 1187—Janney Vertical Key Yoke for Tandem Gear

ler to receive the heat treated key. This does not weaken the coupler in any way. Furthermore, it permits the continued use of couplers with badly worn rivet holes or horizontal slots which other-

at the coupler end of the yoke. The Eclipse Yoke is strongly designed at every point and can be used for friction or tandem draft gears. It can be used also in connection with any standard coupler and with either plain or slotted shanks.

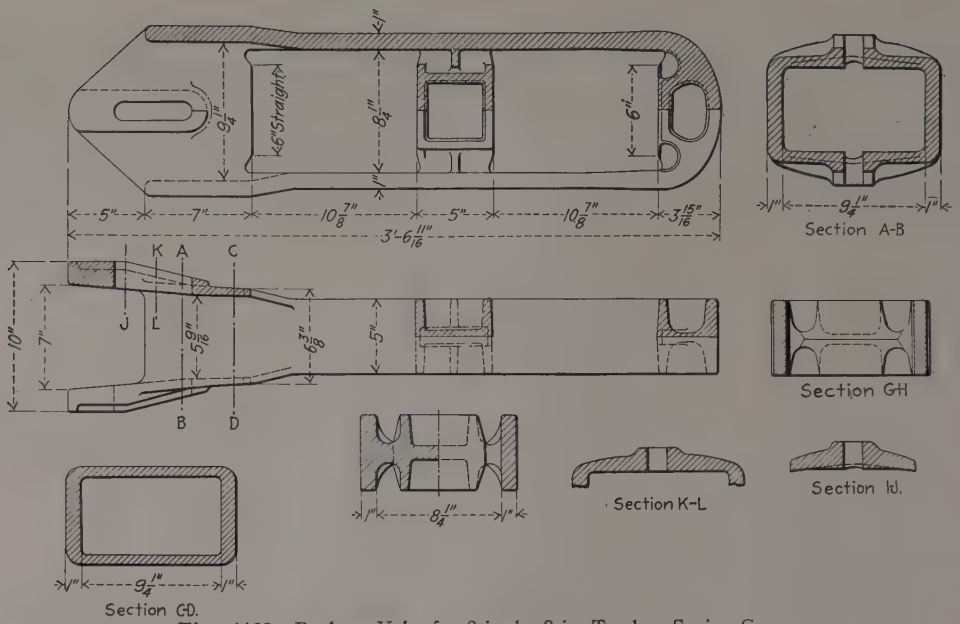


Fig. 1188—Buckeye Yoke for 8 in. by 8 in. Tandem Spring Gear.

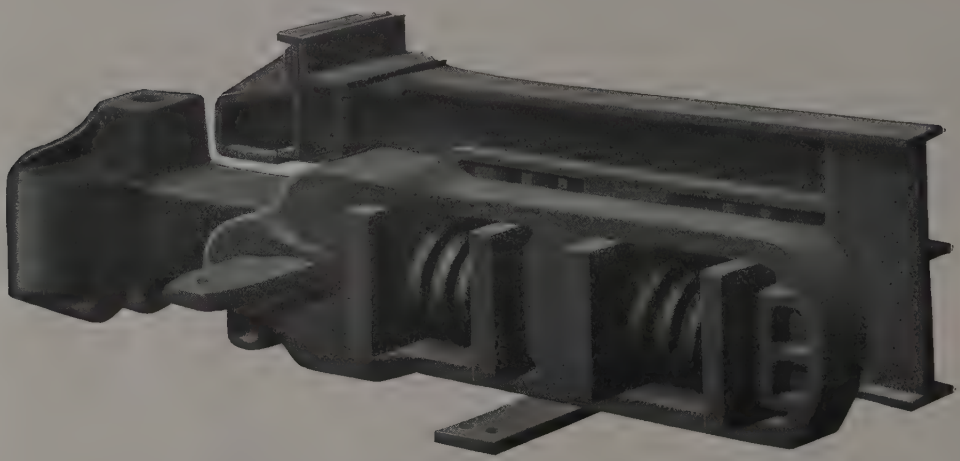


Fig. 1189—Application of Buckeye Cast Steel Keyed Yoke for Tandem Gears.

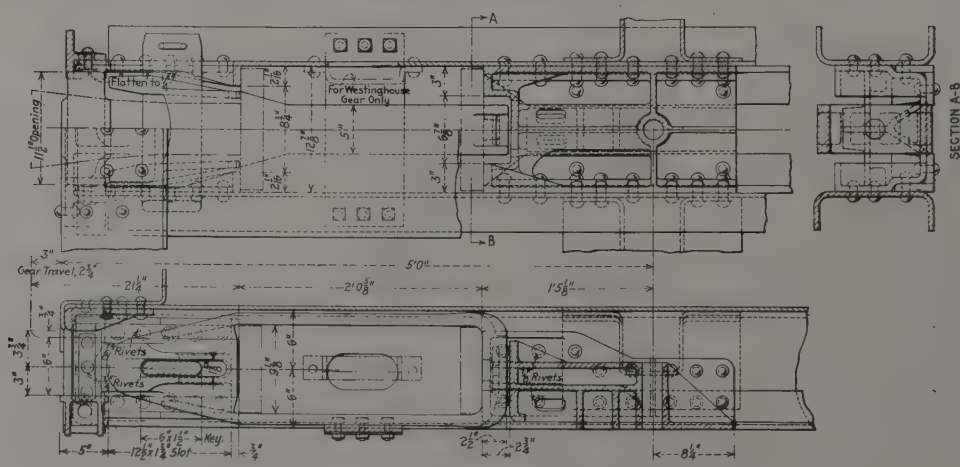


Fig. 1190—Application of Buckeye Yoke with Center Casting and Rear Stops Integral.

Buckeye Steel Casting Company.

(*See also Page* 599)

Fig. 1191—Buckeye Cast Steel Keyed Yoke for Tandem Spring Gears.

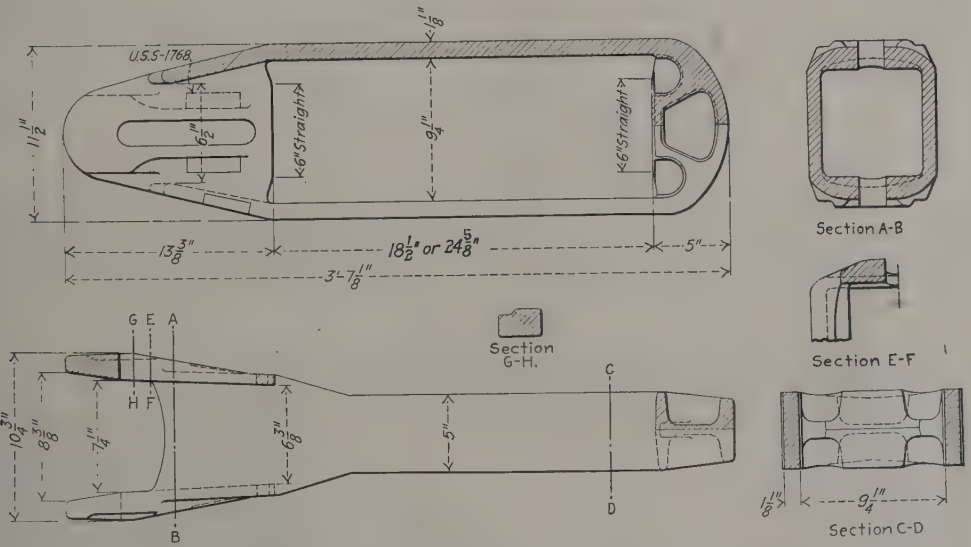


Fig. 1192—Buckeye Cast Steel Keyed Yoke for Friction Gears.

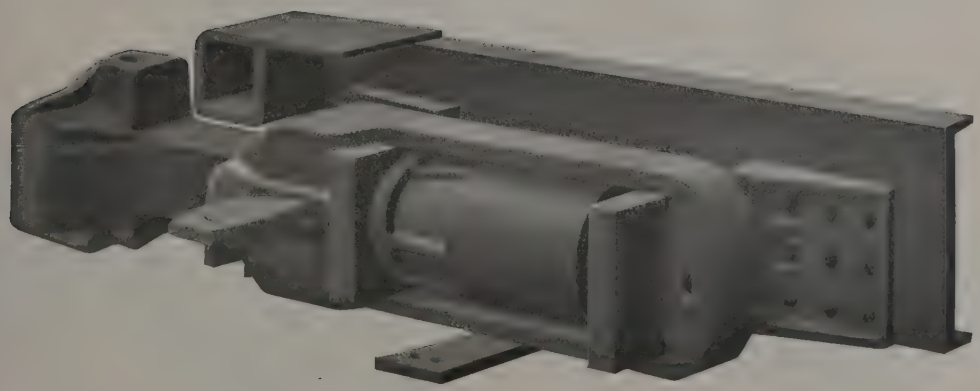


Fig. 1193—Application of Buckeye Cast Steel Keyed Yoke for Friction Gears.

Buckeye Steel Castings Company.

(*See also Page* 599)

Fig. 1194—Miner Cast Steel Yoke. W. H. Miner.

Fig. 1195—Miner Combination Yoke. W. H. Miner.

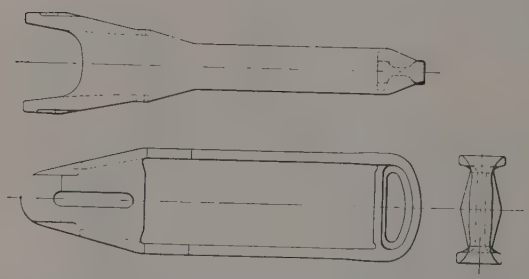


Fig. 1196—A. S. F. Cast Steel Coupler Yoke. American Steel Foundries.

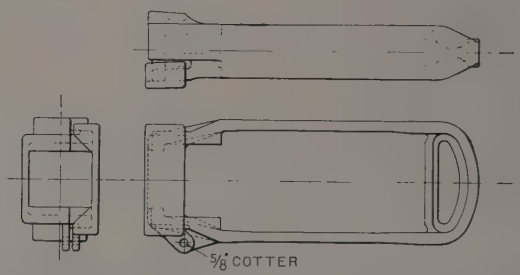


Fig. 1197—Eclipse Cast Steel Coupler Yoke. American Steel Foundries.

(*See also Pages* 542-543)

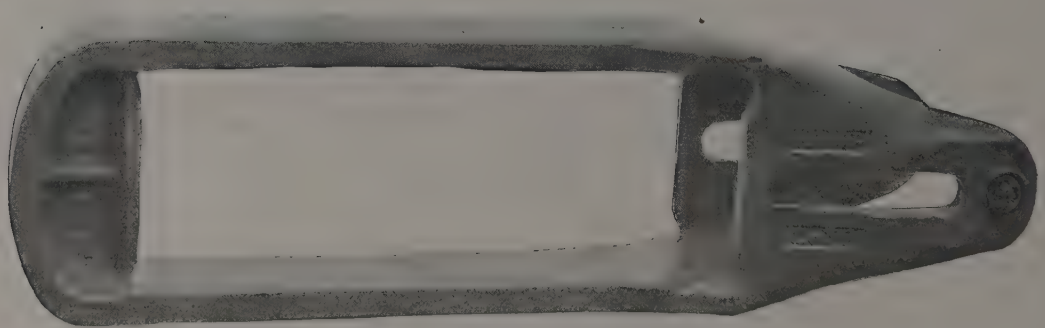


Fig. 1198—Cast Steel Coupler Yoke. Scullin Steel Company.

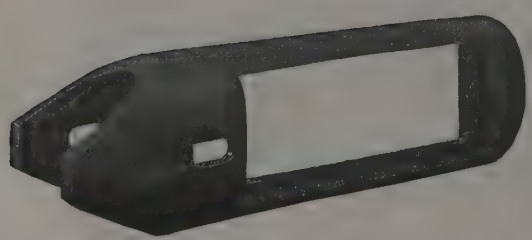


Fig. 1199—Forged Steel Draft Yoke. Forged Steel Yoke Corporation.

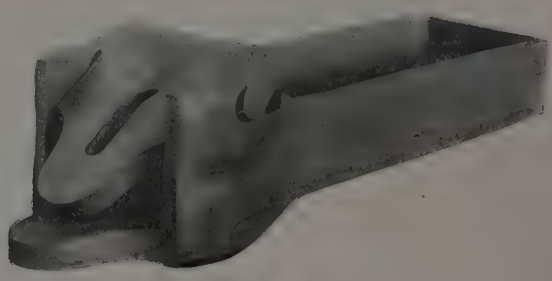


Fig. 1200—Forged Key-Connected Yoke. Standard Forgings Company.

(*See also Page* 968.)

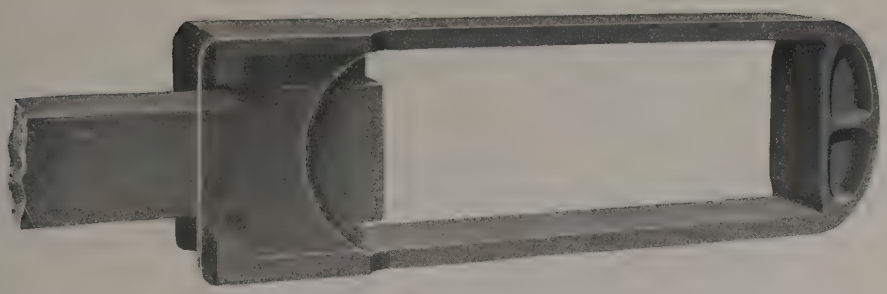


Fig. 1201—Murray Keyless Cast Steel Yoke.
Keyoke Railway Equipment Company.

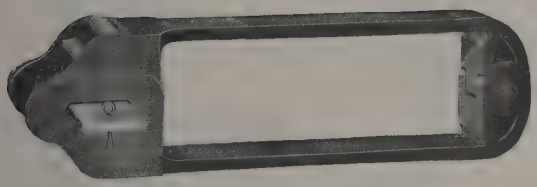


Fig. 1202—Murray Cast Steel Keyoke.
Keyoke Railway Equipment Company.

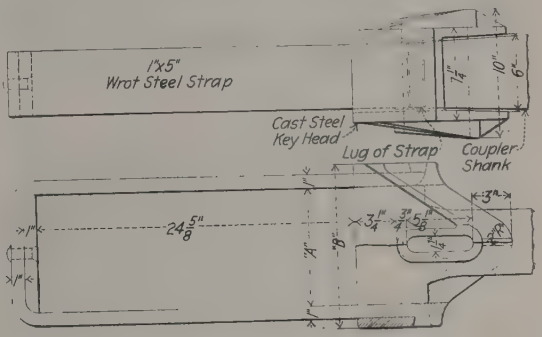
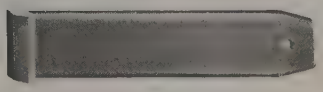


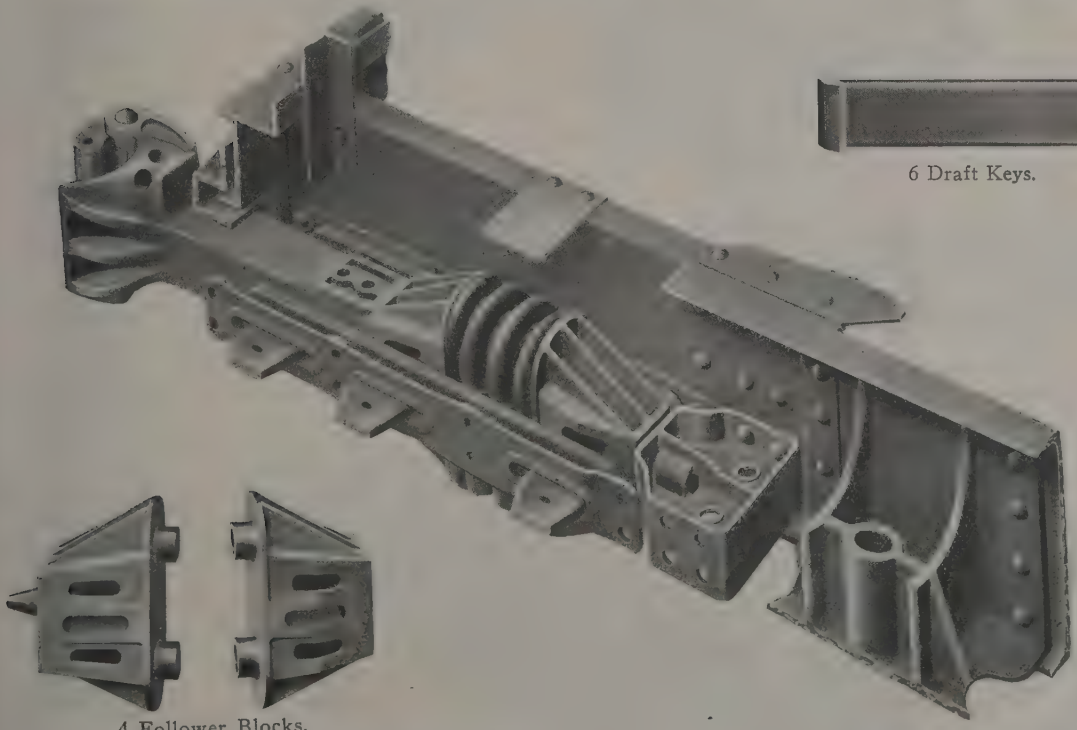
Fig. 1203—Composite Coupler Yoke
Gould Coupler Company.

4 Side Links

4 Cheek Plates.

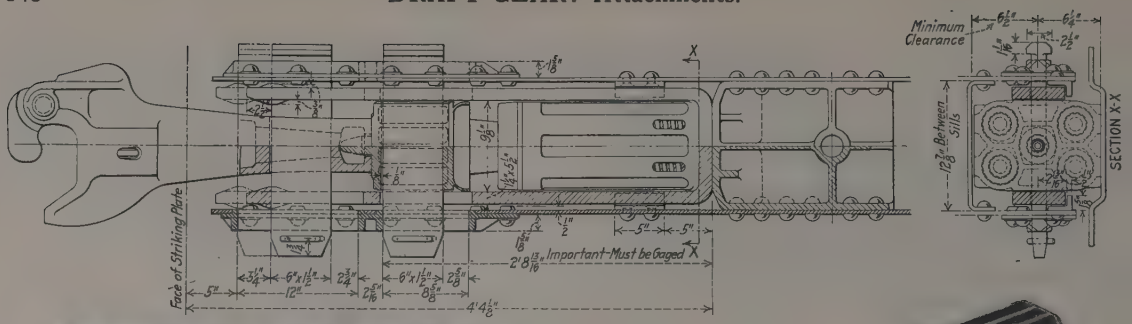


6 Draft Keys.

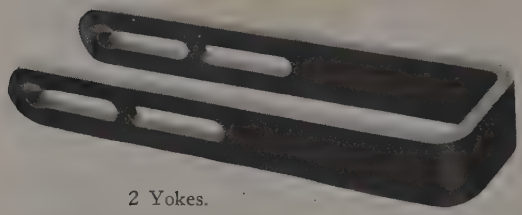


4 Follower Blocks.

Fig. 1204—Farlow Three-Key Draft Attachment for Use with A. R. A. Class G, 8 in. by 7⅞ in. Twin Springs, and Parts for One Car. T. H. Symington Company.



4 Cheek Plates



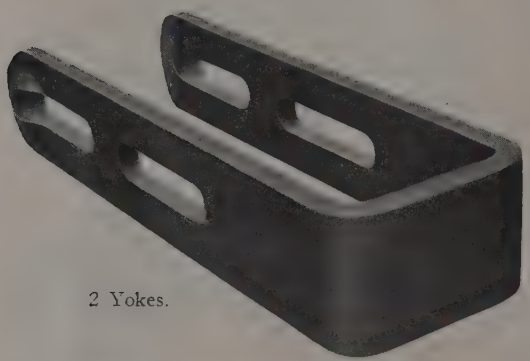
2 Yokes.

2 Yoke Fillers.

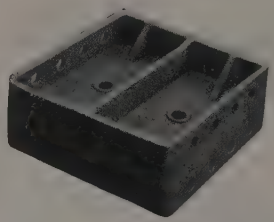
2 Front Follower Blocks.

4 Keys.

Fig. 1205—Application of Farlow Two-Key Draft Attachment for Use with Friction Draft Gears; and Parts for One Car.



2 Yokes.

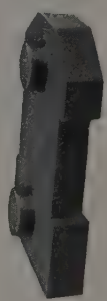


2 Back Stops.

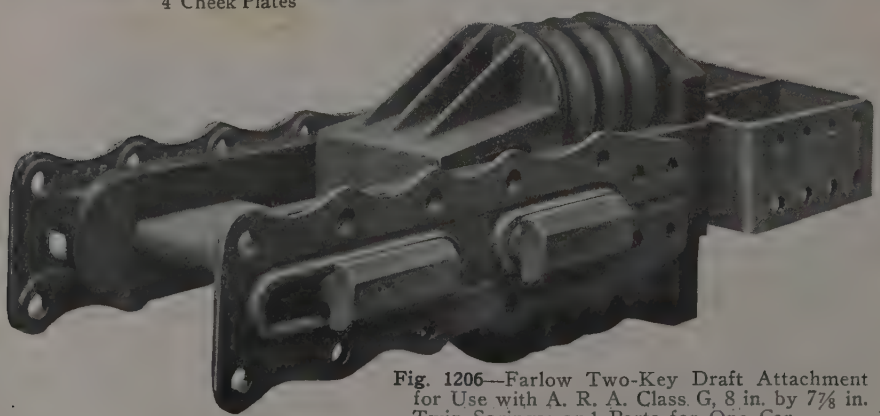
2 Front Follower Blocks.

4 Cheek Plates

4 Keys.



2 Rear Followers.



2 Spring Spacers.

Fig. 1206—Farlow Two-Key Draft Attachment for Use with A. R. A. Class G, 8 in. by 7⅞ in. Twin Springs; and Parts for One Car.

The T. H. Symington Company.

(See also Page 549)

Farlow Two-Key Attachments

The draft gear or cushioning device which is interposed to lessen the shocks incident to relative changes of speed between adjacent cars has developed from the single spring of 50 years ago to the 500,000-lb. capacity friction gear of today, in an effort to keep pace with the increase in weight of rolling equipment and in severity of service.

The function of the Draft Attachments is to connect the coupler to the draft gear, and the draft gear to the car underframe, and it often happens that the sturdiness and reliability of the attachments becomes of more importance than the capacity of the draft gear itself, since service shocks frequently exceed the capacity of the most efficient gear, and the attachments must carry the entire load.

The Farlow Attachments were an early practical application of the horizontal draft key principle, and to their success was due in large measure the adoption of the horizontal coupler key as standard practice.

The Farlow attachments are adaptable for single or twin draft springs or for any existing type of friction draft gear whose parts are contained within the limits of the standard gear pocket. The choice of materials of which the various parts of the attachments are made insures maximum efficiency and reliability of each part and no castings are subject to tension in service.

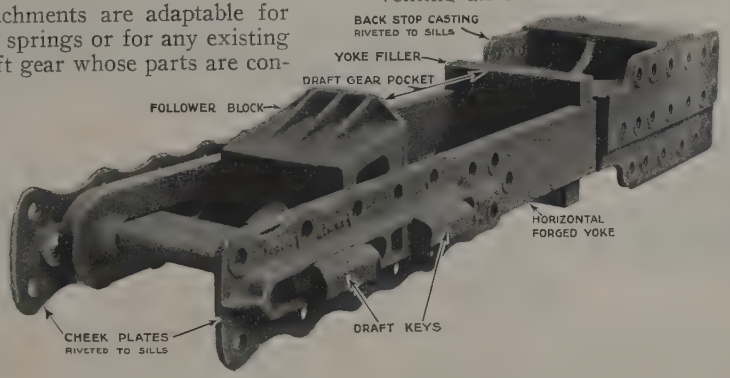


Fig. 1207—Farlow Two-Key Draft Attachment for Friction Gears

The Complete Attachments include the following parts: cheekplates, front follower blocks, backstop, horizontal draft yoke, draft keys and rear yoke fillers if the friction draft gear, with which the attachments are used, is less than 24⅝ in. in length. The cheekplates and front follower block are manufactured from high-grade malleable iron, the yoke, rear yoke filler and keys are forged from a high grade of open-hearth steel under rigid specifications and the backstop is a malleable iron or steel casting.

The first, or coupler key, serves to connect the coupler with the horizontal forged yoke in the usual manner, the ends of this key passing through the front slots in the cheekplates. The second key which carries the follower block extends through clearance slots in the yoke and is supported in the second slot in the cheekplates. In normal position or when the draft gear is compressed under pull, the front edge of the second key is in contact with the front end of the second slot in each cheekplate and, therefore, performs the function of a front draft stop. The follower block interposed between the coupler butt and the front end of the draft gear provides adequate area to resist the forward reaction of the draft gear, transferring this load through the second key to the abutments formed by the cheekplates. Under buff, this follower block transmits the load from the coupler butt to the draft gear and protects the latter from damage which would otherwise result from the concentration of the entire buffing shock on a relatively small area in the center of the front face of the friction gear. A generally similar design of front follower block is used in combination with twin draft springs, both this follower block and the rear yoke filler having integral lugs to center and support the springs. The follower block also insures the buffing load being distributed uniformly over a considerable area regardless of the angular movement of the coupler in either a horizontal or a vertical plane.

In normal position or with the draft gear compressed under buff, the rear end of the yoke seats against the front face of the backstop casting, the latter as a continuous bridge between the sills preventing all distortion of these and insuring that the entire load will be transmitted to the car underframe without possibility of local deformation.

The cheekplates are locked to the sill webs by means of bosses surrounding the key slots which fit within accurately punched slots in the webs of the draft sills and are attached to the sills with ⅞ in. rivets distributed over a considerable distance. They insure against a damaging concentration of load over a small sill area as is likely to be the case with the old style draft lugs.

As described above the front end of the second cheekplate slot forms the front stop abutment and both the front and second slots are of such length that under buff the second key brings up at the end of its slot simultaneously with complete closure of the draft gear, while the first key is arranged to function as an emergency stop. This feature prevents damage to the draft gear from shocks in excess of its nominal capacity, and the excess load is distributed directly to the draft sills over a large sill area.

With the Farlow attachments it is possible to remove the draft gear and the coupler each independently of the other and the use of a horizontal yoke permits inspection of the draft gear without removing the latter from the car. When it is necessary to remove the gear or the attachments, this removal may be accomplished without jacking up the car or without interference from any part of the truck.

For other products and branch offices, see classified and alphabetical indexes.

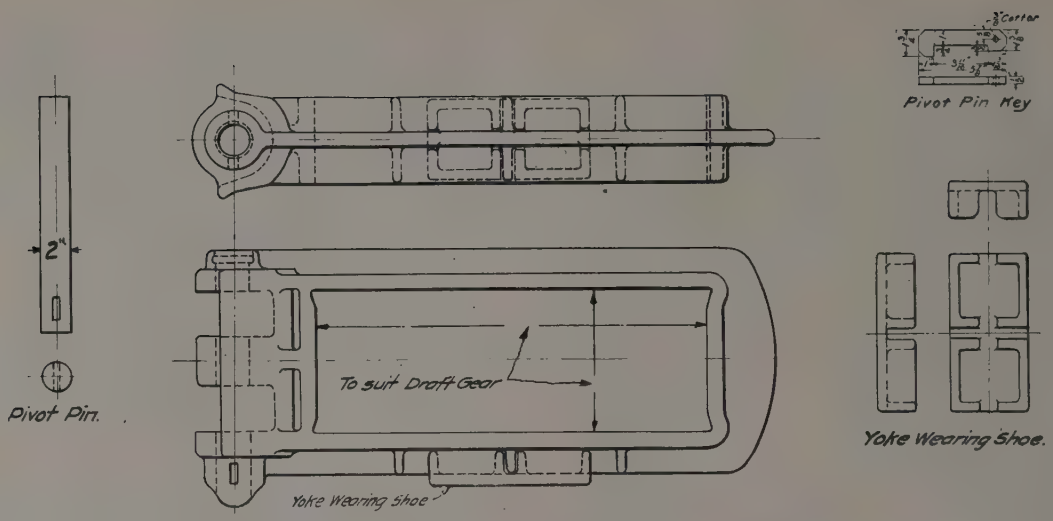


Fig. 1208—Cast Steel Yoke with Quadruple Shear Pivot Pin.

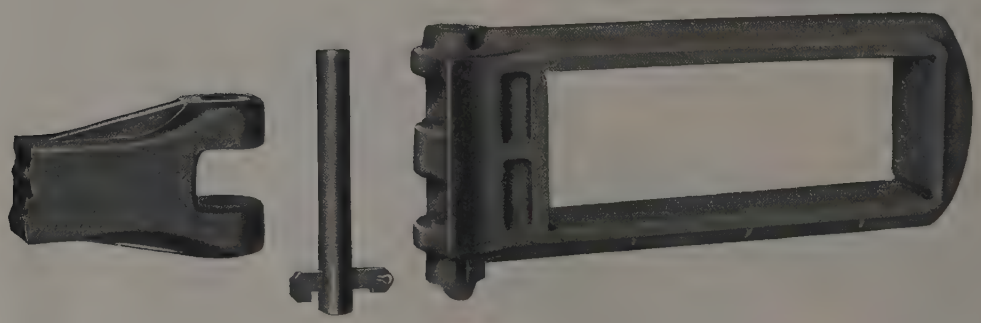


Fig. 1209—Cast Steel Yoke with Quadruple Shear Pivot Pin.

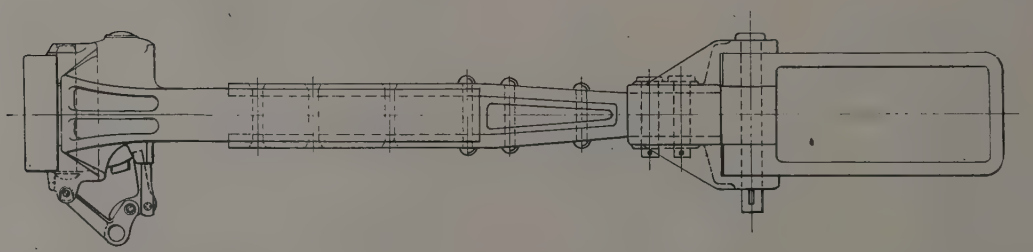


Fig. 1210—Cast Steel Connection Between Wrought Shank and Yoke for Quadruple Shear Pivot Pin.

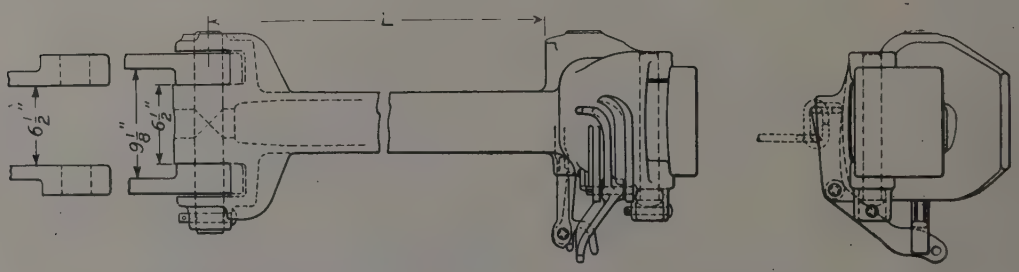


Fig. 1211—Sharon Side Operating Coupler with Shank for Quadruple Shear Pivot Pin.

The National Malleable Castings Company.

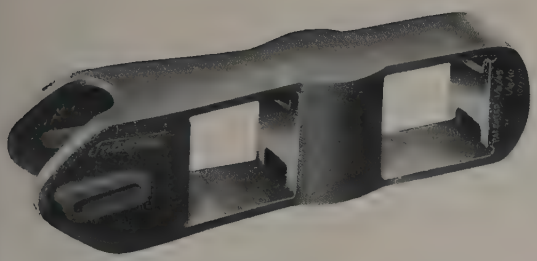


Fig. 1212—Universal Keyed Yoke for Tandem Spring Gear.

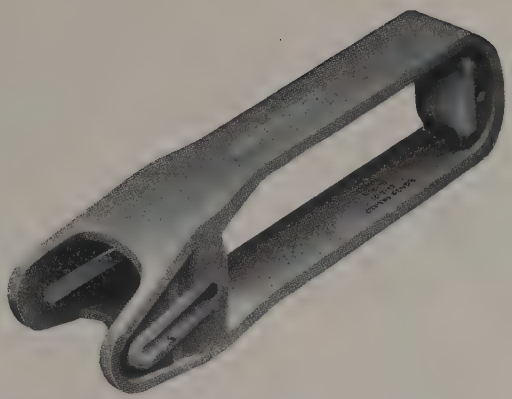
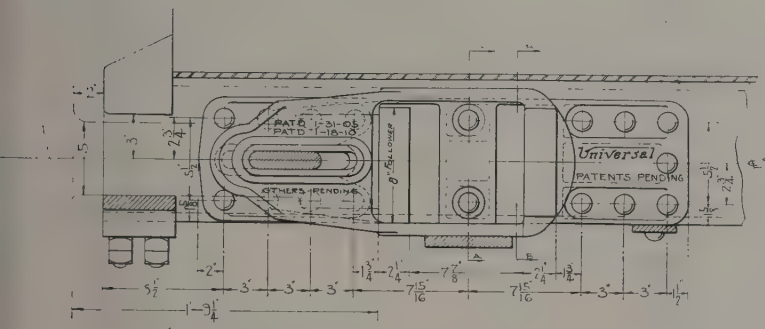
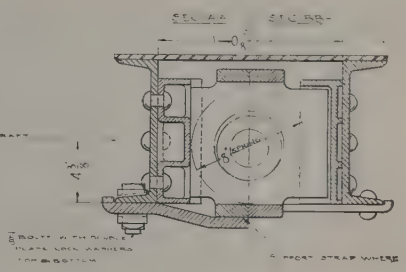


Fig. 1213—Universal Keyed Yoke for U. S. Government Standard Cars.





Parts Furnished Per Car		
2	Yokes & Back Followers	
2	Front Followers	
2	Keys	
2	Key Chafing Plates	M-43
2	Cotters	
4	Draft Plates	

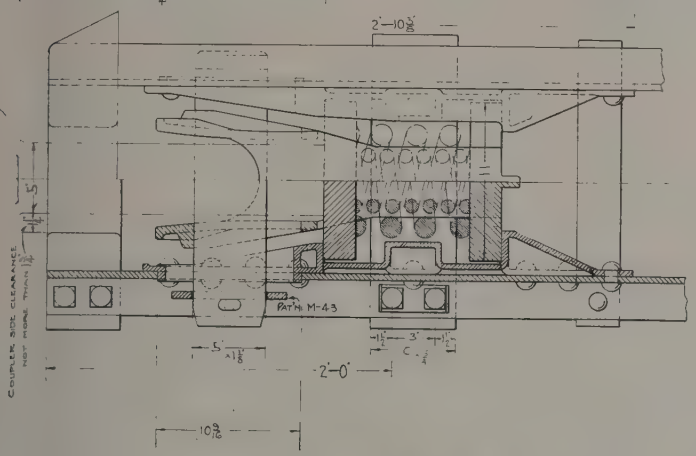


Fig. 1214—Universal Attachments with Keyed Yoke for Single Spring Draft Gear for Light Capacity Cars.

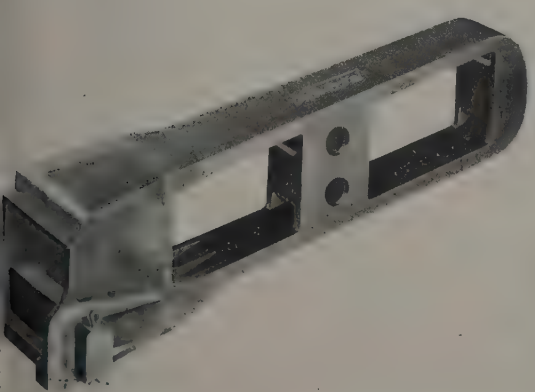


Fig. 1215—Universal Rivles Yoke for Tandem Spring Draft Gear

Fig. 1216—Universal Rivles Yoke for Friction Type of Draft Gear.

Universal Draft Gear Attachment Company.

(See also Pages 552-556.)

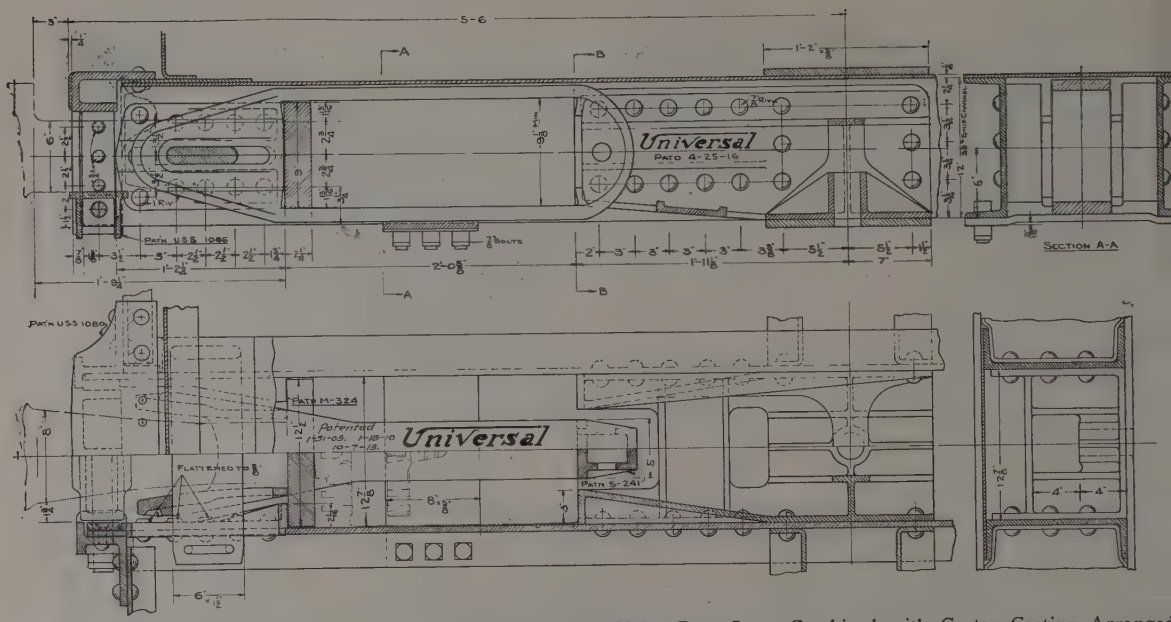


Fig. 1217—Universal Attachments, Draft Lugs and Keyed Yoke, Rear Lugs Combined with Center Casting Arranged for Westinghouse N-12-A Draft Gear.

(See also Page 553)

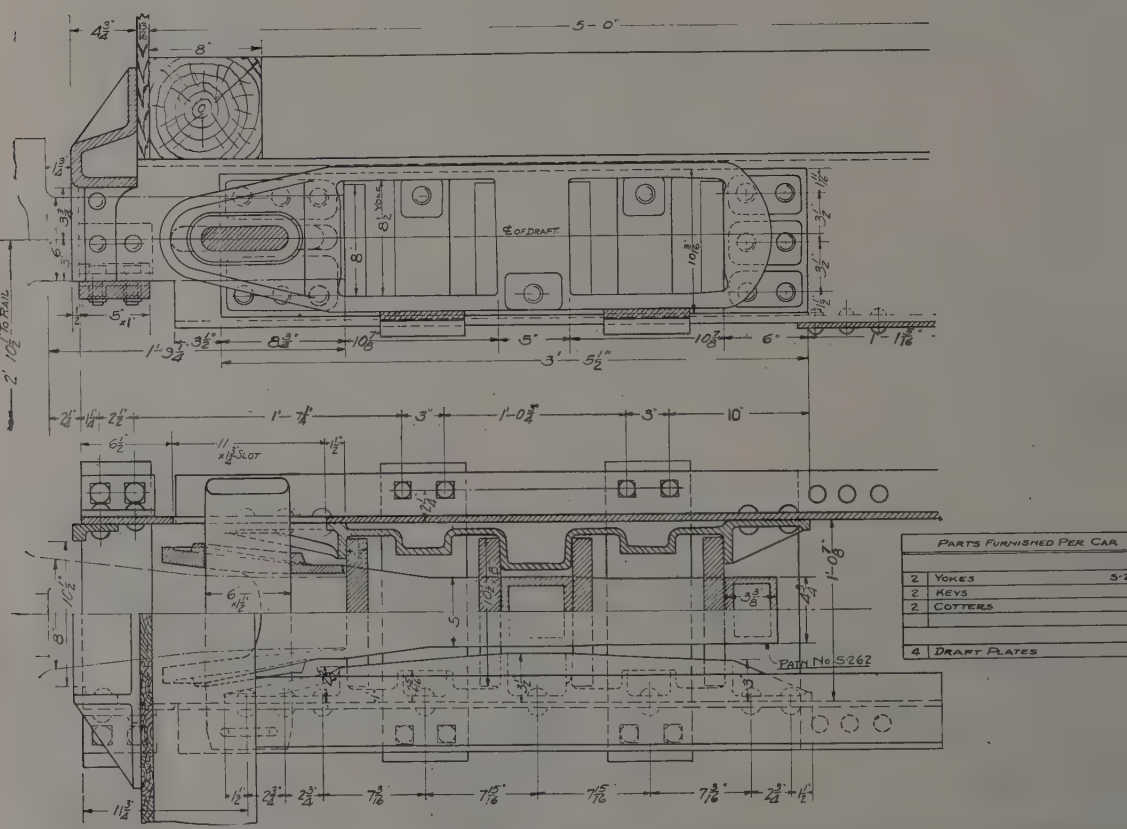


Fig. 1218—Universal Tandem Spring Draft Rigging with Keyed Yoke having Integral Follower Plate Separator.

Universal Draft Gear Attachment Company

(See also Pages 551, 553-556.)

Universal Draft Lugs and Plates

The large increase in steel and composite cars using structural shapes for car sills has made necessary the use of standard lugs and plates to connect the draft gear to the center or draft sills.

The Universal Draft Gear Attachment Company has for a long time made a study of these attachments and has designed lugs and plates for application to every modern type of draft gear regardless of its capacity.

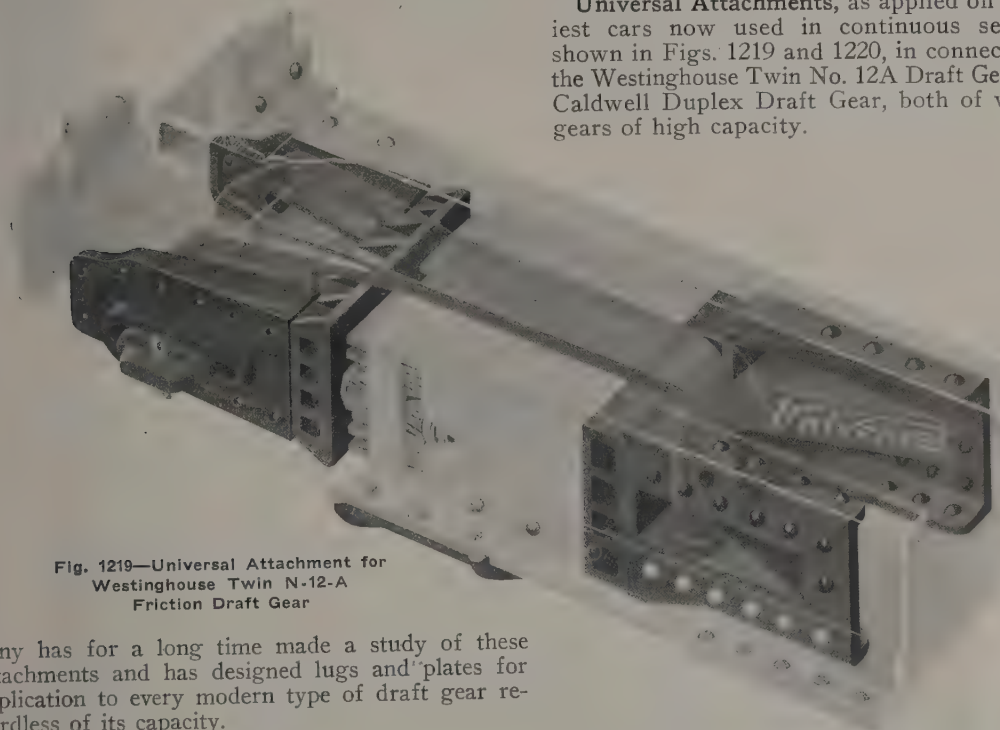


Fig. 1219—Universal Attachment for Westinghouse Twin N-12-A Friction Draft Gear

The Universal Draft Gear Attachment Company also furnish plates for any type of draft gear in use on railway cars.

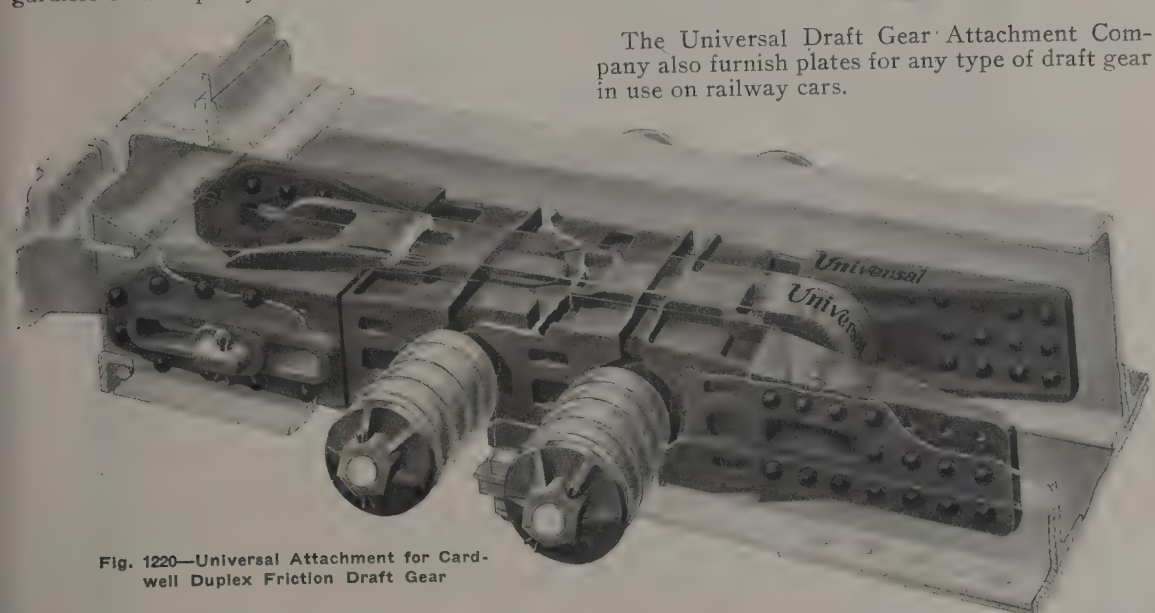


Fig. 1220—Universal Attachment for Cardwell Duplex Friction Draft Gear

Universal Draft Lugs and Plates are designed for strength, simplicity and long life. The front lugs, where used with keyed yokes are thimbled around the draft key and pass through the draft sills.

This increased bearing surface gives greater resistance to shear and provides a wide unbroken bearing area for the key. The rear lugs are made with the Universal fold which greatly stiffens and strengthens the lug, providing reinforcement right where it is needed.

Universal Attachments, as applied on the heaviest cars now used in continuous service are shown in Figs. 1219 and 1220, in connection with the Westinghouse Twin No. 12A Draft Gear and the Caldwell Duplex Draft Gear, both of which are gears of high capacity.

Universal Attachments which are refinements in design are in general use throughout the country on thousands of cars.

For other products and branch offices, see classified and alphabetical indexes.

UNIVERSAL DRAFT GEAR ATTACHMENT CO., CHICAGO, ILL.

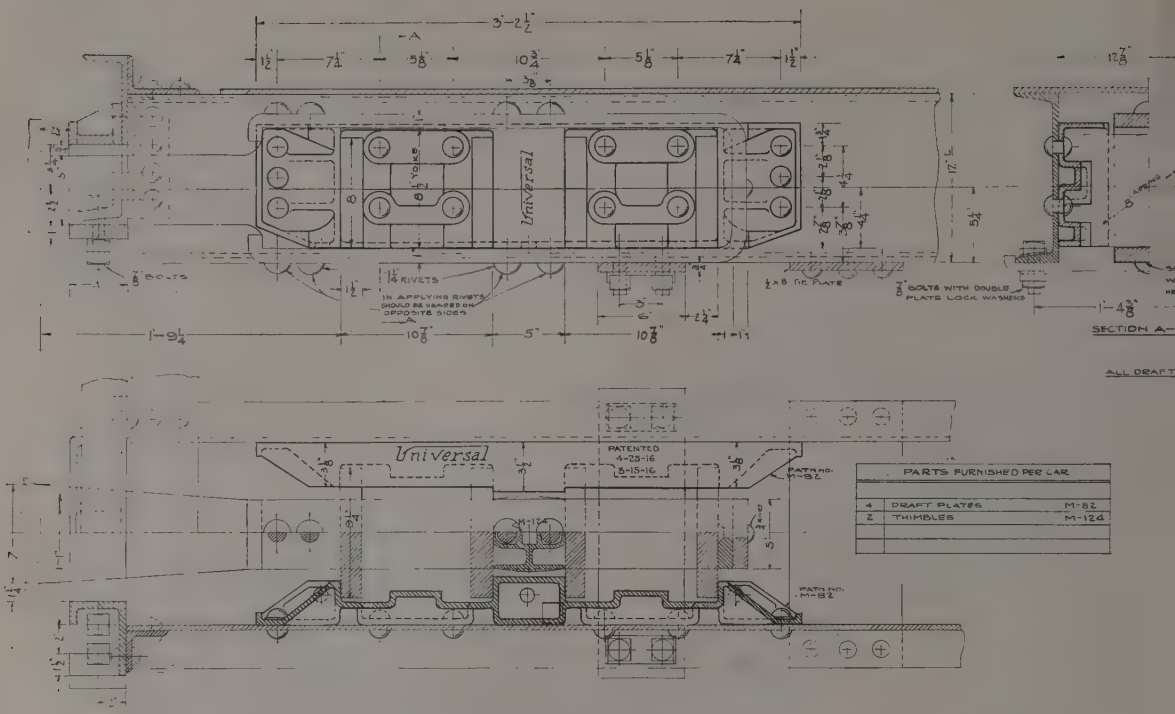


Fig. 1221—Universal Tandem Spring Rigging with Riveted Connection for Yoke and Follower Plate Separator.

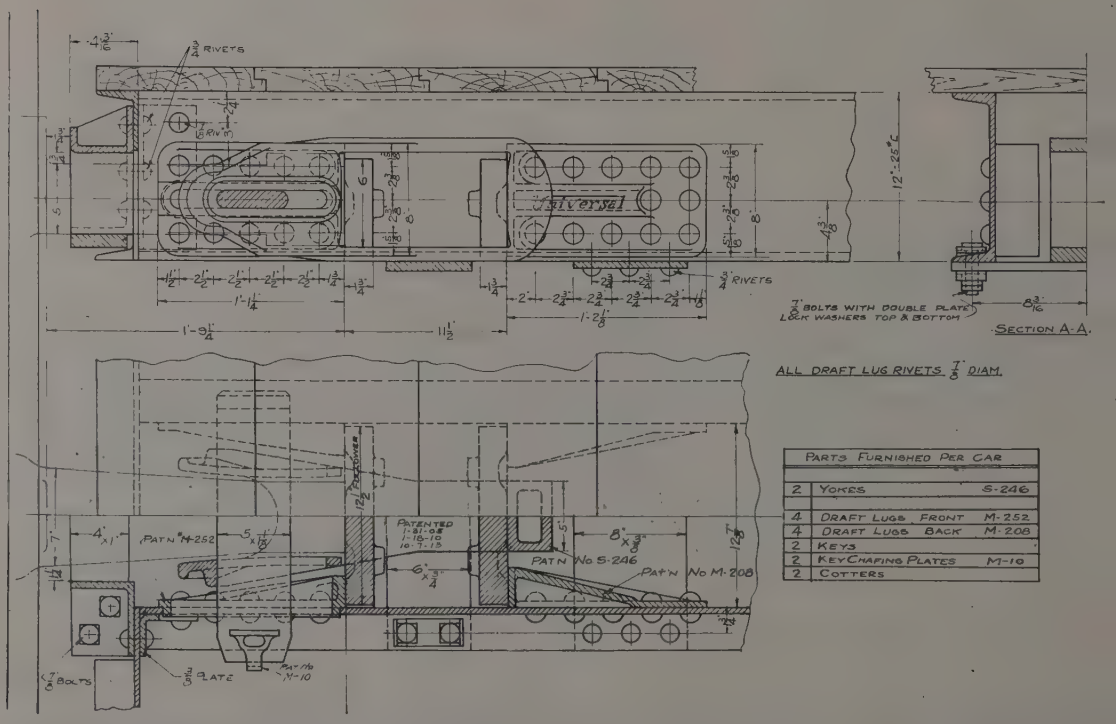


Fig. 1222—Universal Twin Spring Draft Rigging, Keyed Yoke and Draft Lugs, for 6¼ x 8" Springs for Ligh Capacity Cars.

Universal Draft Gear Attachment Company.

(*See also Page* 555)

Universal Draft Gear Yokes and Rigging

The advent of steel underframe cars transferred the weak points in a car train from the draft sills to the yokes and couplers. Rivets used for securing yokes to drawbars have been a source of annoyance; to produce best results a rivet must hold tightly, but the connection between yokes and couplers on the other hand should be flexible. The rivets not only become loose, reducing efficiency, but they often shear thus breaking the joint and causing delay in train service. A flexible connection if strong and easily installed is therefore more efficient and reliable.

The Universal Keyed and Rivles Cast Steel Yokes meet this demand. They are designed with the view of eliminating coupler rivets—and the corresponding necessary blacksmith labor, shop handling, etc.—; quick and economical exchange of couplers without disturbing yokes or draft gear; and greater strength and flexibility than is possessed by ordinary wrought yokes riveted to the couplers.

Universal Yokes are thoroughly heat treated and are practically unbreakable so that the weak point of the car train is invariably shifted to the couplers. The couplers, keyed to the yokes, can be replaced in a few minutes without disturbing the draft rigging or other parts of the car.

Universal Yokes permit the backward movement of couplers, as in buff, without corresponding movement themselves, except when used with the tandem type of draft rigging requiring follower plate separators. This is a very important feature, as it lessens the wear of parts and permits the application of draft gear in space otherwise prohibitive.

The Universal Keyed Yoke is the most desirable type as the key passing through the side sills provides an additional safety feature.

Universal Rivles Yoke, which may be used on old cars without changing their construction, engages the gibs of the couplers permitting the use of couplers that are not key slotted and also allowing exchange of couplers without disturbing the draft gear or sending the car to the repair tracks.

It is conceded to be good practice to reduce to a minimum the classes and sizes of couplers and yokes needed in stock as repair parts. When couplers are riveted to the yokes, each coupler ready for service must have a yoke, but, as there are ten or more standard sizes and lengths of yokes, the investment in extra couplers and yokes when the riveted types are used, is entirely out of proportion to the active service rendered. To reduce the stock of repair parts it is only necessary to adopt the Universal Attachment System and use Universal Draft Gear Yokes.

The Universal Draft Gear Attachment Company pioneered one piece key connected cast steel yokes. They have been generally adopted and thousands of them are in use.

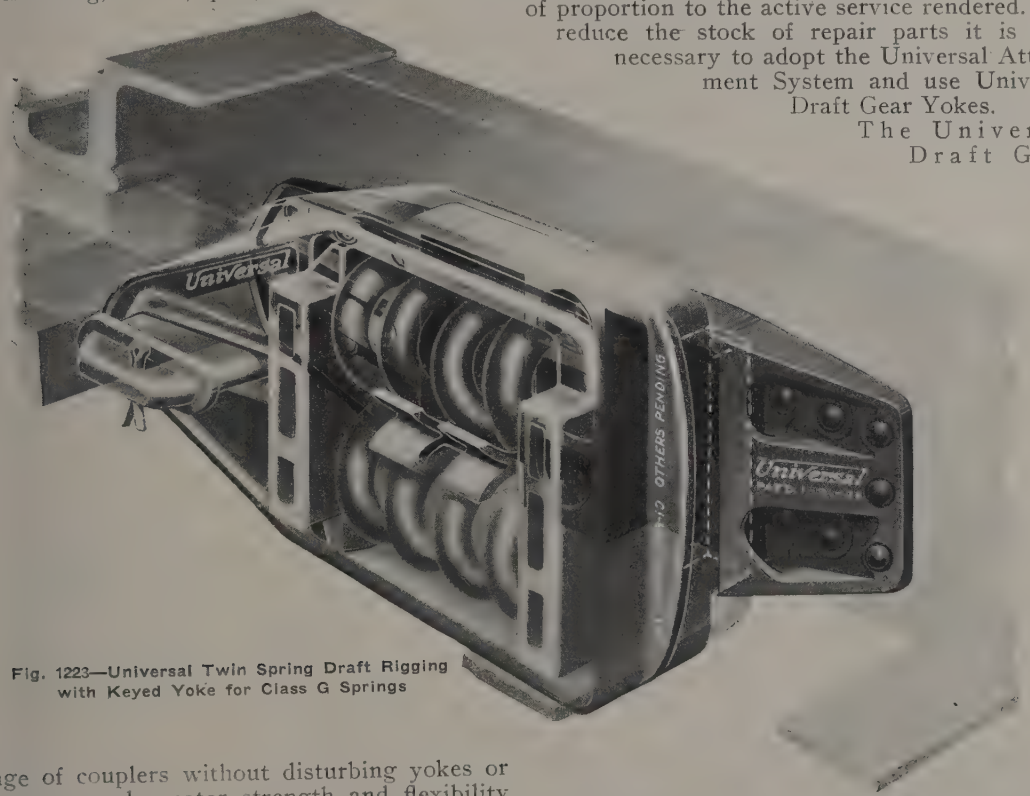


Fig. 1223—Universal Twin Spring Draft Rigging with Keyed Yoke for Class G Springs

Universal Spring Draft Gear Riggings are adaptable to all classes of cars, wooden or steel construction.

The Universal Twin Spring Rigging, shown in Fig. 1223, is simple, strong, compact, having a large bearing surface.

The Universal Tandem Spring Rigging as illustrated in Fig. 1218 is the latest design. The keyed yoke, with integral follower plate separator does away with the expensive and annoying failures so common with older types of this gear.

For other products and branch offices, see classified and alphabetical indexes.

UNIVERSAL DRAFT GEAR ATTACHMENT COMPANY, CHICAGO, ILL.

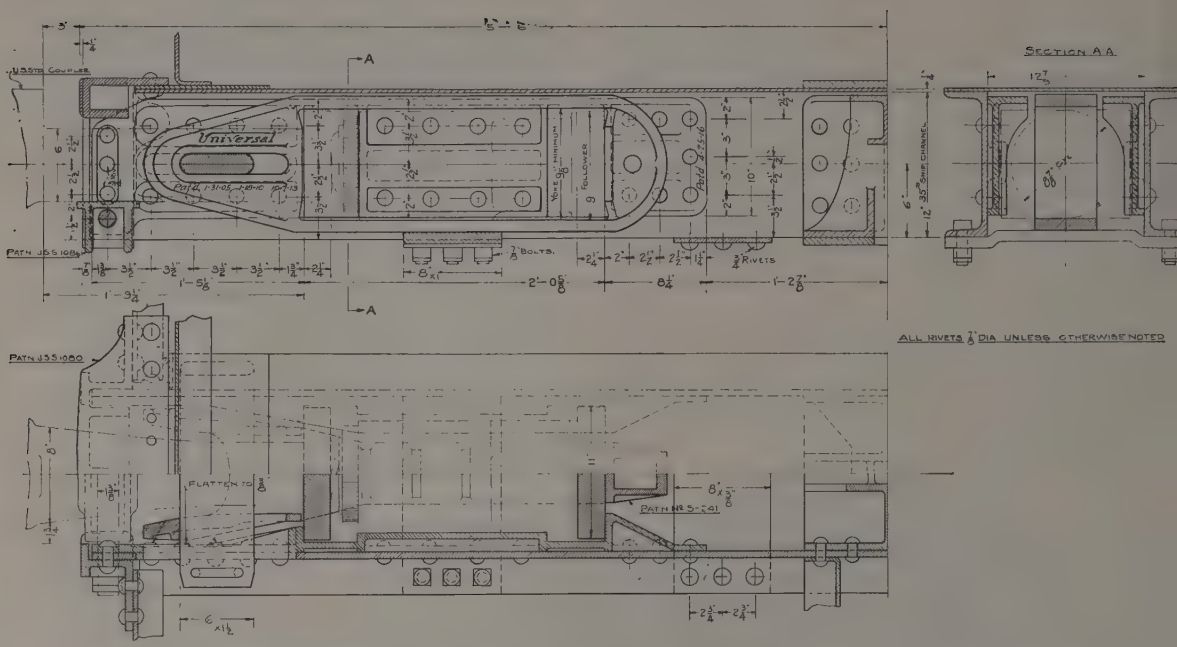


Fig. 1224—Universal Continuous Draft Plate and Keyed Yoke with Westinghouse D-4 Friction Draft Gear.

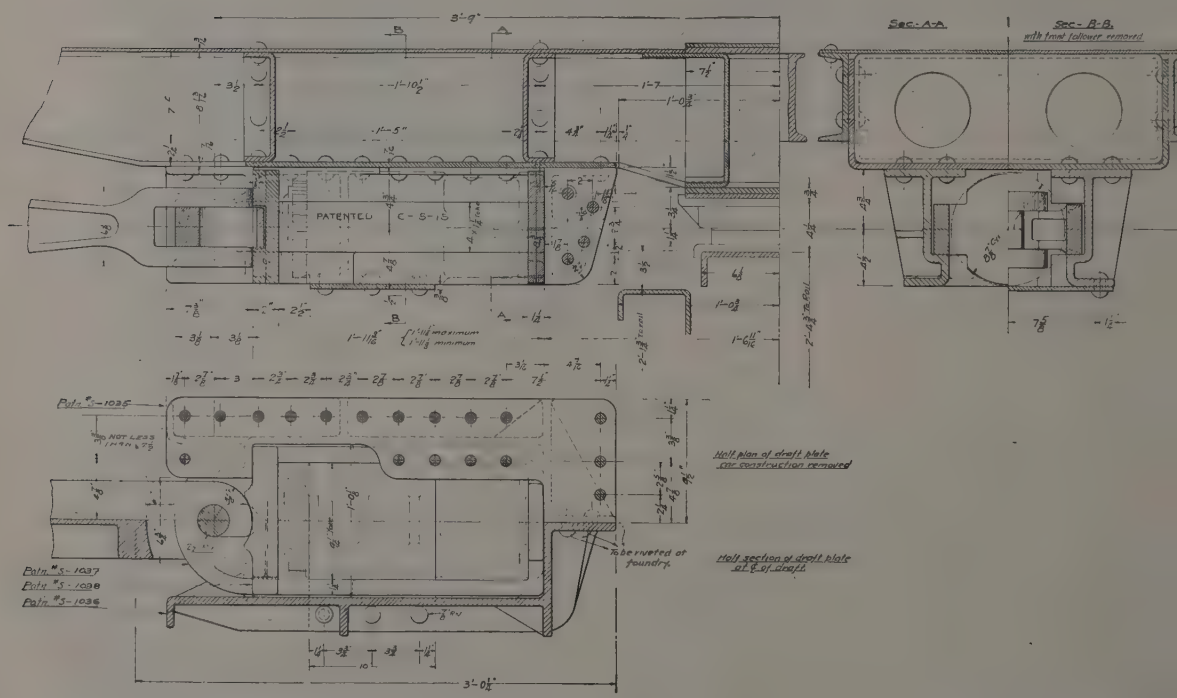


Fig. 1225—Universal Attachments with Westinghouse Friction Type "D" Gear for Elevated and Subway Cars.

Universal Draft Gear Attachment Company.

(*See also Pages* 551-555)

Couplers

THE STANDARD "D" TYPE COUPLER as adopted by the American Railway Association has now come into general use. Since its adoption as a standard of the Association, the rules governing the application to both new and existing cars, the performance of the couplers and gaging of the product has been followed closely.

Slight changes in detail of construction, as well as minor modifications in gages, that tend to improve the manufacture and gaging of the couplers, have been made from time to time.

The dates of revision in specifications are as follows:

Specifications for the M. C. B. Automatic Couplers were adopted as Recommended Practice by the former M. C. B. Association in 1899; revised in 1903. Revised and advanced to Standard in 1905; revised in 1909, 1911, 1912, 1913 and 1915.

In 1919 this specification was superseded by Specifications for Purchases and Acceptance of Type "D" Couplers. In 1922 changes in "Limiting Weights" were recommended by the Committee but as they were still to be submitted to letter ballot they are not given here.

The application of the Type "D" coupler to passenger train cars has also been given attention and is shown in Fig. 1246 on page 568.

Specifications for Purchase and Acceptance of A. R. A. Standard "D" Couplers

Standard—ADOPTED, 1918.

1. *Scope.*—These specifications cover all cast steel for complete couplers and for repair parts.

I. MANUFACTURE.

2. *Process.*—The steel shall be made by the open-hearth or electric-furnace process and in accordance with the best foundry methods.

3. *Heat Treatment.*—(a) Unless otherwise specified, all castings shall be allowed to become cold before the process of heat treatment (annealing). They shall then be uniformly heated to the proper temperature to refine the grain and cooled uniformly in the atmosphere.

(b) If the results of physical tests of any melt do not conform to the requirements specified, a manufacturer may re-treat such melt, but not more than two additional times. Tests after re-annealing shall be made as specified in Sections 7 and 8.

4. *Annealing Test Lugs and Physical Test Coupons.*—(a) For the purpose of determining the quality of annealing, annealing lugs shall be cast with and attached to each casting when presented for inspection. The location of the annealing lugs shall be as shown by Figs. 1229-1231.

(b) A sufficient number of test coupons to provide a test for each melt shall be cast with and attached to the coupler bodies or knuckles when presented for inspection. The size of coupon shall be sufficient to insure a machined test piece as required in paragraph 11-c, and shall be cast on the coupler bodies or knuckles at a location optional with the manufacturer. The manufacturer shall keep a record of the coupler bodies and knuckles by serial or heat numbers which have been poured from a melt for the purpose of identifying each casting in that melt.

II. CHEMICAL PROPERTIES AND TESTS.

5. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon	0.20 to 0.35 per cent.
Manganese	not over 0.75 per cent.
Phosphorus	not over 0.05 per cent.
Sulphur	not over 0.05 per cent.

6. *Ladle Analysis.*—To determine whether the material conforms to the requirements specified in Section 5, an analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the test ingot. A copy of this analysis shall be given to the purchaser.

7. *Check Analysis.*—Check analysis may be made by the purchaser from drillings taken from the test coupons described in Section 4, paragraph (b), which have satisfactorily passed the physical requirements. These drillings shall be taken not less than ¼ in. beneath the surface. The phosphorus and sulphur content thus determined shall not exceed that specified in Section 5 by more than 20 per cent.

III. PHYSICAL PROPERTIES AND TESTS.

8. *Tension Tests.*—(a) The steel shall conform to the following minimum requirements as to tensile properties:

Tens. Str. lb. per sq. in.....60,000
Elastic Limit. lb. per sq. in....0.45 Tens. Str.
Elongation in 2 in.—per cent..1,400,000 not under 20%
Tens. Str.
Reduction of area, per cent...30

(b) The elastic limit shall be determined by an extensometer.

9. *Annealing.*—To determine the quality of annealing, the inspector will have not less than two of the annealing test lugs, preferably those farthest away from each other, nicked and broken off from each bar and knuckle for the examination of the fracture. If, in his opinion, the annealing has not been properly done, he will require the castings to be re-annealed as prescribed in Section 3. If, after annealing or re-annealing, any casting is so much out of gage as to require heating in order to bring it within the gage limits, it shall be re-annealed before it shall be accepted. In event of failure of the inspector and manufacturer to agree upon the quality of annealing as determined by the fracture, the matter shall be arbitrated by polishing and etching a portion of the annealing lug to develop the structure and examining this under the microscope. If the structure is in accordance with Fig. 1226 the material will be considered to be properly annealed, but if the structure is similar to that of Figs. 1227 or 1228, the manufacturer shall re-anneal the castings to produce a structure like Fig. 1226.

10. *Waiving Tests.*—Tests will be waived on orders for

NOTE.—These specifications replace specifications for M. C. B. Automatic Couplers adopted in 1899.

FIG. 1226—NORMAL ANNEALING MAGNIFIED 100 DIAMETERS.

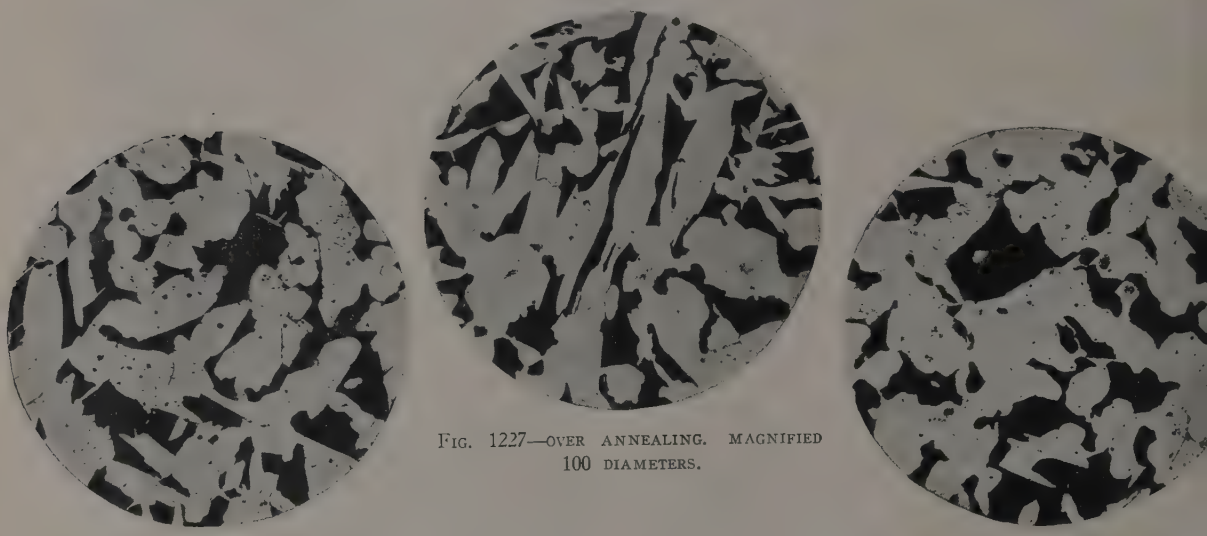


FIG. 1227—OVER ANNEALING. MAGNIFIED 100 DIAMETERS.

FIG. 1228—UNDER ANNEALING. MAGNIFIED 100 DIAMETERS.

less than ten (10) complete couplers or less than one hundred (100) parts other than bars, in which event all castings shall preferably be from the same melt, and the manufacturer shall furnish the purchaser a copy of his record showing satisfactory chemical analysis and physical properties obtained from the melt of steel in question, and the annealing lug showing his proof of the appearance of the fracture of the annealing lugs.

11. *Test Specimen.*—(a) Test specimens shall be obtained as prescribed in Section 4.

(b) When sufficient coupons have not been cast, a test specimen may be cut from the finished casting at a location mutually agreed upon by the inspector and the manufacturer, and this casting replaced in the lot.

(c) Tension test specimens shall be machined to ½ in. in diameter with a 2 in. gage length, with either blank or threaded ends to suit holder.

12. *Number of Tests.*—At least one chemical and physical test shall be made from each melt of steel represented.

13. *Tests of Knuckle Pivot Pins.*—For each two lots of 100 couplers or less, otherwise accepted, one pivot pin shall be removed from a complete coupler and subjected to the requirements of the A. R. A. Specifications for heat treated knuckle pivot pins. If this pin fails to pass the specifications, all pins in this lot of couplers will be rejected. Pins thus removed from the assembled couplers shall be replaced by the manufacturer by an additional pin after the test in order to complete the coupler.

14. *Grouping.*—The manufacturer shall have the material grouped in lots of 100 complete couplers or 100 detail parts, and this will be an inspection lot. Where possible, care should be taken to put all couplers of the same melt number in the same lot. The manufacturer should endeavor to cast as many parts from one melt on a given order as is possible.

IV. Variation in Weight and Gage.

15. *Weight.*—(a) One detail part of the lots as established by Section 14 shall be weighed and come within the limits as shown in the table. Failure of any part to come within the minimum weight shall reject that detail and each such detail in the entire lot so represented shall then be weighed and every piece less than the minimum weight shall be rejected.

Limiting Weights—"D" Coupler.

		Minimum Pounds.	Maximum Pounds.
Coupler bar—5-in. by 7-in. shank—9⅜-in. butt		265	285
Coupler bar—5-in. by 7-in. shank—6½-in. butt		259	279
Coupler bar—6-in. by 8-in. shank—6-in. butt		271	291
Solid knuckle—9-in. face		97	103
Cored knuckle—9-in. face		90	96
Solid knuckle—11-in. face		101	107
Cored knuckle—11-in. face		94	100
Lock		13.5	15.5
Complete coupler—5-in. by 7-in. shank—6½-in. butt	9-in. solid knuckle.	386	416
	9-in. cored knuckle.	379	409
Complete coupler—5-in. by 7-in. shank—9⅜-in. butt	9-in. solid knuckle.	392	422
	9-in. cored knuckle.	385	415
Complete coupler—6-in. by 8-in. shank—6-in. butt	9-in. solid knuckle.	398	428
	9-in. cored knuckle.	391	421
	11-in. solid knuckle.	402	432
	11-in. cored knuckle.	395	425

(b) When couplers are purchased complete and assembled, each assembled coupler shall be individually weighed and shall come within the limits shown. Detail parts shall come within the limits as shown, one coupler being dismantled in each 100 and weighed.

(c) When castings are more than the allowable maximum weight as shown in the table and all other requirements are satisfactory, castings may be accepted at the maximum allowable weight, excess weight being at the expense of the manufacturer.

16. *Gage.*—(a) Castings shall conform to the prescribed limits and gages. Five per cent of each lot of 100 or less, but in all cases at least one of the complete couplers or separate parts in each, shall be completely gaged. Assembled couplers shall be dismantled before gaging.

(b) Failure of any part in the lot to come within the gages or limits shall be sufficient cause to reject the lot so represented. Failure of a lot to meet the gages will not be sufficient cause to reject a re-offering of the same lot on the same order after the manufacturer has adjusted these parts to the gages. After this adjustment by the manufacturer, the inspector will then gage ten couplers or pieces selected at random in the lot, and failure of any to meet the gages will reject the entire lot, which will not again be offered.

(c) The inspector shall inspect and gage each coupler in a lot in order to determine if they comply to the contour gage.

(d) Gages referred to are listed above.

GAGES TO INSURE INTERCHANGEABILITY OF COUPLER PARTS.

Standard "D" Coupler.

Class I, Inspectors' Gages.—To be used by inspectors for rejection of couplers and parts not conforming to same.

	Drawing Number.	
1.	13242	Knuckle thrower gage.
2.	13815	Movable point knuckle gage.
3.	13818	Inspectors' contour gage, No. 10 contour.
4.	13906	Knuckle pin protector gage.
5.	14220	Knuckle hub gage.
6.	14413	Drawbar pulling lug gage.
7.	14414	Drawbar pin protector gage.
8.	14437	Knuckle tail height gage.
9.	14480	Drawbar lock chamber gage.
10.	14487	Drawbar lock hole gage.
11.	14491	Lock thickness gage.
12.	14492	Lock contour gage—guard arm side.
13.	14513	Drawbar pivot lug gage.
14.	14514	Top lock lift gage.
15.	14604	Lock contour gage—knuckle side.
16.	14628	Knuckle pulling lug gage for top half.
17.	14643	Knuckle pulling lug gage for bottom half.
18.	14690	Lock slot gage.
19.	14849	Minimum gage—1⅝ in. by 6⅛ in. key slot.
20.	14849	Maximum gage—1⅝ in. by 6⅛ in. key slot.

Class II, Checking Gages.—To be used by inspectors periodically, but not as rejection gages.

	Drawing Number.	
1.	13167	Top lock lift hole gage.
2.	14480	Maximum gage, lock chamber and lock hole.
3.	14511	Drawbar knuckle thrower hole gage.
4.	15077	Top operating anti-creep gage.

Note.—Drawings of the above gages are held by the Secretary.

V. Workmanship and Finish.

17. *Workmanship.*—(a) The castings shall conform to the size and shape as shown on A. R. A. Standard drawings and shall be finished in a workmanlike manner.

(b) When assembled, knuckles and locking pins or blocks must work freely, but the lost motion between knuckles and locks must be such that the knuckle cannot be pulled forward by hand beyond the proper contour line, but ⅛ to ¼ in. lost motion in opposite direction is desirable.

(c) In order to determine that the requirements of paragraph (b) have been complied with, not less than ten (10) couplers out of each lot of 100 shall be tried. Failure of any one to properly operate will be sufficient cause for rejection of the lot, but this does not prohibit the manufacturer re-offering the lot on the same order for inspection after adjustment, providing it is shown that all other requirements of the specifications have been complied with.

18. *Finish.*—The castings shall be free from blow holes, sand pockets, shrinkage cracks and other injurious defects.

19. *Sand or Shot Blast.*—All castings shall be properly

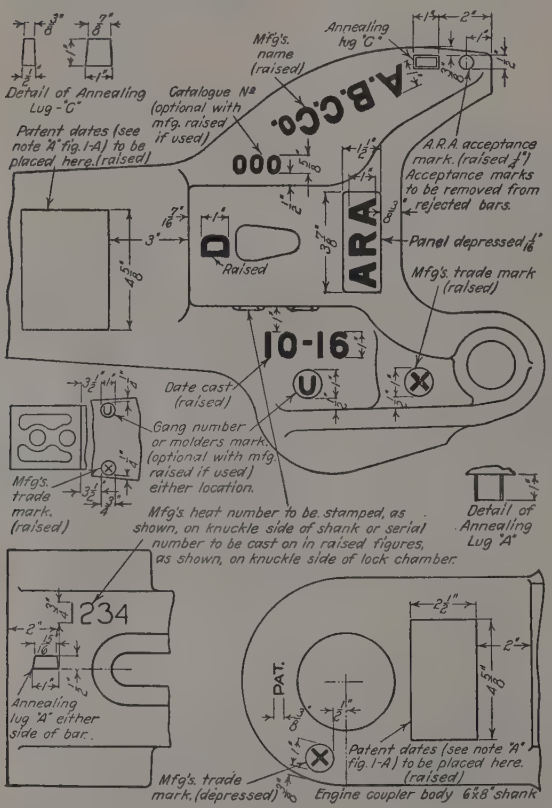

Detail of Annealing Lug "C"
Patent dates (see note "A" fig. 1-A) to be placed here. (raised)
Mfg's. name (raised)
Annealing lug "C"
Catalogue No. (optional with mfg. raised if used)
A.R.A. acceptance mark. (raised 1/4") Acceptance marks to be removed from rejected bars.
Panel depressed 1/16"
Raised
Mfg's. trade mark (raised)
10-16
Date cast (raised)
Gang number or molders mark (optional with mfg. raised if used) either location.
Mfg's. trade mark. (raised)
Mfg's. heat number to be stamped, as shown, on knuckle side of shank or serial number to be cast on in raised figures, as shown, on knuckle side of lock chamber.
Detail of Annealing Lug "A"
1234
Annealing lug "A" either side of bar.
PAT.
Patent dates (see note "A" fig. 1-A) to be placed here. (raised)
Mfg's. trade mark. (depressed)
Engine coupler body 6x8" shank

FIG. 1229.

cleaned by sand or shot blast or other approved process. The inspector may require that any or all castings again be subjected to sand or shot blast or cleaning in order to better examine for checks and shrinkage cracks which in his opinion would be detrimental to the strength of the castings.

20. *Welding.*—Welding minor imperfections which do not impair the strength of the castings will be permitted when done under the jurisdiction of the inspector and by a practice approved by him. All castings shall be reannealed after such welding.

21. *Painting.*—The castings as offered for inspection shall not be painted or covered with any substance that will hide defects, nor rusted to such an extent as to make defects invisible. If the castings are to be painted, it shall be so specified on the order, but this shall only be done after complete inspection and acceptance of the mate-

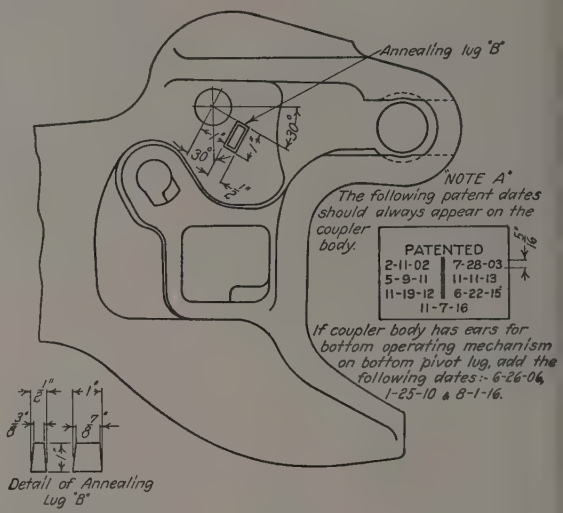

Annealing lug "B"
NOTE A
The following patent dates should always appear on the coupler body.
PATENTED
2-11-02 | 7-28-03
5-9-11 | 11-11-13
11-19-12 | 6-22-15
11-7-16
If coupler body has ears for bottom operating mechanism on bottom pivot lug, add the following dates:- 6-26-06, 1-25-10 & 8-1-16.
Detail of Annealing Lug "B"

FIG. 1230

rial by the inspector, and then with a quick-drying paint.

22. *Lubrication.*—Couplers when assembled shall be properly lubricated.

23. *Marking.*—(a) All parts shall have the manufacturer's name or identification mark, and when required, serial numbers, and such additional marking as shown on Fig. 1229-1234, cast legibly in letters or figures of size, manner

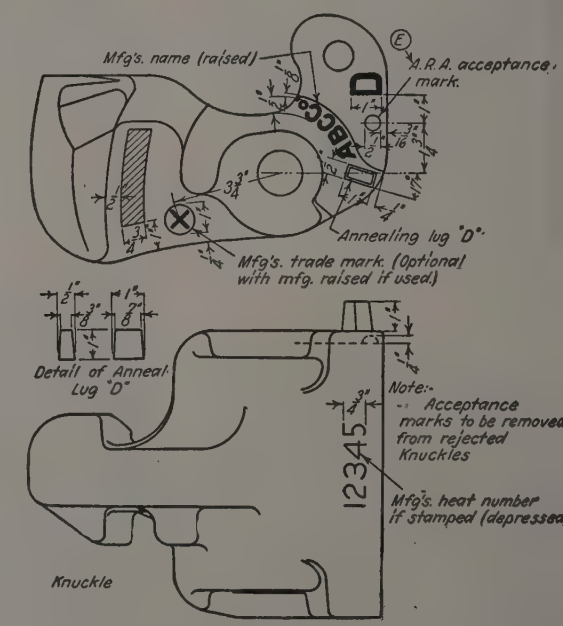

Mfg's. name (raised)
A.R.A. acceptance mark.
Annealing lug "D"
Mfg's. trade mark. (Optional with mfg. raised if used)
Detail of Anneal. Lug "D"
Note:- Acceptance marks to be removed from rejected Knuckles
12345
Mfg's. heat number if stamped (depressed)
Knuckle

FIG. 1231.

and location as specified. Manufacturer to give purchaser list of serials in each melt. When melt numbers are used in place of serial numbers they shall be legibly stamped on each piece in the melt.

(b) The serial number for each manufacturer, when used, shall begin with 1 and continue consecutively throughout the month, when a new series shall be started. In all cases, however, a new serial number shall start at the beginning of each month.

(c) After the material has been inspected and is ready to be shipped, the inspector shall stamp each casting with his private mark.

VI. Inspection and Rejection.

24. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture, test and inspection of the material ordered. The

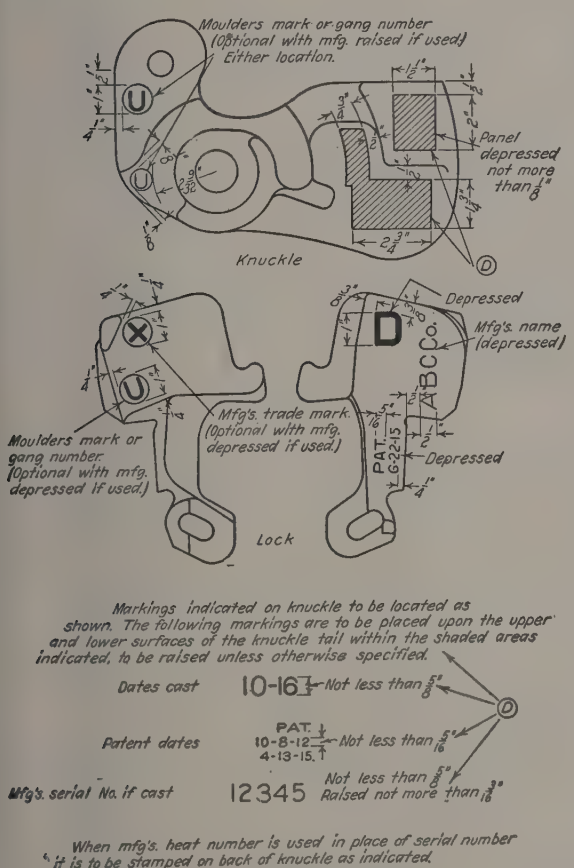

Moulders mark or gang number (Optional with mfg. raised if used) Either location.
Panel depressed not more than 1/8"
Knuckle
Depressed
Mfg's. name (depressed)
Mfg's. trade mark (Optional with mfg. depressed if used.)
Moulders mark or gang number (Optional with mfg. depressed if used.)
Depressed
Lock
Markings indicated on knuckle to be located as shown. The following markings are to be placed upon the upper and lower surfaces of the knuckle tail within the shaded areas indicated, to be raised unless otherwise specified.
Dates cast 10-16 Not less than 5/8"
Patent dates PAT. 10-8-12 4-13-15. Not less than 5/16"
Mfg's. serial No. if cast 12345 Not less than 5/8" Raised not more than 3/16"
When mfg's. heat number is used in place of serial number it is to be stamped on back of knuckle as indicated.

Fig. 1232.

manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy himself that the material is being furnished in accordance with the specifications.

(b) The purchaser may make the chemical tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such chemical tests, however, shall be made at the expense of the purchaser.

(c) The physical tests may be made at the plant of the manufacturer, providing the purchaser is satisfied with the accuracy of the test machine and that the pulling speeds for determining the elastic limit and ultimate strength are in accordance with the recommended practice of the A. S. T. M. for 2-in. test piece.

(d) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

(e) After the inspection and tests have been completed

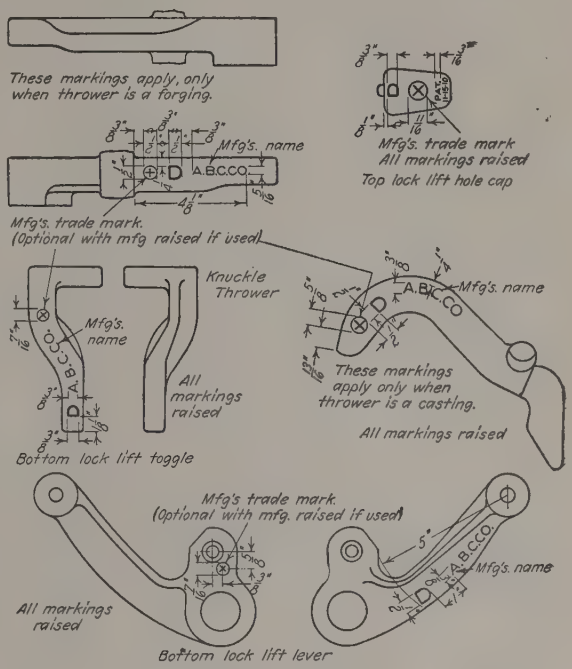

These markings apply, only when thrower is a forging.
Mfg's. name
Mfg's. trade mark
All markings raised
Top lock lift hole cap
Mfg's. trade mark. (Optional with mfg raised if used)
Knuckle Thrower
Mfg's. name
All markings raised
Bottom lock lift toggle
These markings apply only when thrower is a casting.
Mfg's. name
All markings raised
Mfg's trade mark (Optional with mfg. raised if used)
All markings raised
Mfg's. name
Bottom lock lift lever

Fig. 1233.

and before castings are loaded, at the option of the purchaser, all remaining annealing lugs shall be removed and surface where located put in a workmanlike condition.

25. *Rejections.*—(a) If any of the test coupons or annealing lugs selected to represent the melt do not conform to the requirements specified in Sections 7, 8 and 9, the lot will be rejected.

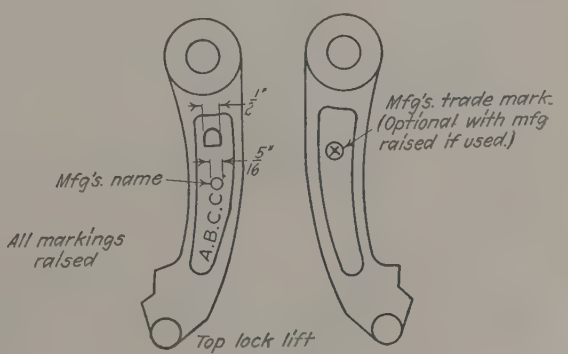


Fig. 1234.

(b) The basis of acceptance of physical tests shall be upon test coupons showing clean fracture without blow holes or imperfections and that break within the middle third or gage length. In event the test coupon is imperfect or breaks outside of the middle third of the gage

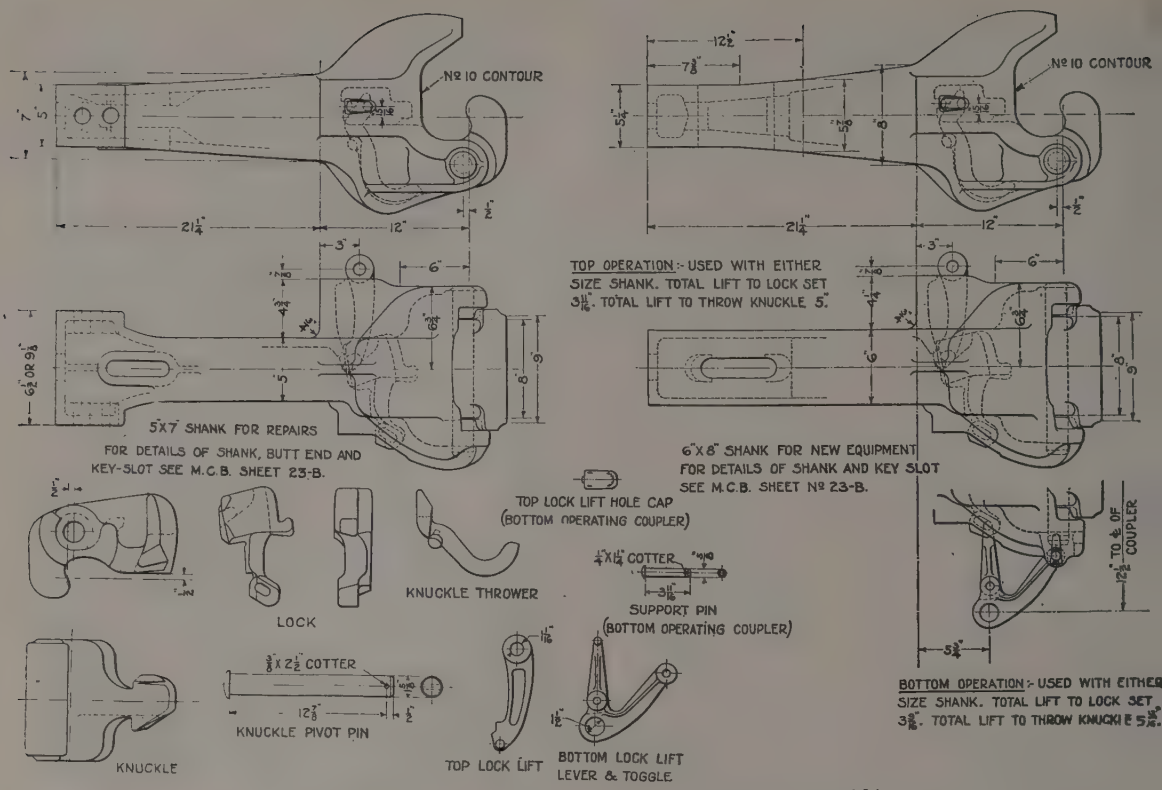

№ 10 CONTOUR
5"X7" SHANK FOR REPAIRS
FOR DETAILS OF SHANK, BUTT END AND KEY-SLOT SEE M.C.B. SHEET 23-B.
TOP OPERATION:- USED WITH EITHER SIZE SHANK. TOTAL LIFT TO LOCK SET 3 1/16". TOTAL LIFT TO THROW KNUCKLE 5".
6"X8" SHANK FOR NEW EQUIPMENT
FOR DETAILS OF SHANK AND KEY SLOT SEE M.C.B. SHEET № 23-B.
TOP LOCK LIFT HOLE CAP (BOTTOM OPERATING COUPLER)
LOCK
KNUCKLE THROWER
¾"X1¼" COTTER
SUPPORT PIN (BOTTOM OPERATING COUPLER)
⅝"X2½" COTTER
KNUCKLE PIVOT PIN
KNUCKLE
TOP LOCK LIFT
BOTTOM LOCK LIFT LEVER & TOGGLE
BOTTOM OPERATION:- USED WITH EITHER SIZE SHANK. TOTAL LIFT TO LOCK SET 3 1/16". TOTAL LIFT TO THROW KNUCKLE 5".

FIG. 1235—M. C. B. STANDARD "D" COUPLER (M. C. B. SHEET 23.)

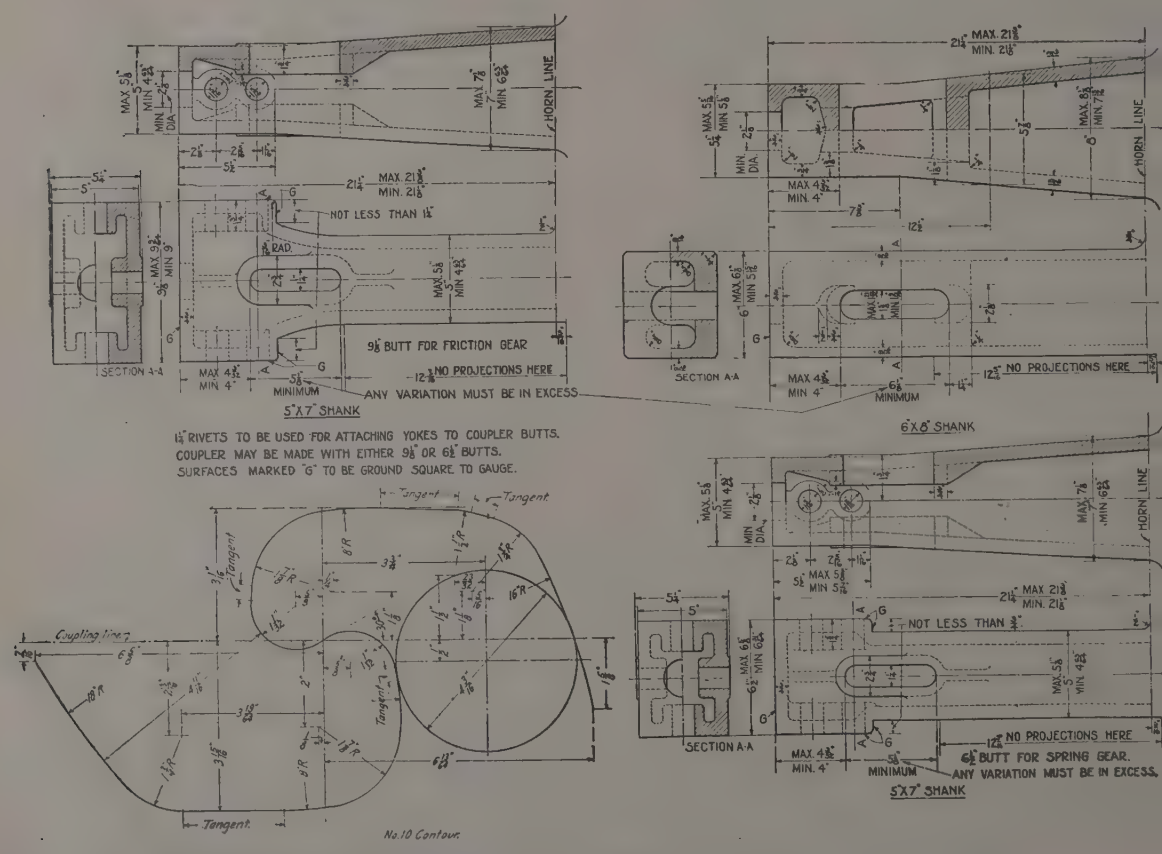

HORN LINE
NOT LESS THAN 1"
9⅛" BUTT FOR FRICTION GEAR
NO PROJECTIONS HERE
ANY VARIATION MUST BE IN EXCESS
5"X7" SHANK
1" RIVETS TO BE USED FOR ATTACHING YOKES TO COUPLER BUTTS.
COUPLER MAY BE MADE WITH EITHER 9⅛" OR 6½" BUTTS.
SURFACES MARKED "G" TO BE GROUND SQUARE TO GAUGE.
6"X8" SHANK
6½" BUTT FOR SPRING GEAR.
ANY VARIATION MUST BE IN EXCESS.
5"X7" SHANK
Coupling line
Tangent
No.10 Contour

FIG. 1236—STANDARD 6-IN. X 8-IN. AND 5-IN. X 7-IN. COUPLER SHANKS AND DETAIL OF NO. 10 CONTOUR.

length, additional test coupons shall be furnished but this shall be the only cause for rehearing for physical tests, except as specified in paragraph 3 (b).

(c) All castings which show any injurious defects or do not conform to the weights or gages shall be rejected.

(d) From each bar or knuckle rejected by the inspector under these specifications, he shall cause to be chipped the A. R. A. acceptance mark — Figs. 1229 and 1231.

Coupler Knuckle Pivot Pins

Standard—ADOPTED, 1917.

I. MANUFACTURE.

1. *Process.*—The steel shall be made by the open-hearth process.

2. *Heat Treatment.*—The pins shall be properly heat-treated to meet the requirements of the physical tests.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon	0.55—0.70 per cent.
Manganese, not over	0.60 per cent.
Phosphorus, not over	0.05 per cent.
Sulphur, not over	0.05 per cent.

4. *Ladle Analyses.*—An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative. This analysis shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—A check analysis shall be made from the finished material representing each melt, by the purchaser or his representative, and shall meet the requirements specified in Section 3.

III. PHYSICAL PROPERTIES AND TESTS.

6. *Drop Tests.*—This test shall be made on a standard A. R. A. drop-test machine, the pins resting on rounded supports held rigidly. 10 in. center to center, shall be subjected to one blow by a 1640-lb. tup dropping from a height of 3 ft., or a 2240-lb. tup dropping from a height of 2¼ ft., and shall show a deflection of not less than 15 deg. or more than 30 deg., without cracking or breaking.

7. *Number of Tests.*—The manufacturers shall furnish, free of charge, one extra pin with each lot of 200 or less.

IV. PERMISSIBLE VARIATIONS.

8. *Permissible Variations.*—The diameter of the pins shall conform to the standard A. R. A. limit gages for rounds. The length shall not vary more than ⅛ in. below or above that specified.

V. FINISH.

9. *Finish.*—The finished pin shall be straight, have a smooth surface, be uniform in diameter and shall not be painted.

VI. MARKINGS.

10. *Markings.*—The manufacturer's name or identification marks shall be stamped on the head of each pin.

VII. INSPECTION AND REJECTION.

11. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

12. *Rejection.*—Material which, subsequently to above tests at the mills or elsewhere, and its acceptance, develops weak spots, cracks or imperfections, or is found to have injurious defects, will be rejected and shall be replaced by the manufacturer at his own expense.

13. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Height of Couplers and Uncoupling Arrangement

Standard—ADOPTED, 1918.

The uncoupling arrangements for freight equipment cars built prior to January 1, 1919, were designed to conform to the requirements of the U. S. Safety Appliance Act as shown on plate B under the Safety Appliances for freight cars as shown in Section G of the A. R. A. manual.

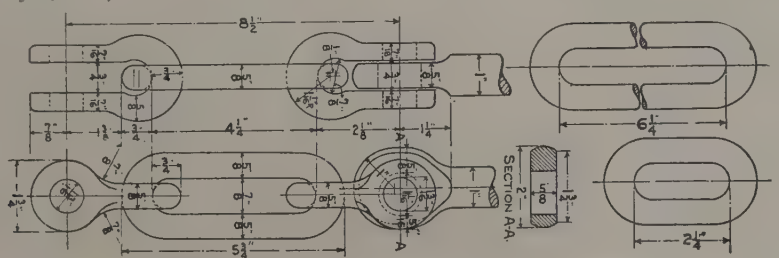


FIG. 1237—M. C. B. STANDARD UNCOUPLING ATTACHMENTS

The uncoupling arrangement for passenger equipment cars should be located on the left hand side of car facing the end of the car, the same as for freight equipment.

Coupler operating device for new freight cars and application of new design coupler operating device to existing freight cars must be of type directly connected to coupler locking block or locking block lifter without use of clevises, links, chain or pin and must conform to the detailed specifications prescribed in the United States Safety Appliance Standards.

Standard—ADOPTED, 1911.

The maximum height of drawbars for freight cars, measured perpendicularly from the level of top of rails

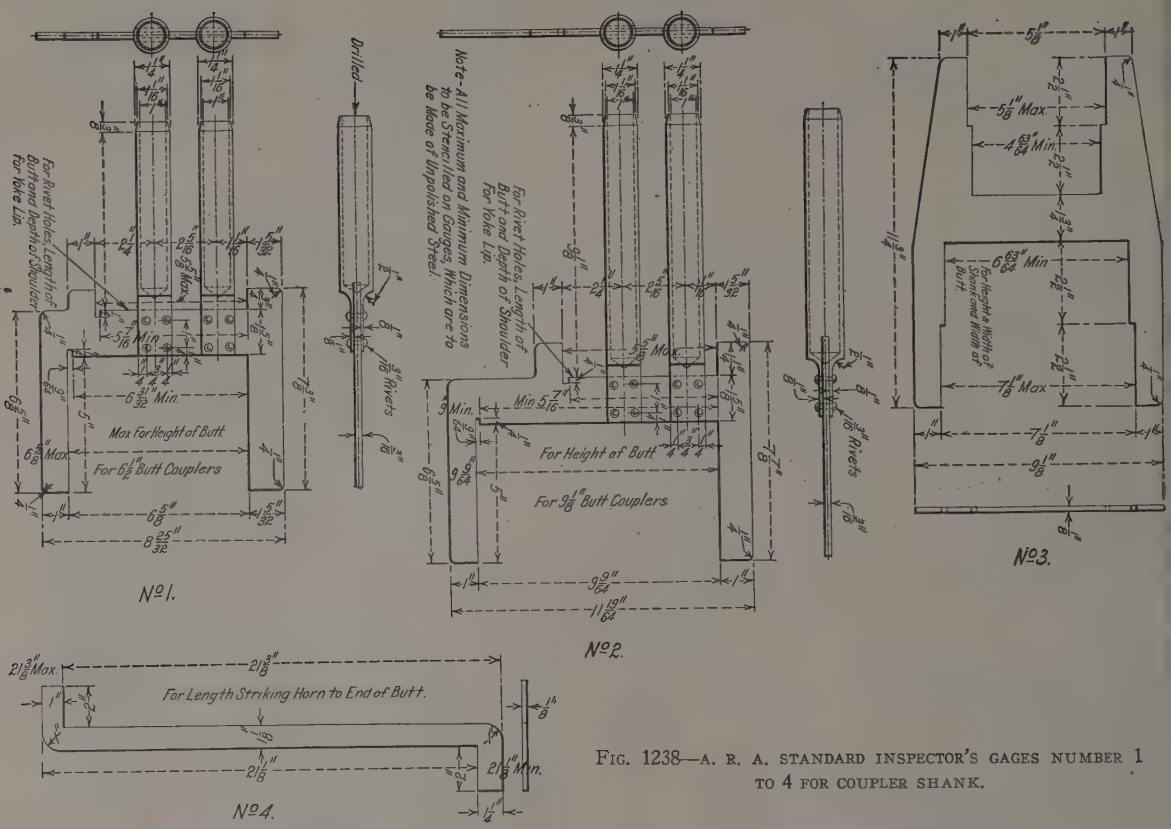


FIG. 1238—A. R. A. STANDARD INSPECTOR'S GAGES NUMBER 1 TO 4 FOR COUPLER SHANK.

to the center of drawbars for standard-gage railroads, shall be 34½ in., and the minimum height of drawbars for freight cars on such standard-gage railroads, measured in the same manner, shall be 31½ in. and on narrow gage railroads the maximum height of drawbars for freight cars, measured from the level of tops of rails to the center of drawbars, shall be 26 inches, and the minimum height of drawbars for freight cars on such narrow-gage railroads, measured in the same manner, shall be 23 in., and on 2-ft. gage railroads the maximum height of drawbars for freight cars, measured from the level of the tops of rails to center of drawbars, shall be 17½ in., and the minimum height of drawbars for freight cars on such 2-ft. gage railroads, measured in the same manner, shall be 14½ in.

The standard height of couplers for passenger equipment measured perpendicularly from the level of top of rails to center of drawbars shall be 35 in.

Standard—ADOPTED, 1901.

In adjusting the height of couplers to meet the requirements of the United States law fixing the height from the top of rail to center of coupler for standard gage cars in interstate traffic, cars should be adjusted when empty, as far as possible. In order to justify a bill for work done under the Rules of Interchange, an empty car should be adjusted to 34½ in., or within ¼ in. thereof, and when it is necessary to alter the loaded car it should be adjusted to 33½ in., or within ¼ in. thereof, or as near as possible to such height as will bring it to 34½ in. when the car is unloaded.

NOTE.—This standard conforms to the order of the Interstate Commerce Commission dated October 10, 1910.

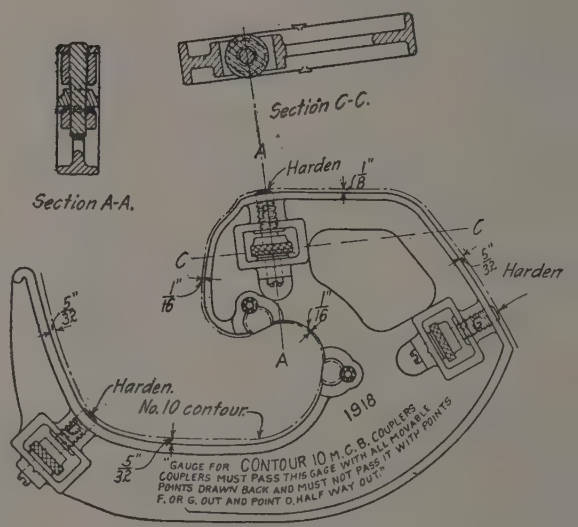

Section C-C.
Section A-A.
Harden
Harden
Harden.
No. 10 contour.
1918
"GAUGE FOR CONTOUR 10 M.C.B. COUPLERS COUPLERS MUST PASS THIS GAGE WITH ALL MOVABLE POINTS DRAWN BACK AND MUST NOT PASS IT WITH POINTS F. OR G. OUT AND POINT O. HALF WAY OUT."
Coupler Limit Gage.

FIG. 1239—INSPECTOR'S COUPLER LIMIT GAGE.

Coupler Tests

In 1900 the Master Car Builders' Association considered the testing of couplers and drawings of a proposed testing machine are shown on page 185 of the proceedings of that year. Subsequently changes were made and the testing machine as modified and adopted as standard in 1911 is shown in pages following; the tests are described in the Proceedings of 1915.

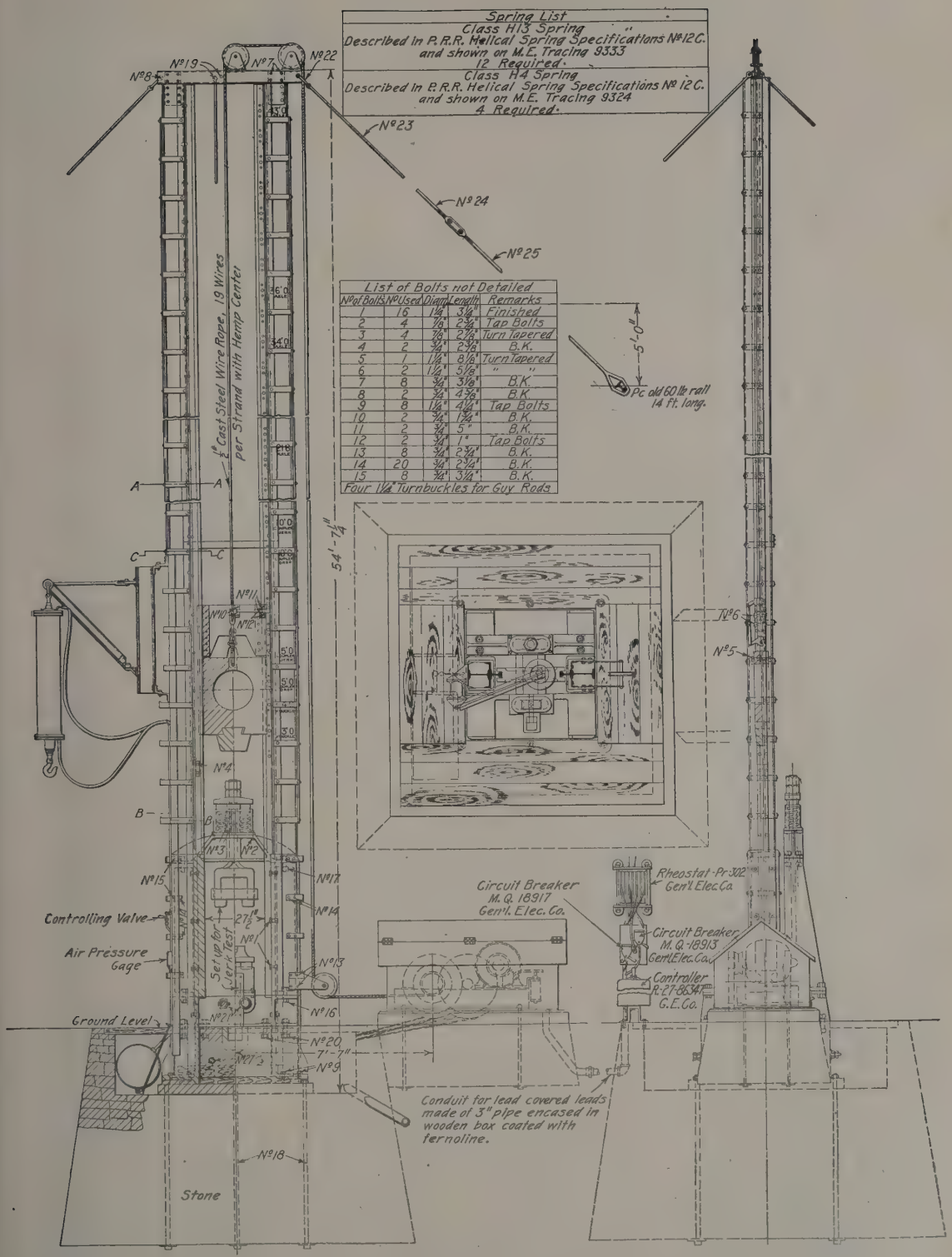

Spring List
Class H13 Spring
Described in P.R.R. Helical Spring Specifications No 12C. and shown on M.E. Tracing 9333
12 Required.
Class H4 Spring
Described in P.R.R. Helical Spring Specifications No 12C. and shown on M.E. Tracing 9324
4 Required.
List of Bolts not Detailed
No of Bolts | No Used | Diam | Length | Remarks
1 | 16 | 1" | 3½" | Finished
2 | 4 | ⅞" | 2¾" | Tap Bolts
3 | 4 | ⅞" | 2⅛" | Turn Tapered
4 | 2 | ¾" | 2⅜" | B.K.
5 | 1 | 1⅛" | 8⅛" | Turn Tapered
6 | 2 | 1½" | 5⅛" | " "
7 | 8 | ¾" | 3⅛" | B.K.
8 | 2 | ¾" | 4⅜" | B.K.
9 | 8 | 1⅛" | 4½" | Tap Bolts
10 | 2 | ¾" | 1¾" | B.K.
11 | 2 | ¾" | 5" | B.K.
12 | 2 | ¾" | 1" | Tap Bolts
13 | 8 | ¾" | 2¾" | B.K.
14 | 20 | ¾" | 2¼" | B.K.
15 | 8 | ¾" | 3¼" | B.K.
Four 1½" Turnbuckles for Guy Rods
No 19
No 7
No 22
No 8
No 23
No 24
No 25
1" Cast Steel Wire Rope, 19 Wires per Strand with Hemp Center
5'-0"
Pc old 60 lb rail 14 ft. long.
54'-7¼"
A
C
B
No 11
No 10
No 12
No 6
No 5
No 4
No 3
No 2
No 15
No 17
No 14
No 1
No 13
No 16
No 20
No 21
No 9
No 18
Controlling Valve
Air Pressure Gage
Set up for Work Test
27½"
Ground Level
Stone
7'-7"
Circuit Breaker M.Q. 18917 Gen'l. Elec. Co.
Rheostat Pr 302 Gen'l Elec Co
Circuit Breaker M.Q. 18913 Gen'l Elec Co.
Controller R 27 8634 G.E. Co.
Conduit for lead covered leads made of 3" pipe encased in wooden box coated with terroline.

Fig. 1240—General Arrangement of Standard Drop Test Machine for A. R. A. Couplers and Axles.

(*See also Figs.* 1241-1245.)

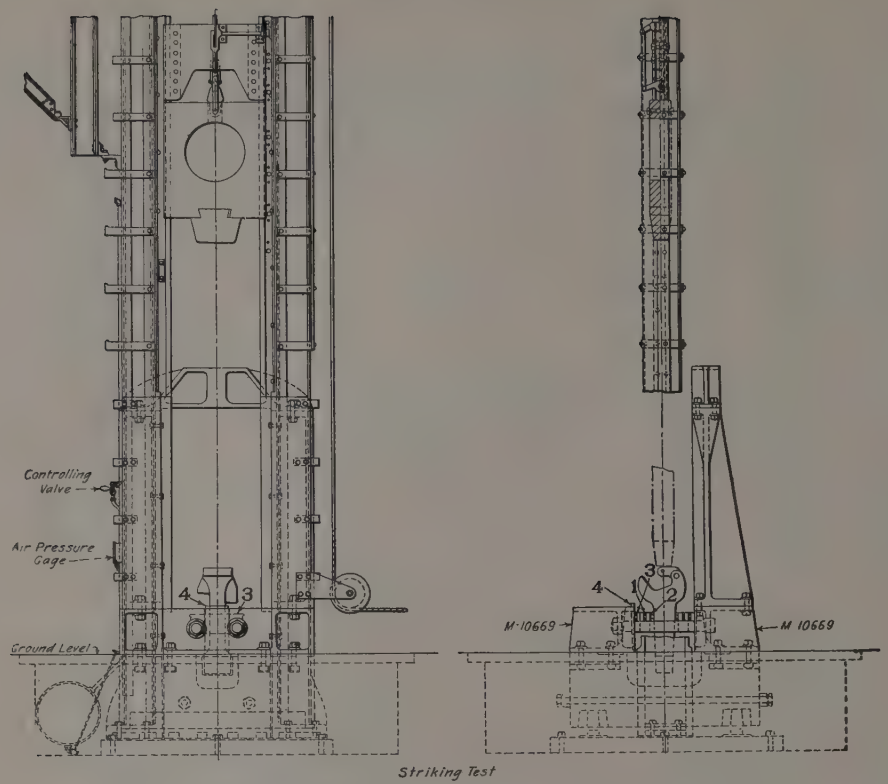
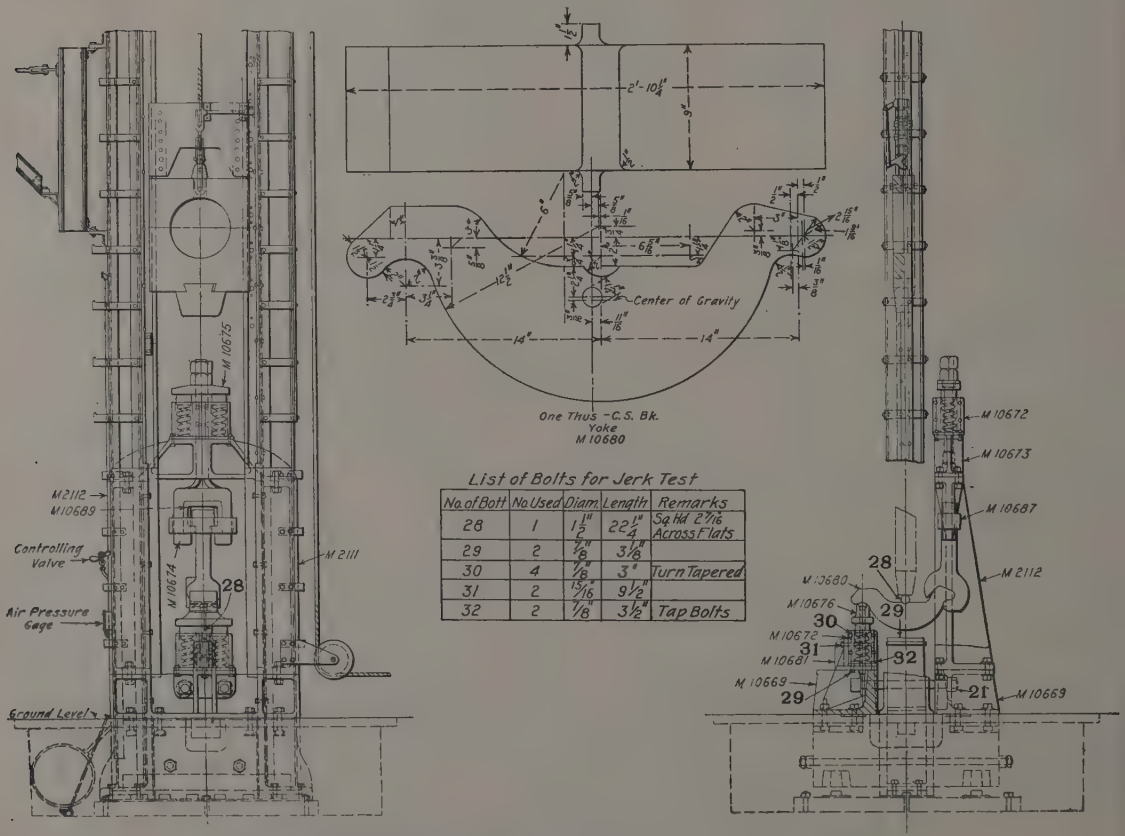


Fig. 1241—Details for Standard Striking Test for A. R. A. Couplers.



List of Bolts for Jerk Test

No. of Bolt	No. Used	Diam.	Length	Remarks
28	1	1½"	22¼"	Sq. Hd 2 7/16 Across Flats
29	2	⅞"	3⅛"	
30	4	⅞"	3"	Turn Tapered
31	2	15/16"	9½"	
32	2	⅛"	3½"	Tap Bolts

Fig. 1242—Details for Standard Jerk Test for A. R. A. Couplers.

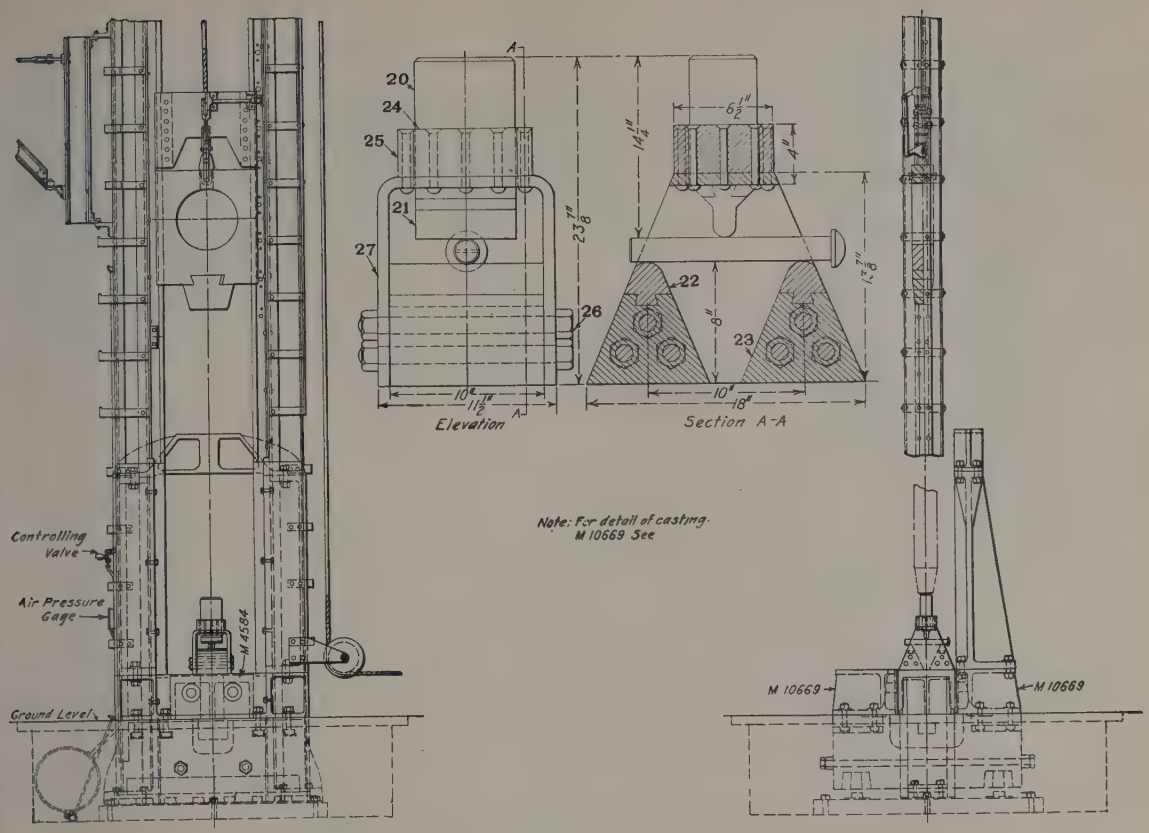


Fig. 1243—Details for Standard A. R. A. Knuckle Pin Test.

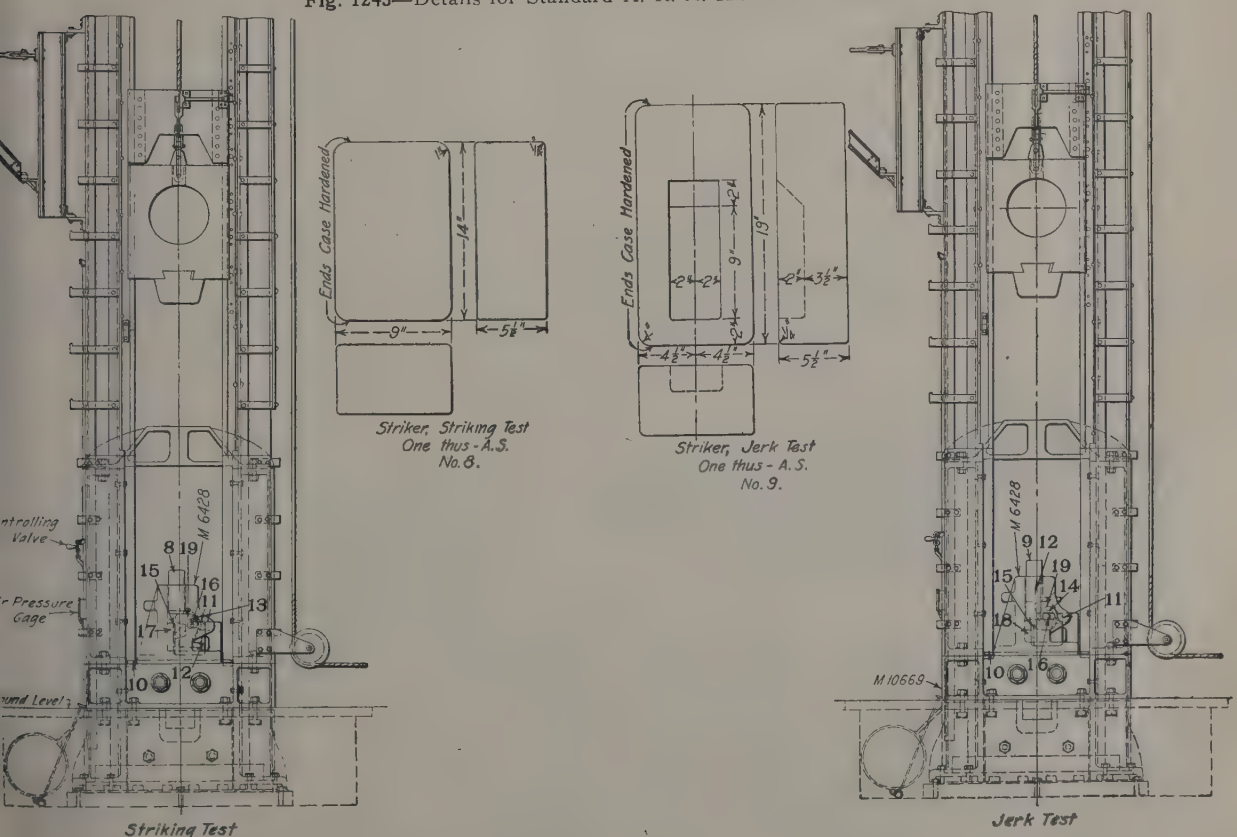


Fig. 1244—Details for A. R. A. Standard Separate Knuckle Test.

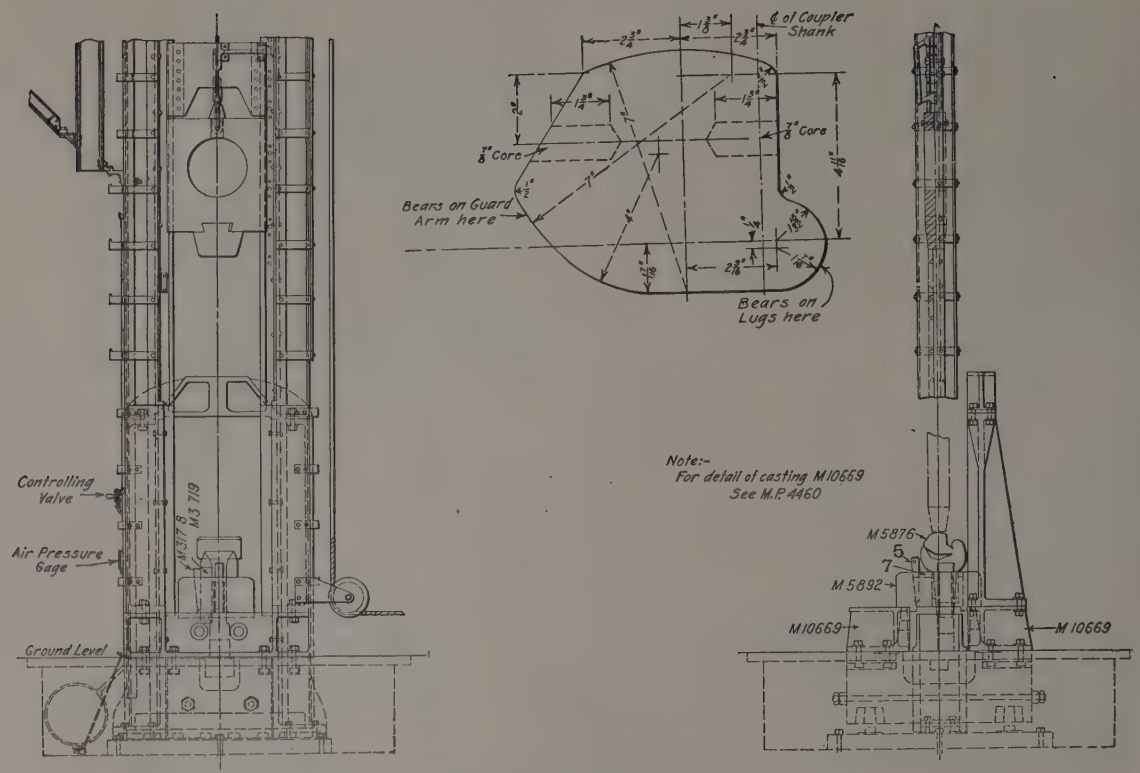


Fig. 1245—Details for Standard Face Test for A. R. A. Couplers. (A. R. A. Sheet 29C.)

(*See also Figs.* 1240-1244)

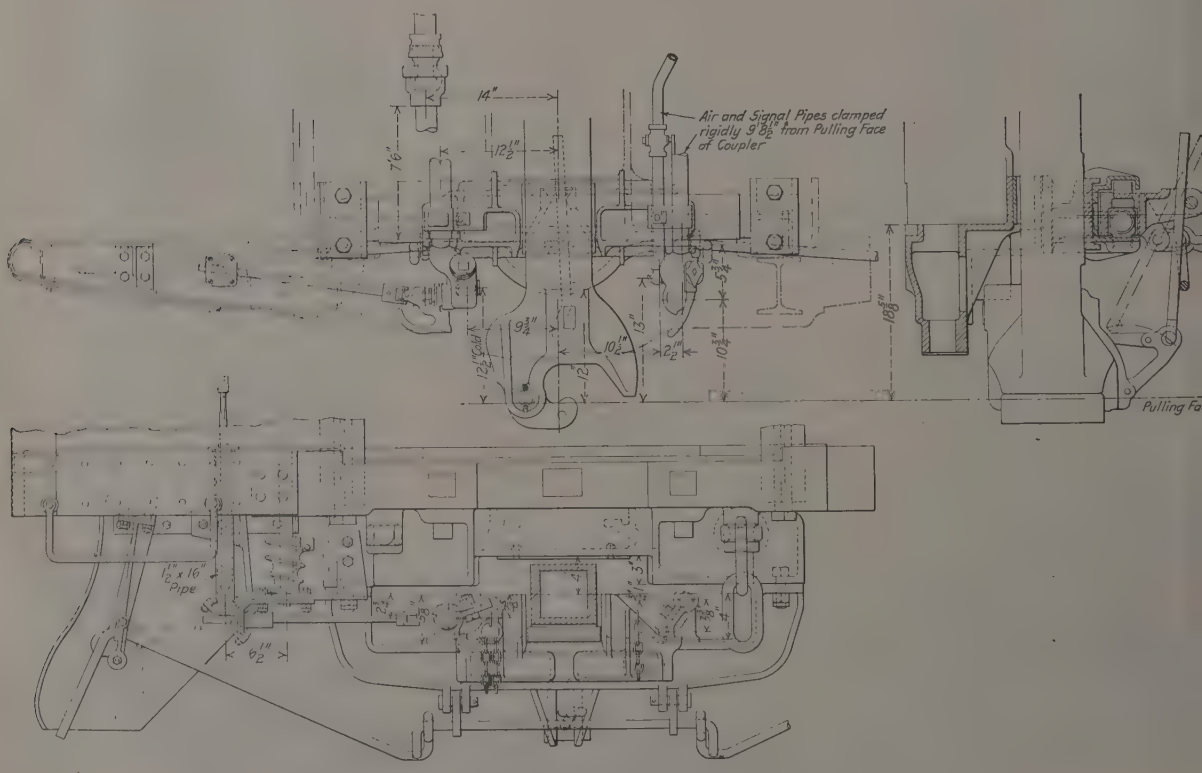
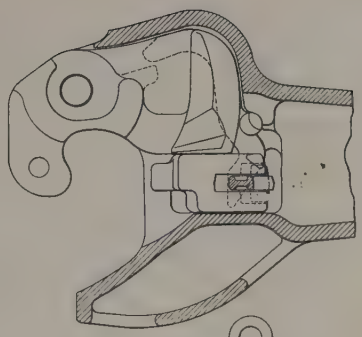
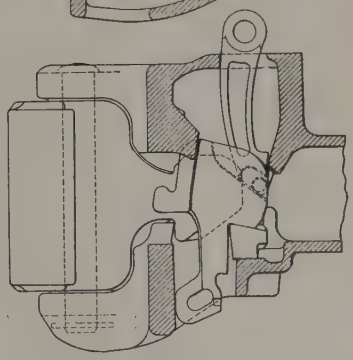
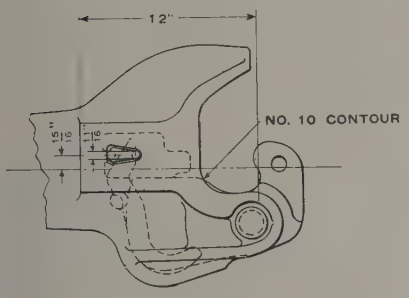


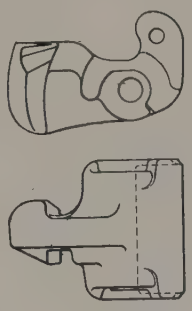
Fig. 1246—Application of A. R. A. Standard "D" Coupler to Pullman Passenger Cars.

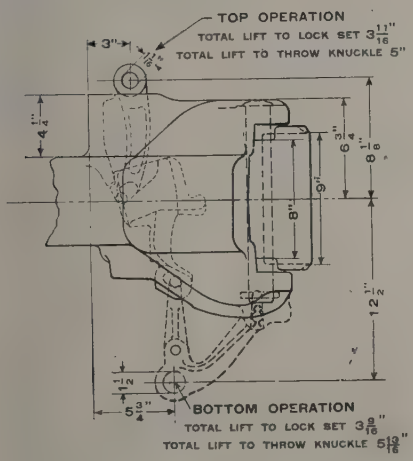
Top Operating, A. R. A. Standard "D" Coupler with Standard 6" x 8" Shank.

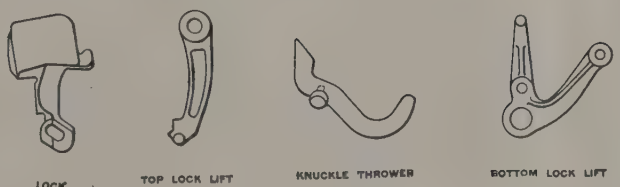


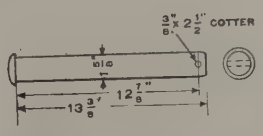


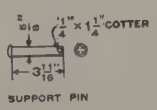


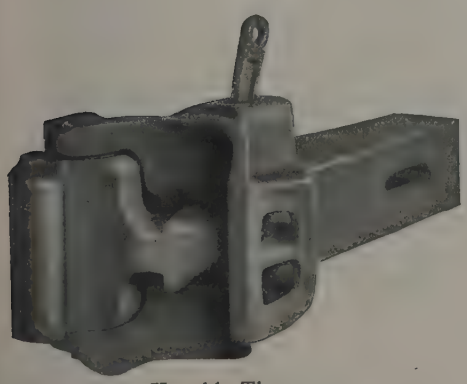



TOP OPERATION
TOTAL LIFT TO LOCK SET 3 11/16"
TOTAL LIFT TO THROW KNUCKLE 5"
3"
BOTTOM OPERATION
TOTAL LIFT TO LOCK SET 3 3/16"
TOTAL LIFT TO THROW KNUCKLE 5 13/16"









Knuckle Thrown

Bottom Operating "D" Coupler

Fig. 1247—The A. R. A. Standard "D" Coupler and Parts. American Steel Foundries. Buckeye Steel Castings Company, Gould Coupler Company, McConway & Torley Company, The National Malleable Castings Company.

(*See also Pages* 570-573)

The A. R. A. Standard "D" Coupler

The A. R. A. Standard "D" Coupler became a standard of the Master Car Builders' Association—now part of Division V Mechanical, of the American Railway Association—by letter ballot in July, 1916, and represents the culmination of years of painstaking joint effort on the part of the Association and the several coupler manufacturers.

The design and adoption of the present A. R. A. Standard Coupler has had a threefold purpose:

First, the elimination of the many types of couplers now in use by the selection and substitution of one standard form.

Second, the increase in strength of the new design without resorting to special steels to a point sufficient to meet the increasing demands of service, which on many roads has far exceeded the limits of M.C.B. couplers in ordinary materials.

Third, the increase in efficiency of operation of the new design of coupler, to insure the fullest possible realization in service of all its automatic features.

The first purpose—the reduction to one type—brings in the question of the repair part problem in all its phases. The advantage to the railroads, of carrying but one type of parts or complete couplers for repairs to cars in interchange is so well known as to need no explanation. The saving in cost to any given road by releasing capital which now must be invested in a multiplicity of types of repair couplers is very considerable (see remarks of Mr. Brazier in 1909 Master Car Builders' Proceedings), and can be estimated with a fair degree of accuracy in any particular case. The saving in train delays at places far distant from repair points, by reason of having but one type of coupler to repair, is very great indeed, and is impossible to calculate. The elimination of the multiplicity of designs will tend to make it much simpler to maintain the one standard in proper repair. There will be but one kind of knuckle, one lock, etc., and campaigns of education among the trainmen can he carried out with greater success where but one type of coupler is under consideration.

The attainment of the second purpose—increase of strength to meet the present-day needs—has necessitated increased weight. The standard coupler, weighing approximately 400 lb., represents an increase in weight by approximately one-third, but this increase in weight of 33⅓ per cent has brought about a 100 per cent increase in strength with the material remaining unchanged. The Coupler Committee has stated that the estimated increased length of life in service of the new coupler will be about 300 per cent based upon observations of a number in actual service.

The accompanying table, showing results obtained from the various Coupler Committee's reports for 1912, 1913, 1914, 1915 and 1916, shows the actual comparison of laboratory tests made by the Coupler Committee, and proves without any doubt that the increase in weight of the standard coupler over the old types of couplers has been efficiently distributed, and that the increase in the strength of the standard coupler more than justifies the increase in weight.

Static Pull	Weight	Permanent Set "C" Knuckle opening after 150,000 lbs.	Ultimate Load	Knuckle opening at 150,000 lbs. per lb. weight of Coupler	Ultimate Load per lb. weight of Coupler
"Present"	292	.305"	261,725 lbs.	.00105"	896 lbs.
"D"	405	.028"	518,720 lbs.	.00007"	1279 lbs.
Dynamic Jerk		Permanent Set "C" after:		Inches Permanent Set "C" per lb. Weight of Coupler after:	
		Third blow at 10 feet	Final Measurement after additional blows	Third blow at 10 feet	Final Measurement after additional blows
"Present"	292	.359"	.515" (Avg. 5.5 blows at 10')	.00123"	.00176"
"D"	406.5	.125"	.508" (Avg. 80. blows at 10')	.00031"	.00125"
Dynamic Guard Arm		Permanent Set "A" after:		Inches Permanent Set "A" per lb. Weight of Coupler after:	
		Fourth blow at 5 feet	Final Measurement after additional blows	Fourth blow at 5 feet	Final Measurement after additional blows
"Present"	292	.371"	.562" (Avg. 5.3 blows at 5')	.00127"	.00192"
"D"	396.8	.063"	.333" (Avg. 55. blows at 5')	.00016"	.00084"
Dynamic Strike		Permanent Set "C" after:		Inches Permanent Set "C" per lb. Weight of Coupler after:	
		Third blow at 5 feet	Final Measurement after additional blows	Third blow at 5 feet	Final Measurement after additional blows
"Present"	292	.233"	1.135" (Avg. 4.8 blows at 10')	.00080"	.00389"
"D"	403	.025"	.61" (Avg. 22. blows at 10')	.00006"	.00151"

Weights for "Present" Couplers taken at average of 292 lbs. See Proceedings Master Car Builders' Association, Vol. 48, Part 1, 1914.

Weights for "D" Couplers taken at average for 5" x 7" shank. See Proceedings Master Car Builders' Association, Vol. 50, Part 1, 1916.

For dimensions "A" and "C," see Proceedings Master Car Builders' Association, Vol. 47, Part 1, p. 192, 1913.

Fig. 1248—Comparison of Laboratory Tests Made by Coupler Committees of the A. R. A.

The attainment of the third point—increased efficiency of operation—has been facilitated not only by the observation of large numbers of couplers in service during the trial period, but also by the use of a special machine upon which exhaustive tests have been conducted. This device called a service testing machine, operates a coupler through any desired number of cycles of knuckle throw, coupling by impact, lockset, pulling apart from lockset, and closing knuckle. The

Fig. 1249—The A. R. A. Standard "D" Coupler Knuckle Closed

The A. R. A. Standard "D" Coupler *Cont'd.*

type of coupler finally adopted was put through thirty thousand of such cycles, representing sixty thousand complete operations, without a single failure. This has been calculated as the equivalent of about eighty years of operation in actual service, and while the factors of shock and corrosion do not enter in, there is no question but that this test is one of greatest severity.

The coupler is shown in the accompanying Figs. 1252 to 1256, arranged for top operation, and in Figs. 1257 to 1259, arranged for bottom operation. The essential parts of the coupler are the body 1, knuckle 2, lock 3, knuckle thrower 4, and knuckle pin 5, each of which, except the body, remains unchanged for either type of operation. When equipped for top operation the lifter 6 is used and when the coupler is intended for bottom operation the bottom lock lifter 7 and toggle 8 are used, a cap covering the hole for the lifter 6 and lugs 9 provide a supporter for the lifter 7.

Fig. 1250—View of Knuckle from Locking Side

When in locked position—Fig. 1252—the lock rests upon the top of one end of the knuckle thrower 4, and its head is located between the knuckle tail and inner guard arm wall as shown in Fig. 1253. To lockset the lock, it is lifted either by the top lifter 6, or by the toggle 8, until the lockset seat *a* on the leg of the lock becomes level with the top surface of the knuckle thrower, whereupon the leg of the lock tips rearwardly and seats upon the knuckle thrower as shown in Fig. 1254.

In either top or bottom operating forms the lock is lifted at a point to the rear of its center of gravity so that there is always a tendency for the leg of

Fig. 1251—A. R. A. Standard "D" Coupler Head

the lock to swing rearwardly as soon as the lock is lifted. To throw the knuckle the lock is lifted above its lockset position until the fulcrum *b* upon its forward side strikes the shoulder *c* within the coupler head. The vertical movement of the lock is stopped by this contact, and the lock is thereafter forced to rotate about its fulcrum, which gives the lock leg a positive rearward movement, which in turn rotates the knuckle thrower about its trunnions *d*. The tip *e* of the thrower contacts the shoulder *f* on the underside of the knuckle and throws the knuckle open.

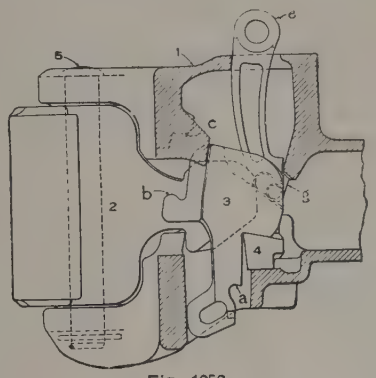


Fig. 1252

The lock-to-the-lock or anti-creep function is obtained in the top operated form by the co-operation of the lock lifter with the rear wall of the coupler head as shown in Fig. 1252. When the parts are locked the lifter slides rearwardly in the lock until its projection *g* underlies the lower edge of the rear wall of the coupler head. Any upward movement of the lock merely binds this projection between the lock and the rear wall. As soon as the lifter itself is raised, however, it slides forward and upward in the lock and frees its anti-creep engagement. In the bottom operated arrangement the upper end of the toggle 8 in Fig. 1257 normally underlies the projection *h* upon the lower wall of the coupler cavity, and thus performs the lock-to-the-lock function. When the lifter 7 and toggle 8 are raised to lift the lock the end of the toggle 8 slides rearwardly and up in the inclined slot of the lock leg and frees the anti-creep engagement.

To obtain the strongest possible anchorage for the knuckle within the coupler head and at the same time to allow the knuckle to swing freely when

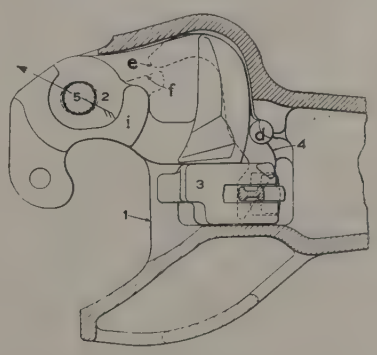


Fig. 1253

unlocked, the knuckle is provided upon its tail with the pulling lugs *m* and *n*—Fig. 1260—which engages the corresponding lugs *o* and *p* upon the upper and lower walls of the coupler head, and serve to relieve the knuckle pivot pin of the greater part of the

The A. R. A. Standard "D" Coupler *Cont'd.*

pulling stress. Above and below the lugs *o* and *p* are the buffing shoulders *q* and *r* against which corresponding shoulders on the knuckle bear when in buff.

The forward pull upon the knuckle in draft not only pulls the knuckle directly forward against the pulling lugs, but also tends to force the knuckle laterally in the direction of the arrow in Fig. 1253. To resist this lateral pressure the knuckle is provided upon the top and bottom with the outwardly extending "pin protector lugs" *i* which enter correspondingly shaped recesses in the upper and lower walls of the coupler head. In order to relieve the knuckle pin of the greater pulling and buffing stresses the pinholes in the pivot lugs of the coupler are elongated slightly, as shown in Figs. 1253 and 1256, allowing the knuckle to take a firm bearing within the head in pull or buff without stressing the knuckle pin.

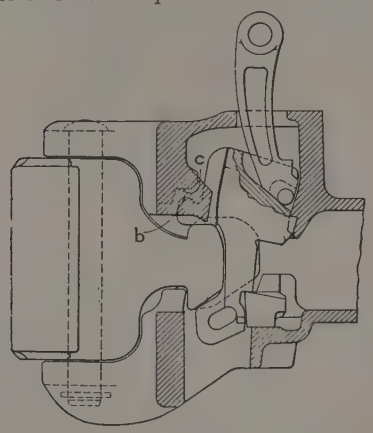


Fig. 1254

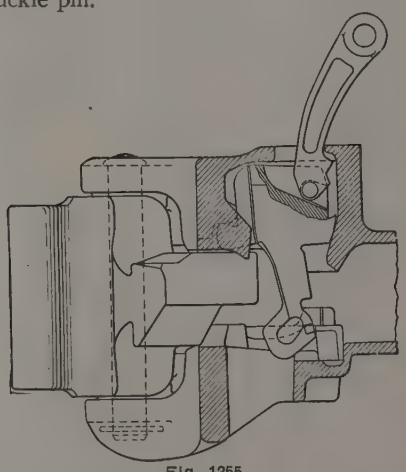


Fig. 1255

Drop tests are not necessary with the standard "D" coupler, it being necessary only to insure that the material is of the proper chemical analysis, tensile strength, and has been thoroughly annealed.

The United States Railroad Administration specifications R-13, dated May 1, 1918, as well as the Coupler Committee's Specifications adopted by letter ballot, August 25, 1918, have been drafted along this line:

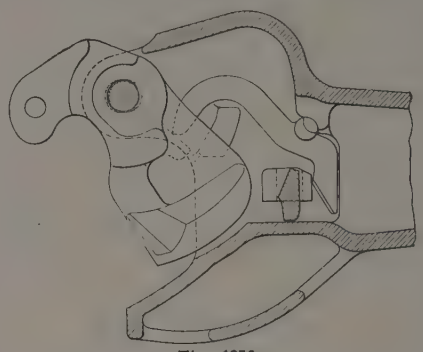


Fig. 1256

The material as specified is to be of open hearth cast steel with the following analysis:

Carbon	.20 to .35
Manganese not over	.75
Phosphorus and Sulphur not over	.05

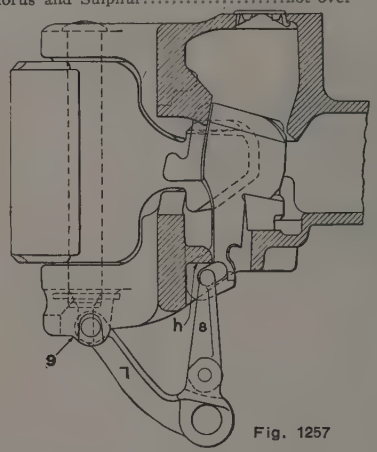


Fig. 1257

The physical requirements to be met by this material are as follows:

Minimum tensile strength 60,000 lb. sq. in. Minimum yield point as determined by drop of beam, 0.45 tensile strength.

Minimum elongation in 2 in. in per cent $\frac{1{,}400{,}000}{\text{tensile strength}}$ not under 20 per cent.

Minimum reduction in area, in per cent, 30.

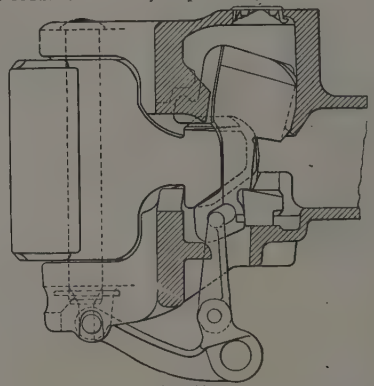


Fig. 1258

The chemical analysis and physical tests under the above prescribed limits are to be made on each heat

The A. R. A. Standard "D" Coupler *Cont'd.*

or melt, and acceptance of the material is to be so governed.

It is also specified that each coupler head and knuckle is to have cast thereon annealing test coupons so that by fracturing these the quality of annealing may be checked for each casting, if desired.

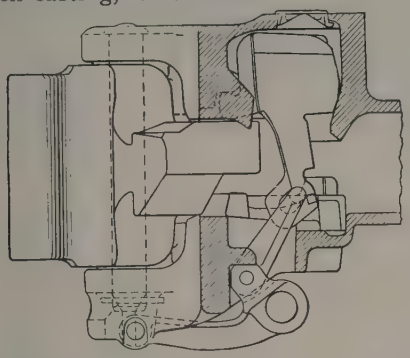


Fig. 1259

In addition to the above physical and chemical requirements, a certain percentage of the couplers and parts are to be weighed individually and meet a definite minimum weight limit.

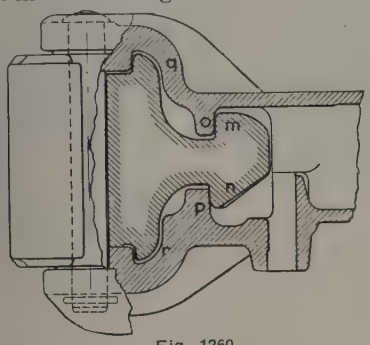


Fig. 1260

In order to govern interchangeability and the proper relation between fitting parts, the American Railway Association Committee on Couplers & Draft Gears, in conjunction with the Coupler Manufacturers, has designed and distributed gages and

Fig. 1261—Knuckle Thrower

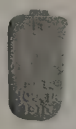


Fig. 1262 — Top Lock Lift Hole Cap

masters. The specifications require that these gages are to be used not only for the complete coupler, but also for the different parts. In this way there will be no doubt as to the interchangeability, proper fitting, and operation of the coupler. These gages have been submitted to letter ballot and were adopted on August 25, 1918.

It is needless to state that the above only represents the general requirements specified by the Coupler Committee. The specifications as finally agreed upon will allow the Standard Coupler to be produced at as low cost as possible and still meet the exacting requirements of interchangeability which should not be compromised on this new and important standard of the American Railway Association.

The adoption of this coupler for use on all new equipment built after November 1, 1920, is now resulting in benefits that will become more and more far reaching and important to the railroad companies of this country.

Fig. 1264—Lock and Top Lock Lift Assembled

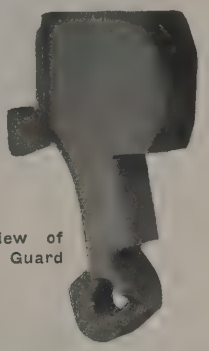


Fig. 1263 — View of Lock From Guard Arm Side

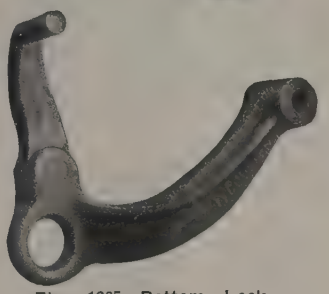


Fig. 1265—Bottom Lock Lift

The Coupler Manufacturers who assisted the Coupler Committee in its work and who are prepared to supply this coupler to the railways are as follows:

American Steel Foundries, Chicago, Ill.

The Buckeye Steel Castings Company, Columbus, Ohio.

Gould Coupler Company, New York, N. Y.

The McConway & Torley Company, Pittsburgh, Pa.

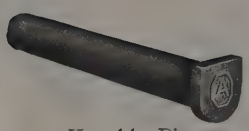
The National Malleable Castings Company, Cleveland, Ohio.

From the beginning the coupler manufacturers have recognized that their immediate individual interests should be subordinated to the larger benefits to be derived from a standard coupler, and it is with great satisfaction that they now announce their readiness to do their part in producing these couplers to the end of making permanent the benefits that have already been established. The above mentioned coupler manufacturers have a very complete equipment of flasks, patterns, core-boxes, gages, etc., and are now in a position to furnish this coupler to meet the increasing demand and in the various designs approved as standards.

MANUFACTURERS OF THE STANDARD "D" COUPLER

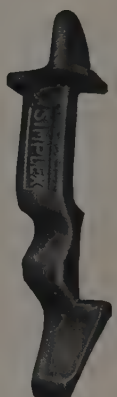
Fig. 1266—Simplex Passenger Coupler.

Lock.



Knuckle Pin.

Knuckle.



Lifter.

Fig. 1267—Parts of Simplex Freight Coupler.

Fig. 1268—Vertical Section Through Simplex Coupler When Closed.

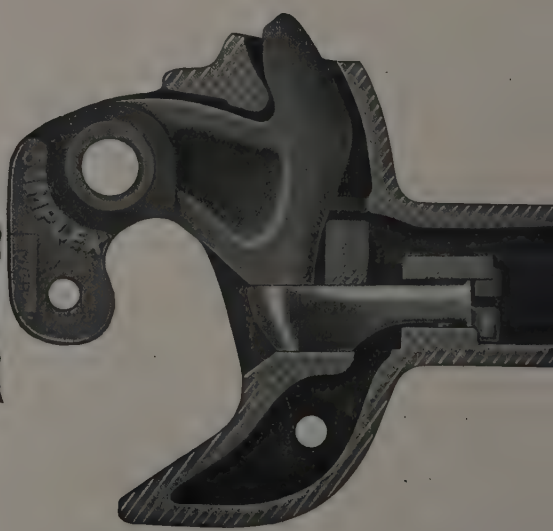


Fig. 1269—Horizontal Section Through Simplex Coupler When Closed.

American Steel Foundries.

(See also Page 575)

Simplex Passenger and Freight Couplers

The coupler problem, in its relation to the construction and operation of freight and passenger cars, ranks with that of the air brakes and wheels. Viewed in this light, the fact that more than a million Simplex Couplers are in use, carries a meaning of special significance when it becomes necessary to specify the accessories for installation on new equipment, or when the service rendered by existing equipment is not proving satisfactory.

Various types of Simplex Couplers have been designed to meet the special requirements of a particular kind of service. Some types are intended primarily for freight service, others for application on passenger cars. Operation may be specified as "top lift" or "side lift" as desired. All designs comply fully with the American Railway Association requirements.

The Simplex passenger coupler is practically identical in construction with the "side lift" freight coupler, the only difference being in the shape of the head for the knuckle pin. "Side lift" couplers are also well adapted to use on ballast and flat cars.

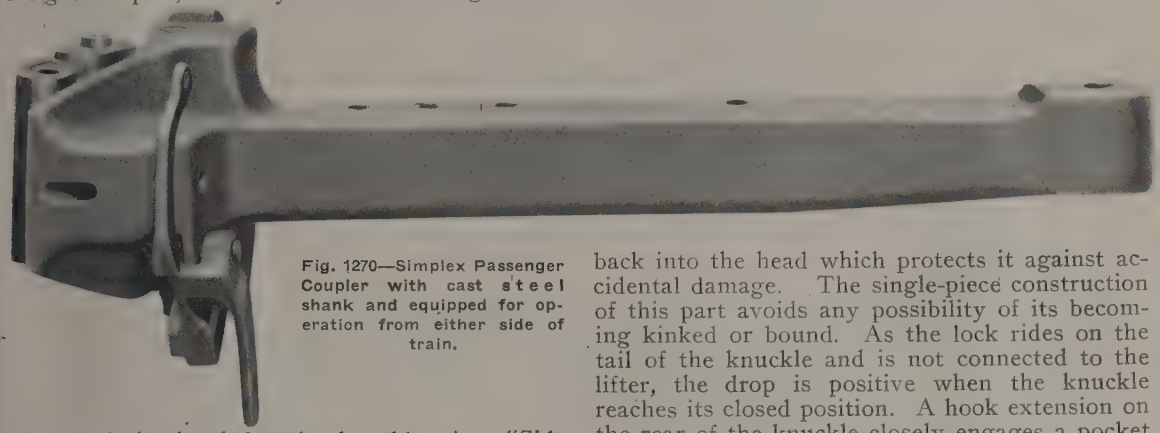


Fig. 1270—Simplex Passenger Coupler with cast steel shank and equipped for operation from either side of train.

Fig. 1271—Simplex Coupler with anti-creep device.

The Simplex "top lift" freight coupler consists of only five pieces. They are the knuckle, pivot or knuckle pin, lock, lifter, and head. The head and shank are cast in one piece, but shanks of any size and shape may be specified. The method of operating "side lift" couplers makes necessary the addition of a sixth piece called the lever.

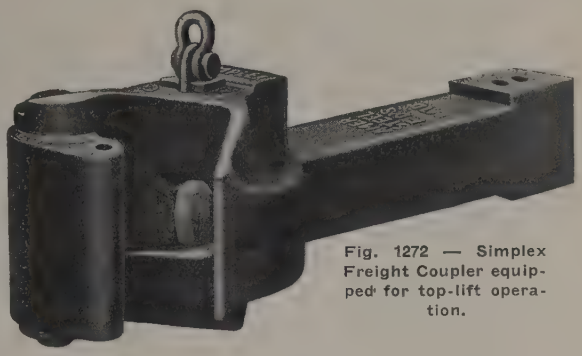


Fig. 1272 — Simplex Freight Coupler equipped for top-lift operation.

The operation of the Simplex Coupler is simple, and effectively accomplishes its function. To throw the knuckle open to its fullest extent a movement of only 4¼ in. is required of the lifter and when opening is complete, the lifter drops back into the head which protects it against accidental damage. The single-piece construction of this part avoids any possibility of its becoming kinked or bound. As the lock rides on the tail of the knuckle and is not connected to the lifter, the drop is positive when the knuckle reaches its closed position. A hook extension on the rear of the knuckle closely engages a pocket in the head and thus relieves the pin of pulling stresses. As a means of preventing wear in the knuckle pin lug holes, the head of the knuckle pin is made *D* shaped. The flat of the *"D,"* bearing against a corresponding flat on the head, does not allow the pin to turn when the knuckle opens. A 2½ in. upward movement from the lifter is sufficient for allowing the coupler to open. "Side lift" passenger couplers can be arranged to uncouple from either side of the train.

The double anti-creep feature of Simplex Couplers acts as a lock-to-the-lock. A projection on the lifter is engaged by notches on the lock. Any tendency of the lock to rise carries the lifter back against the rear wall of the head where it jams, effectively preventing any further movement.

Repair parts for all styles of Simplex Couplers are kept on hand at all times by the American Steel Foundries. The large stock and prompt shipment are of distinct advantage at the storekeeping end of the coupler problem.

The A.R.A. Standard "D" Coupler which is described on pages 569 to 573 is also manufactured by this company.

For other products and branch offices, see classified and alphabetical indexes.

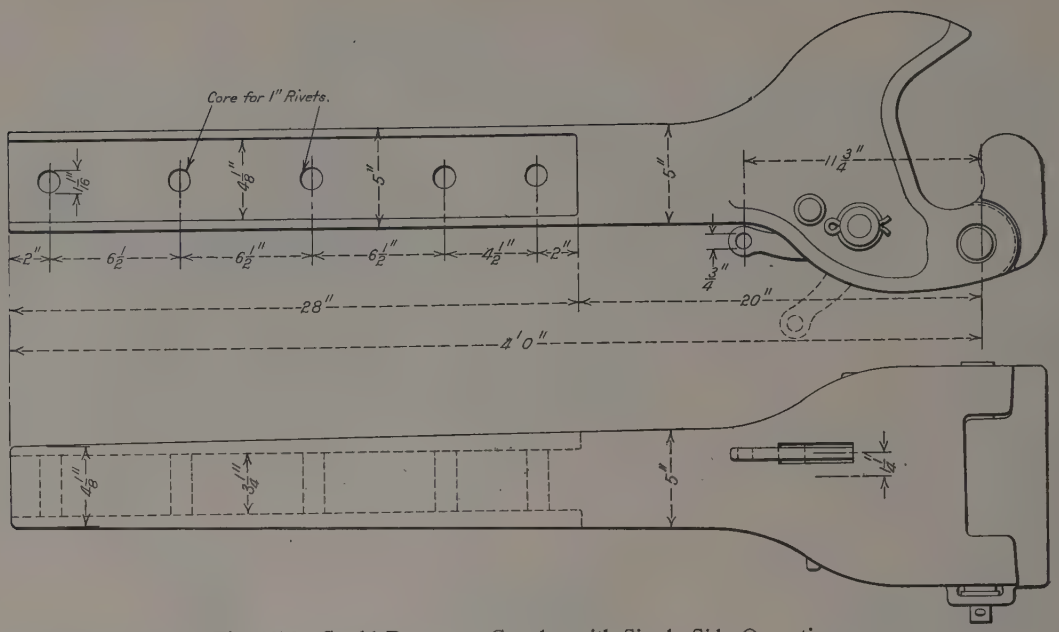


Fig. 1273—Gould Passenger Coupler with Single Side Operation.

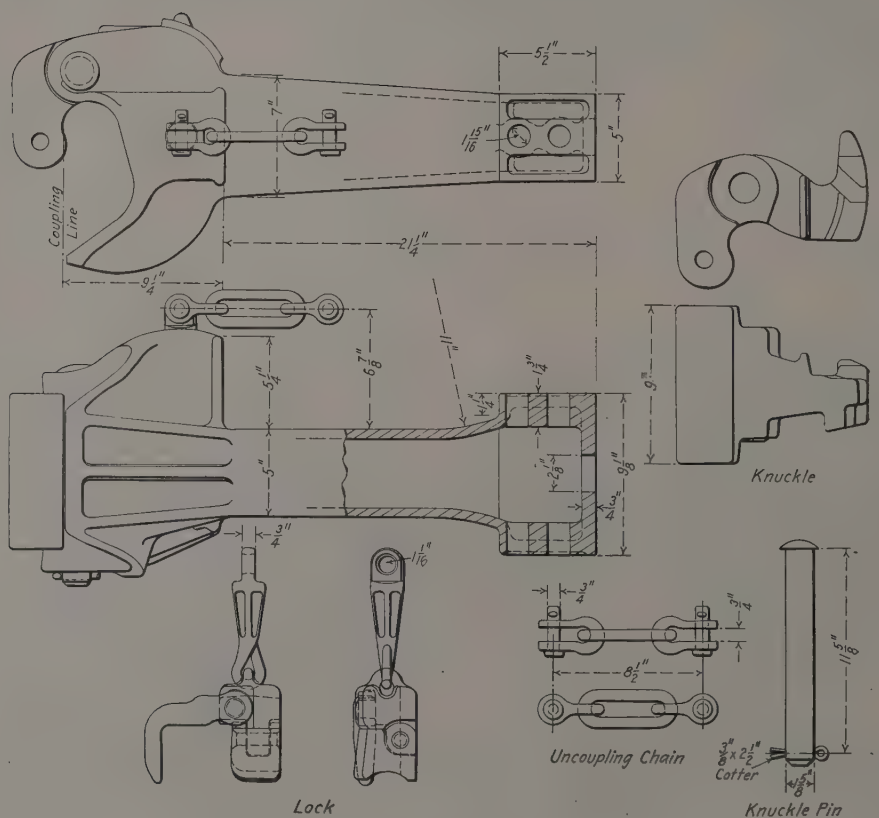


Fig. 1274—Gould Freight Coupler Z201, and Parts.

Gould Coupler Company.

(*See also Page 955.*)

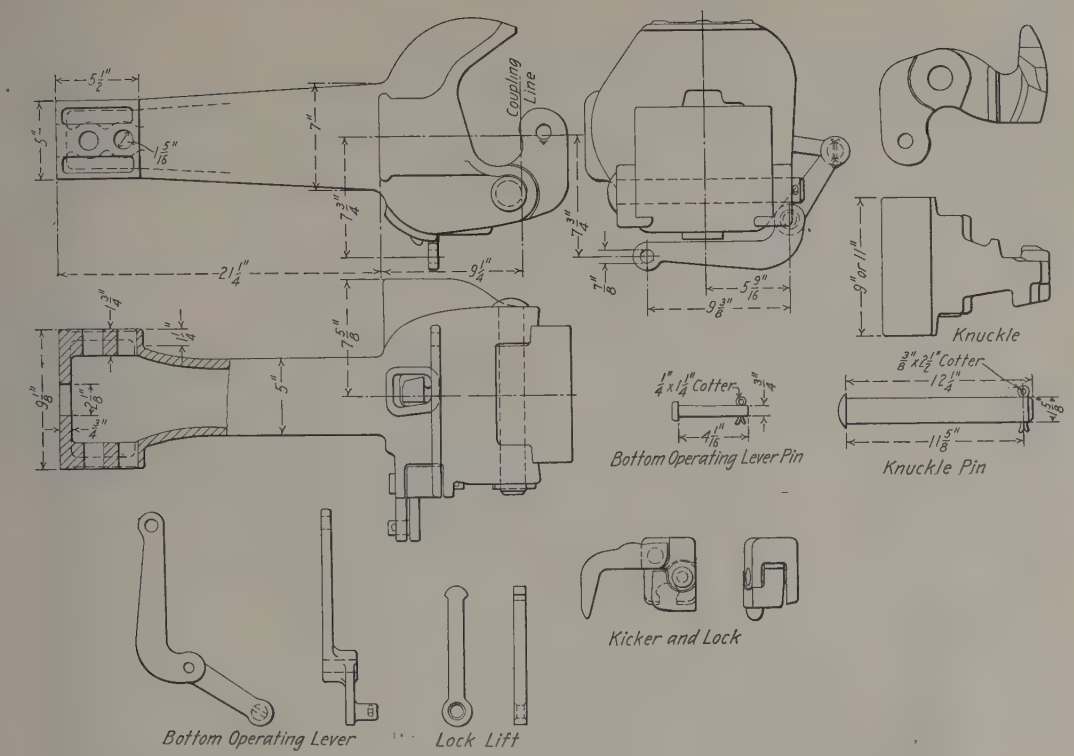


Fig. 1275—Gould Bottom Operating Freight Coupler BZ-201, and Parts.

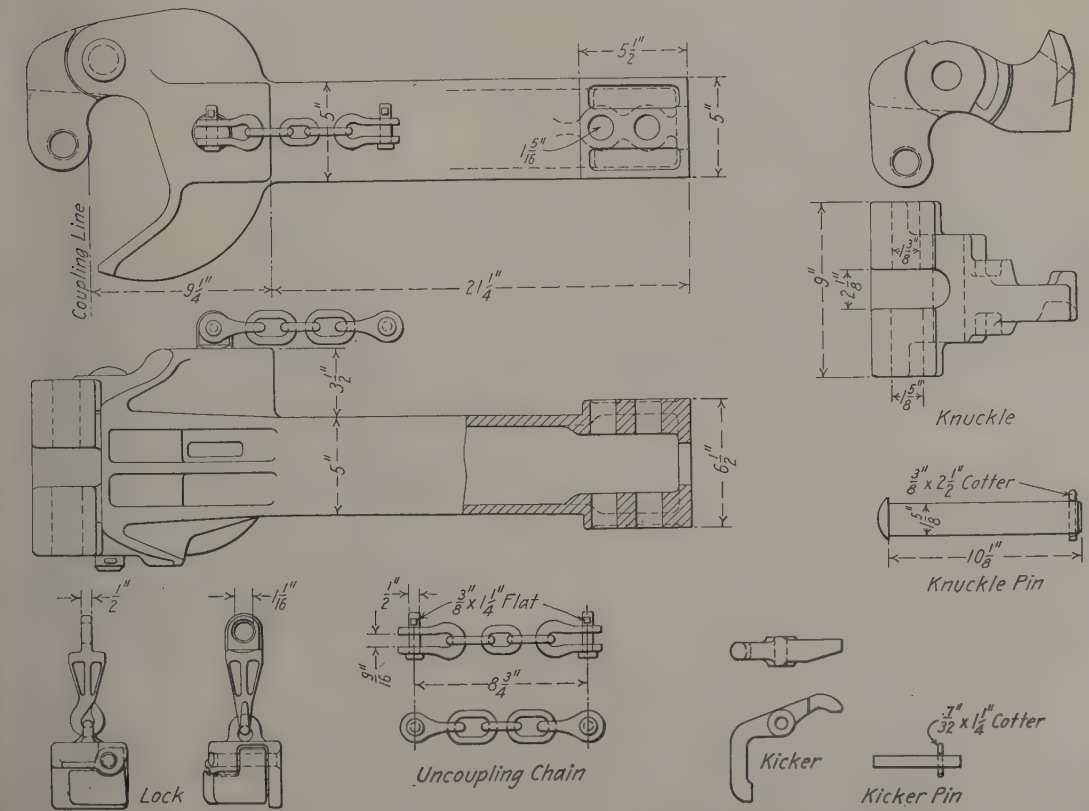


Fig. 1276—Gould Top Operative Medium Type Freight Coupler, V-101, and Parts.

Gould Coupler Company.

(See also Page 955.)

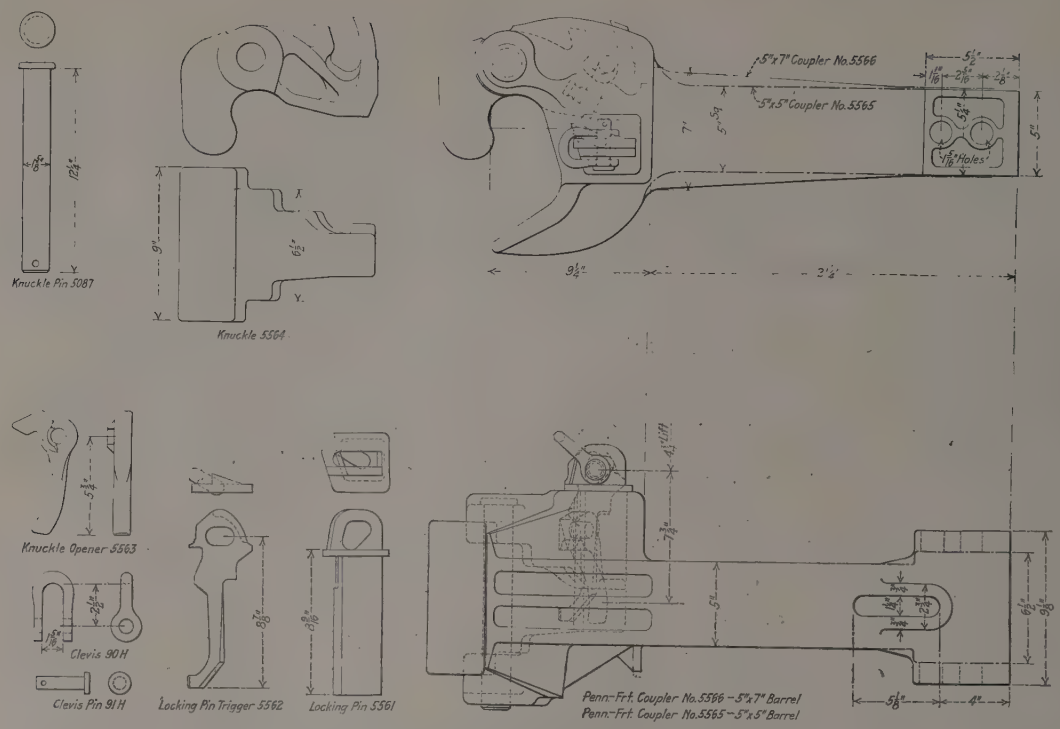


Fig. 1277—Penn Freight Coupler and Parts.
(See also Page 579.)

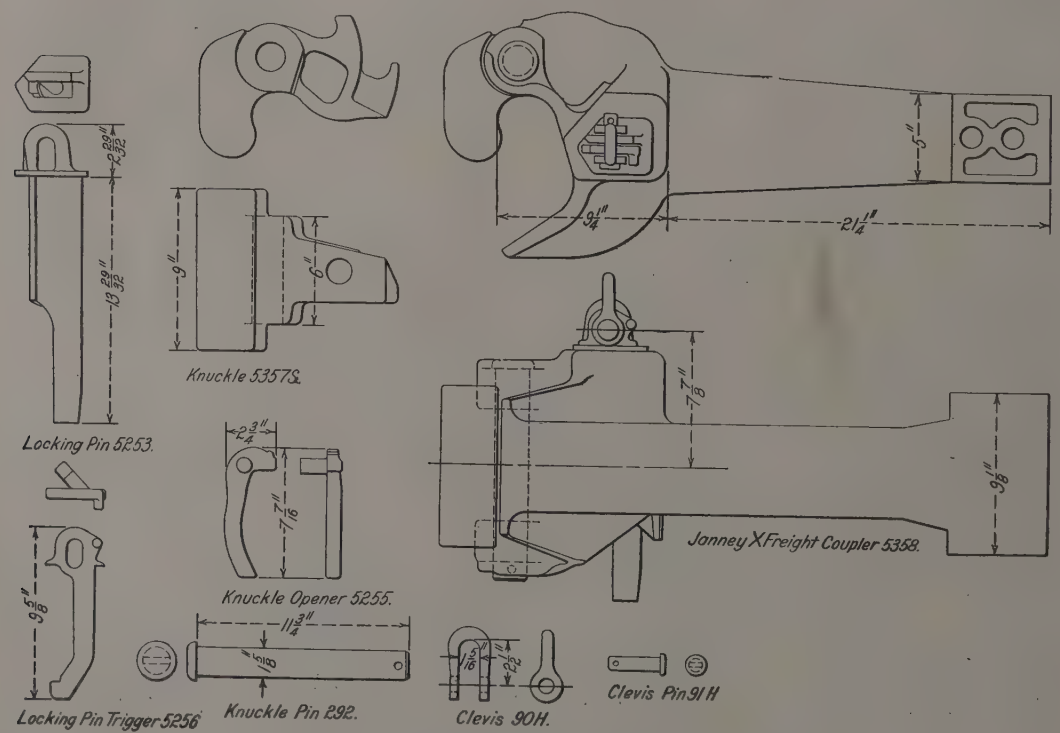


Fig. 1278—Janney X Freight Coupler and Parts.
(See also Page 580)

Penn Coupler for Freight Cars

The Penn Coupler is manufactured by The McConway & Torley Company and is the latest and most up-to-date coupler of the company's design. It is a combination and modification of the Pitt and the Janney X types and is designed to meet all the requirements

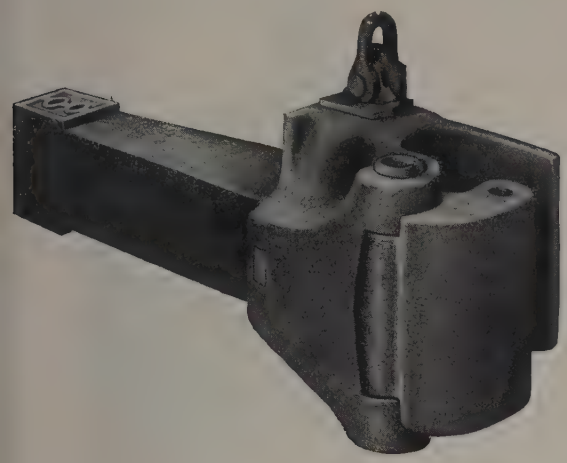


Fig. 1279—Complete View of the Penn Coupler

and recommendations of the M. C. B. Association—now Division V—Mechanical—of the American Railway Association—and to comply fully with the U. S. Safety Appliance Law. In its construction all the desirable features of both the Pitt and Janney types have been retained and at the same time it has the simplicity of the early Janney coupler,

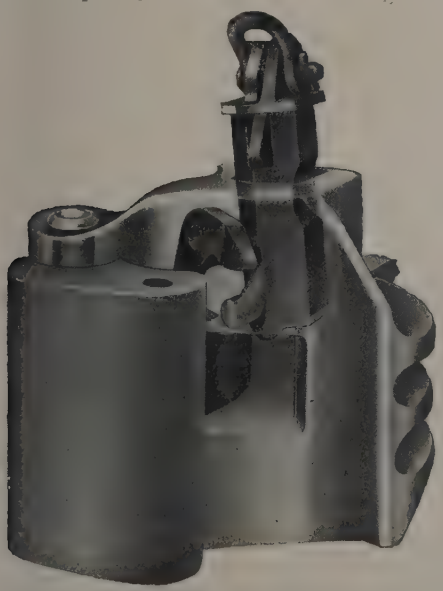


Fig. 1280—Penn Coupler—Lock Set Position

together with those important facilities—a lock-set, a lock-to-the-lock, and a knuckle-opener—so indispensable in the present day heavy freight-train service.

Lock-setting is accomplished by the locking block which rests, when raised to the uncoupling position, on a seat located upon the inside wall of the coupler head, from which seat it can only be dislodged by the movement of the coupler knuckle.

Lock-to-the-lock is attained by means of the trigger which is designed to hold the locking block in a locked position. The trigger has a projection near the upper end which engages the under side of the top wall of the coupler head, thereby interposing a positive obstruction against any undesirable vertical movement and thus avoiding the possibility of an accidental uncoupling.

The knuckle-opener pushes the knuckle to its widest open position either from a fully closed or any partially open condition. Its path of movement is such that an easy and complete opening of the knuckle is obtained without any undue exertion on the part of the operator.

The large area of the locking surfaces, amounting to practically 5 square inches on both the locking block and knuckle, is a valuable feature as the wear concentrated on these surfaces is thus widely distributed and tends to reduce the maintenance cost of the Penn Coupler to a minimum.

Another desirable feature is that no portion of the locking block extends below the bottom wall of the coupler.

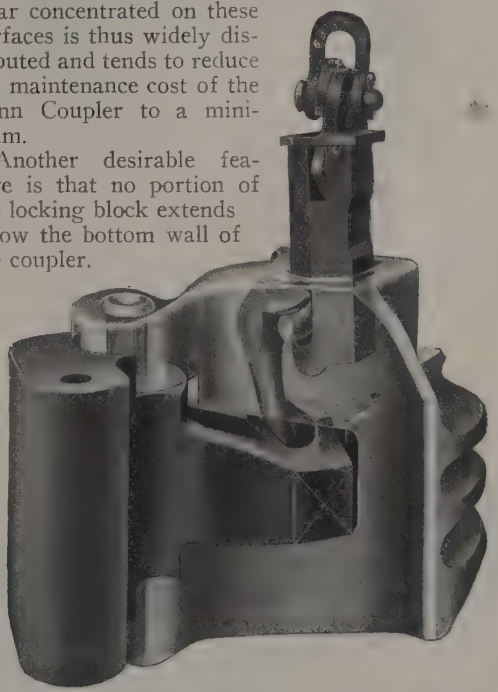


Fig. 1281—Penn Coupler—Knuckle Fully Open. Large Bearing Area indicated at "X"

The easy accessibility of parts, facilitates repairs. To remove the lock it is only necessary to take out the clevis pin and lift out the trigger. After the locking block has been removed, the knuckle-opener can be lifted out through the opening in the top of the coupler. Due to this arrangement, the necessity of first removing the knuckle pin and knuckle in order to get at the locking block of the coupler is obviated.

The Penn Coupler as above described is of the top-operating type. To meet special conditions it is also made for both side and bottom operation, all designs using the same knuckle, knuckle pin and knuckle opener.

For other products and branch offices, see classified and alphabetical indexes.

THE McCONWAY & TORLEY COMPANY, PITTSBURGH, PA.

Janney X Coupler for Freight Cars

The Janney X Coupler is manufactured by The McConway & Torley Company and while retaining the simplicity of their earlier types, has the features of lock-set, lock-to-the-lock, and knuckle-opener, to comply with the requirements of the M. C. B. Association—now the American Railway Association—and the United States Safety Appliance Law. The Janney X Coupler is designed particularly for freight equipment.

Lock-setting is accomplished by the locking pin resting on the bottom wall of the coupler head, the pin being designed with a notch for that purpose.

Fig. 1282—Locking Pin

Fig. 1283—Knuckle

The locking pin cannot climb, being held in the locked position by the trigger the lower end of which projects into a recess in the knuckle, thus preventing accidental uncoupling when the car is running.

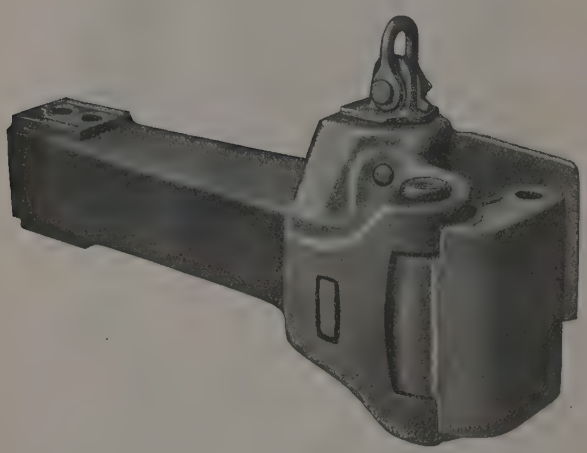


Fig. 1284—Complete View of the Janney X Coupler

The knuckle opener pushes the knuckle open from a fully closed or partially open position, and its path of movement is such as to insure easy and complete opening of the knuckle—a most essential feature from a safety standpoint.

From a maintenance standpoint it is important that couplers be of simple design and so arranged that their parts can be readily removed; the easy accessibility of the lock and knuckle opener in the Janney X Coupler provides this feature. To remove the lock, it is only necessary to lift it by grasping the trigger alone. After the lock has been removed, the knuckle-opener can be lifted out through the opening in the top of the coupler. By this arrangement, the necessity of first removing the knuckle pin and knuckle in order to get at the lock is obviated. When lifted by means of the chain or uncoupling lever, it cannot come out, being prevented by the projecting lower end of the trigger.

Fig. 1285—View Showing Parts in Closed Position

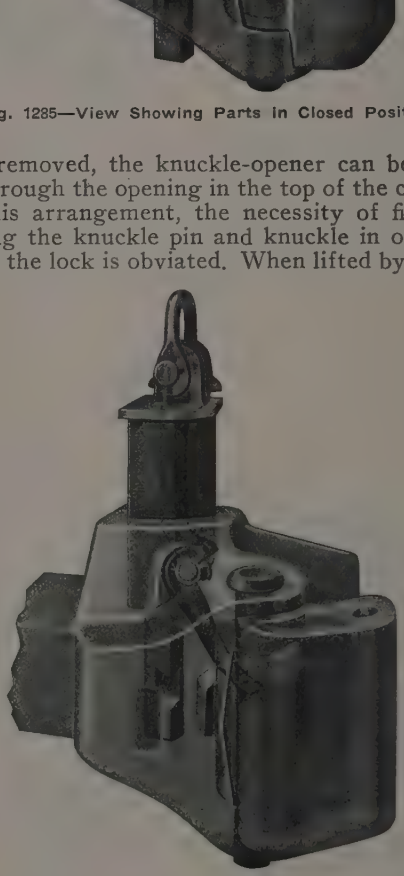


Fig. 1286—View Showing Parts in Open Position

The latest design of these manufacturers is the Penn Coupler which is shown on pages 578 and 579

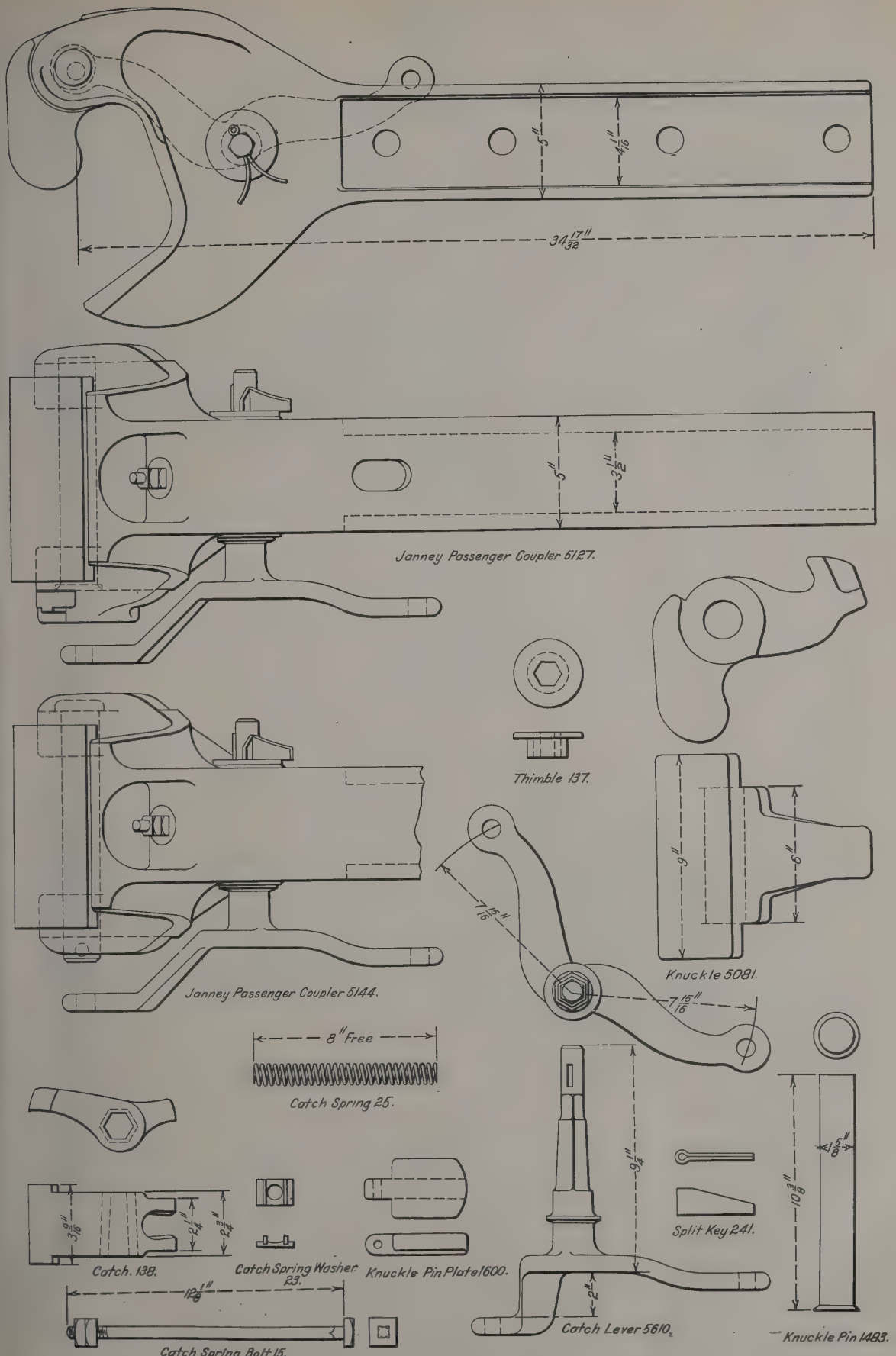


Fig. 1287—Janney Passenger Couplers and Parts.

McConway & Torley Company.

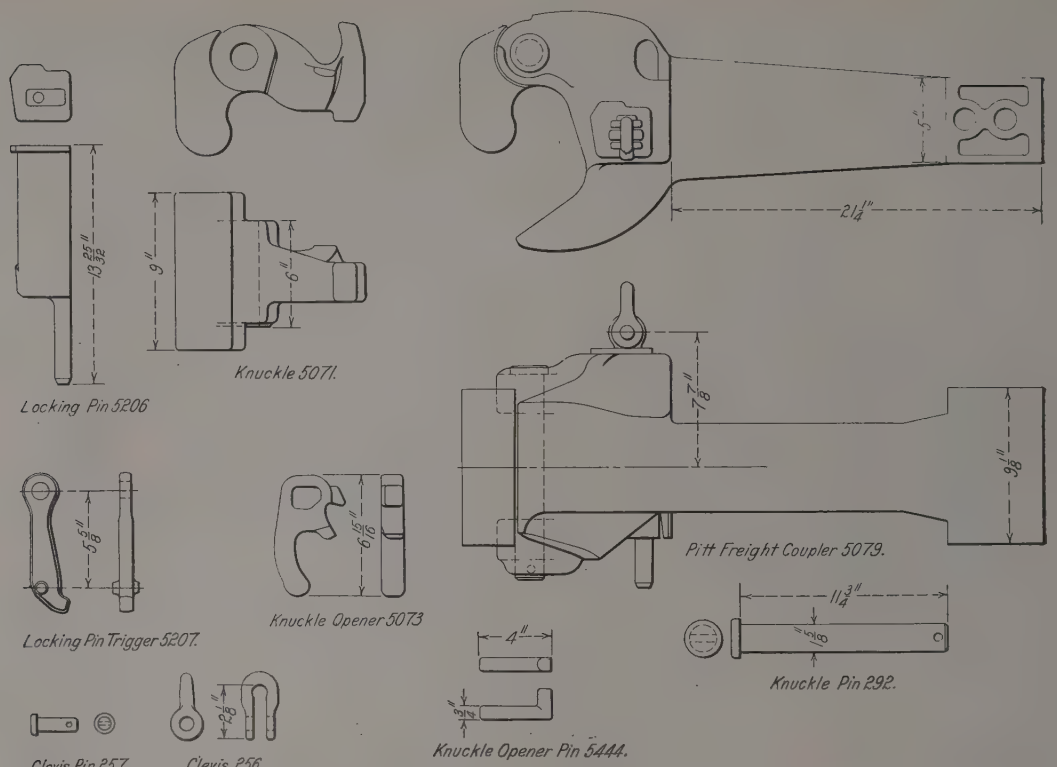


Fig. 1288—Pitt Freight Coupler and Parts.

(See also Page 583.)

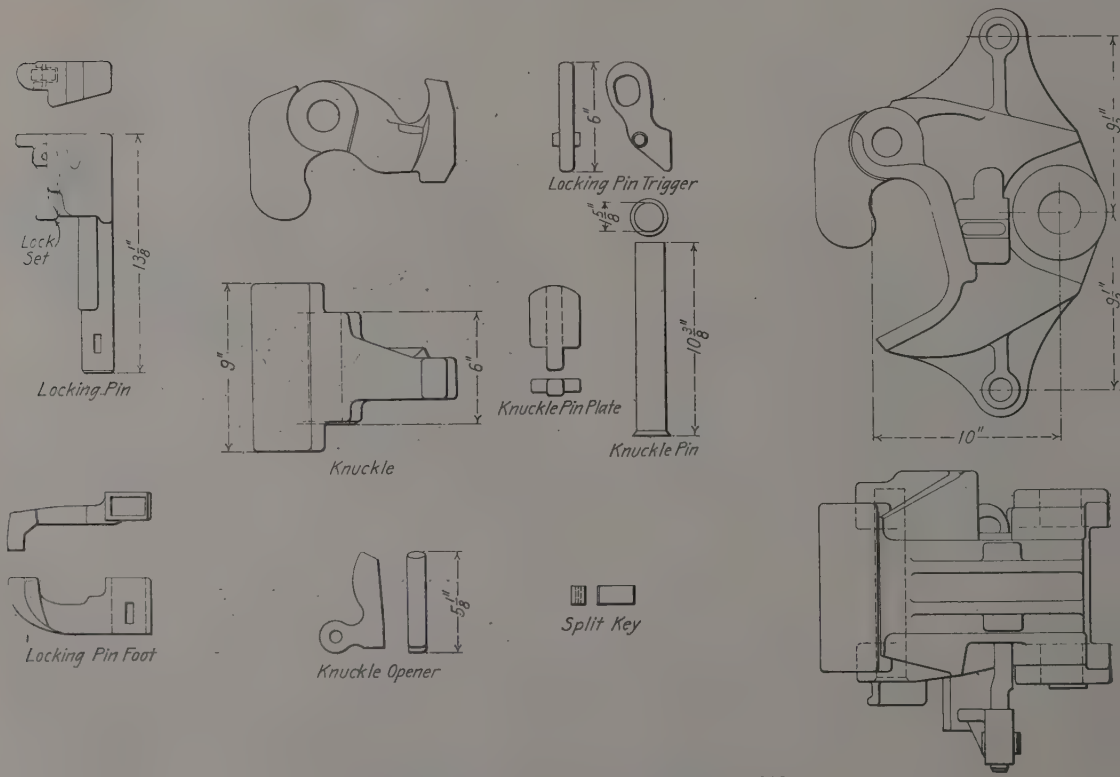


Fig. 1289—Pitt Three-Stem Coupler No. 919.

The McConway & Torley Company

Pitt Coupler for Freight Cars

In developing the Pitt Coupler, The McConway & Torley Company produced a design to meet the requirements of the M.C.B. Association—now the A.R.A.—and to comply with the safety appliance laws of the United States. This is in accordance with the established policy of the company from the time when they introduced the original Janney coupler—to follow closely the gradual evolution of railway equipment, and to incorporate from time to time in their product, new ideas and valuable features, which will best serve a useful purpose under developing service conditions.

The Pitt coupler in principle is similar to the Janney Coupler. It has the same type of vertically operated locking pin, embodying the lock-to-the-lock feature, and is also provided with a lock-set, and a knuckle-opener. The same member which acts as a lock-set, also functions as a knuckle-opener; this assists in reducing the number of parts to a minimum. The lock-set is absolutely positive in its operation, and will not rattle down, either by reason of car oscillations when passing over frogs and switches, or by any slight opening movement of the knuckle, and allow the coupler to re-lock.

The knuckle-opener is also positive in action and pushes the knuckle open to its fullest range of movement, either from an entirely closed or from any partially open position. This is accomplished regardless of rust upon the various parts.

A simplicity of design and ruggedness of detail co-operate to produce a coupling mechanism of great strength and serviceability. The various parts function with a positiveness and reliability that render the Pitt coupler an adjunct of value in the rapid and safe movement of freight traffic.

Special designs of couplers to meet unusual conditions will be made, and blueprints showing them will be furnished free of charge, on receipt of detailed information from those having such problems to solve. Blueprints may also be had on application, of the standard forms of the various couplers made by this company, which is the oldest manufacturer of these cast steel specialties for railway work and which has the equipment and organization necessary to their careful and efficient production.

The McConway & Torley Company also manufactures A.R.A. Standard Type D Couplers, as illustrated and described on pages 569 to 573.

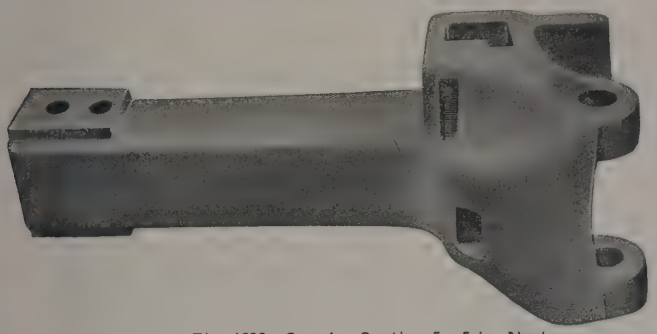


Fig. 1290—Coupler Casting 5 x 5 in. Neck

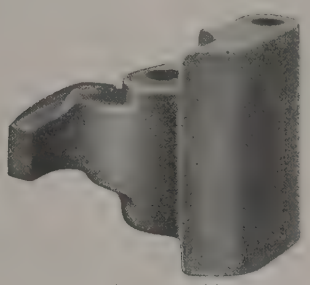


Fig. 1296—Knuckle

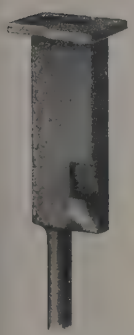


Fig. 1293—Locking Pin

Fig. 1292—Pitt Coupler Complete

Fig. 1291—Locking Pin Trigger

Fig. 1294—Knuckle Opener

For other products and branch offices, see classified and alphabetical indexes.

THE McCONWAY & TORLEY COMPANY, PITTSBURGH, PA.

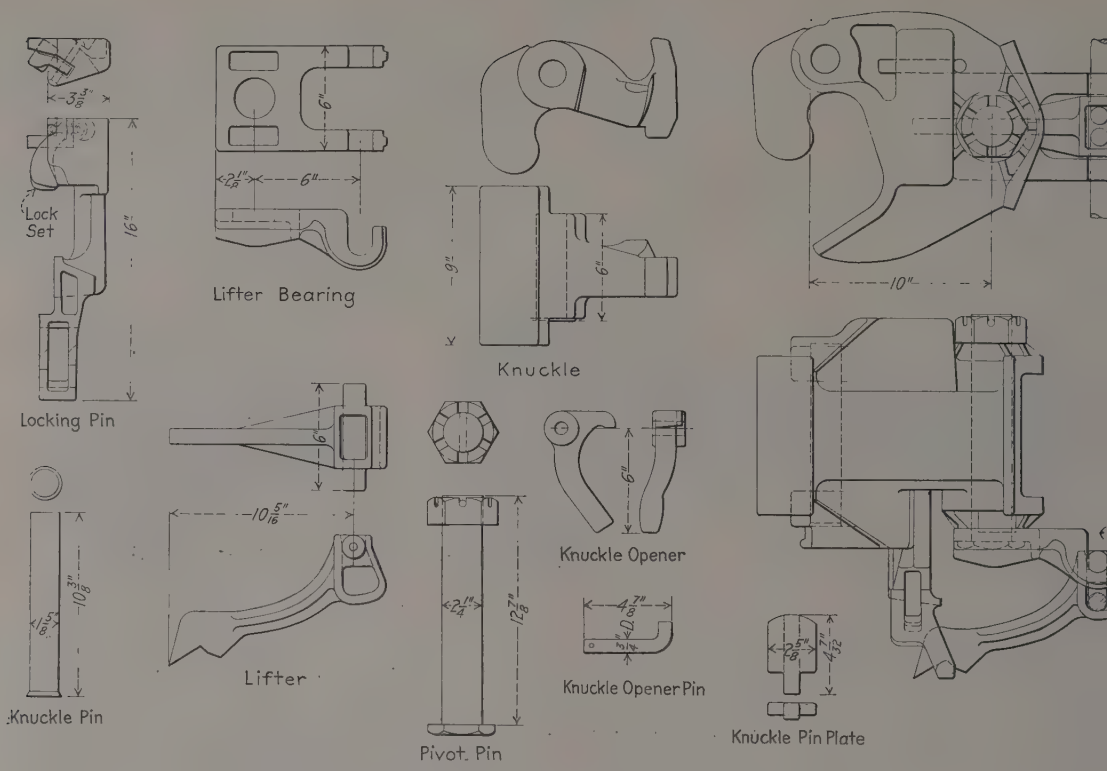


Fig. 1297—Pitt Passenger Coupler, No. 255, with Underneath Release.

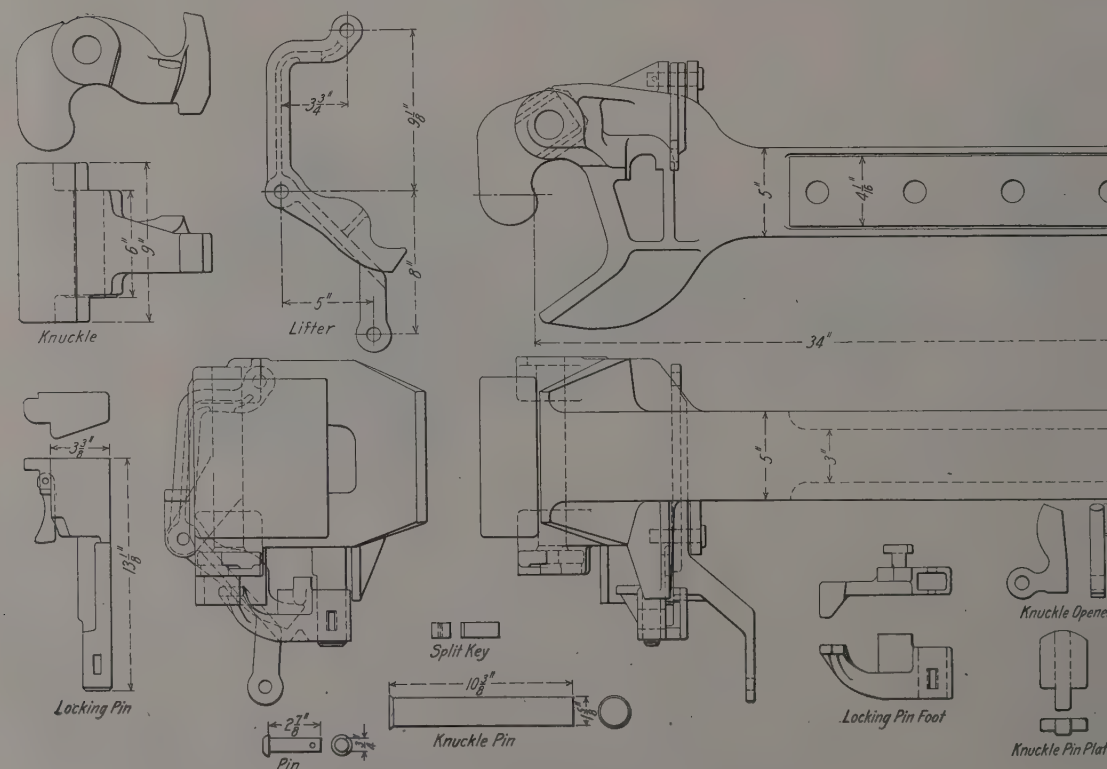


Fig. 1298—Pitt Passenger Coupler, No. 171—SP2.
The McConway & Torley Company
(See also Page 585.)

Pitt Pivoted Passenger Car Couplers

The Pitt Pivoted passenger car coupler has been developed with particular reference to the requirements of passenger service. On American railroads this service demands a coupler of exceptional qualities and great strength, because of the extremely severe conditions imposed by the use of massive steel passenger cars moving in long trains over heavy grades and at high speed. After numerous experiments extending over a period of years, the Pitt Pivoted passenger car coupler was finally perfected. This coupler combines all the desirable features essential in passenger service and has proven itself to be a most thoroughly satisfactory and successful M. C. B. coupling mechanism.

A high degree of flexibility for passenger car couplers is essential, under modern conditions, especially when used on the long heavy coaches now so extensively used. If this quality of flexibility is not present, excessive side strains and severe twisting stresses are necessarily imposed upon the platform structure and the car body during curvature. These stresses are not only detrimental to the entire underframing but also exert a very bad influence upon the running qualities of a train.

The Pitt Pivoted passenger car coupler has been designed to have complete flexibility during curvature; thus is accomplished by the use of a pivoted coupler head acting in conjunction with a coupler stem, which has wide lateral motion in the carry-iron. By means of a coupler-centering device the movement of both coupler head and stem is spring-controlled, so as to keep them normally on center. The highly flexible arrangement thus produced, tends to greatly facilitate the curving properties of passenger cars, adds to their useful life and improves their riding qualities to a very great extent.

In addition to its remarkable flexibility, the Pitt Pivoted passenger car coupler has also great strength. This is obtained by using an extra heavy coupler head and knuckle, together with wrought iron or heavy cast steel stems.

This coupler is of the gravity-lock type with a lock-to-the-lock, a knuckle-opener, and all modern features, operating as in freight car couplers all to comply with the recommendations and the requirements of the M. C. B. Association—now the A. R. A.—and with the provisions of the U. S. Safety Appliance Law. The lock-to-the-lock positively prevents any accidental uncoupling, and the knuckle-opener can be operated by the uncoupling rod to open the knuckle to its widest range of movement either from a fully closed or any partially open position.

Quadruple shear yokes are furnished by The McConway & Torley Company and the Pitt Pivoted or other passenger couplers of its manufacture are supplied with either the plain rear end or for quadruple shear yoke connection as desired.

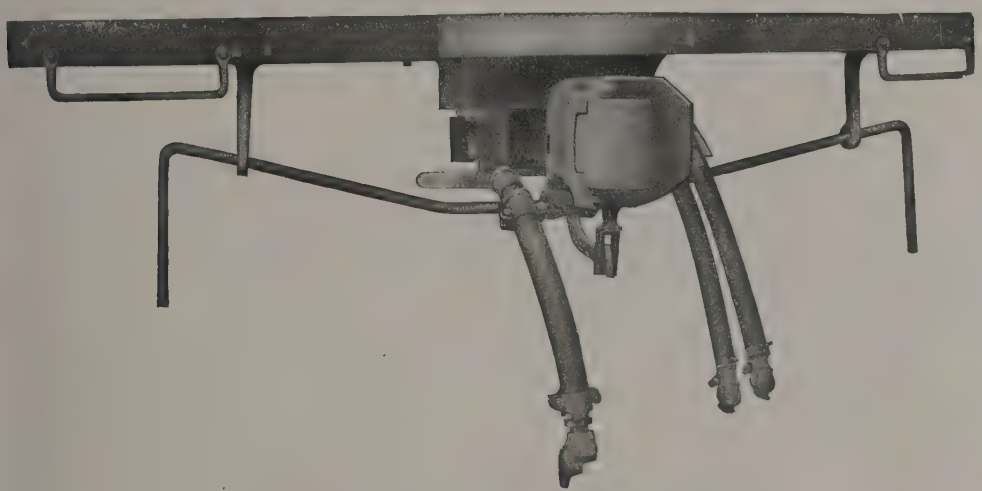


Fig. 1299—Complete Assembly Pitt Passenger Car Coupler

The underneath system of uncoupling levers, as shown by the illustration, is recommended as the simplest and probably the most efficient type for use on passenger equipment. These uncoupling rods can be applied to the coupler from both sides of the car, or if preferred from either the right or left hand side. The rods pass below the train pipes and to the rear of the hose, thus avoiding interference with these attachments. In uncoupling, the uncoupling rods rotate in the same manner as the uncoupling lever on a freight car.

The low cost of maintenance of the Pitt Pivoted Passenger Car Coupler is one of its important characteristics. Its strength and flexibility reduce to a minimum the strains and consequent distortion and breakage. In the event of repairs to the coupler being necessary, the head, being a separate member, is readily removed and can be replaced for a small fractional cost of an entire one-piece coupler of the older type, a saving being effected in both time and material.

For other products and branch offices, see classified and alphabetical indexes.

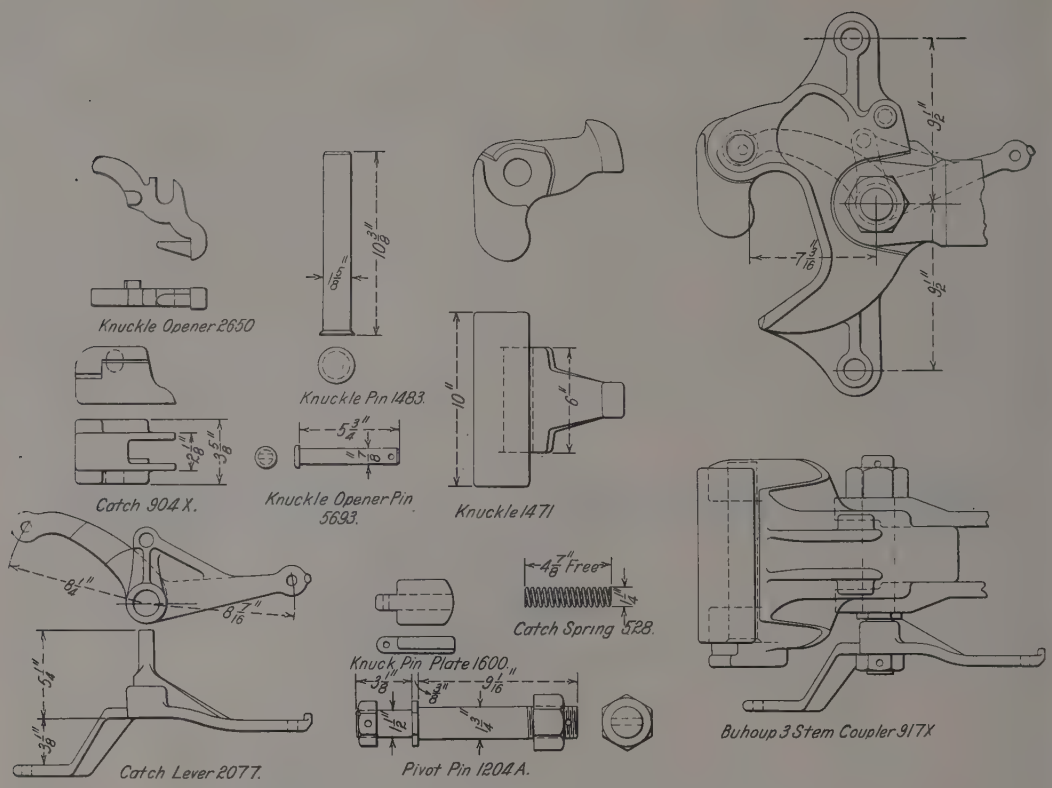


Fig. 1300—Buhoup Three-Stem Passenger Coupler and Parts.

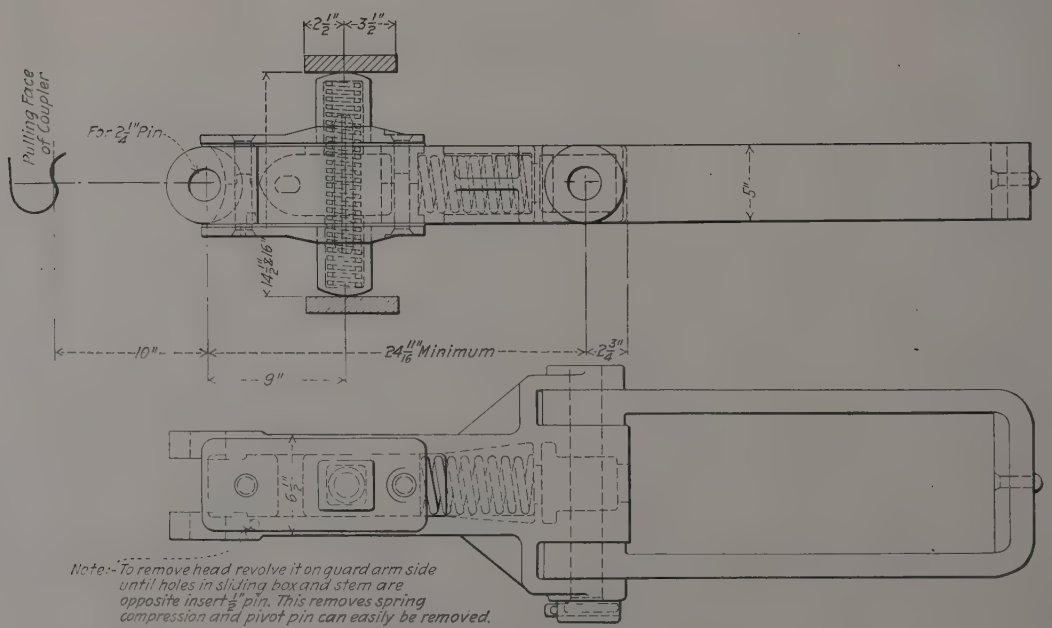

Pulling Face of Coupler
For 2¼" Pin
10"
9"
24 11/16" Minimum
2¾"
5"
Note:-To remove head revolve it on guard arm side until holes in sliding box and stem are opposite insert ½" pin. This removes spring compression and pivot pin can easily be removed.

Fig. 1301—Coupler Stem with Quadruple Shear End for Pitt Passenger Coupler.

The McConway & Torley Company.

(*See also Page 585.*)

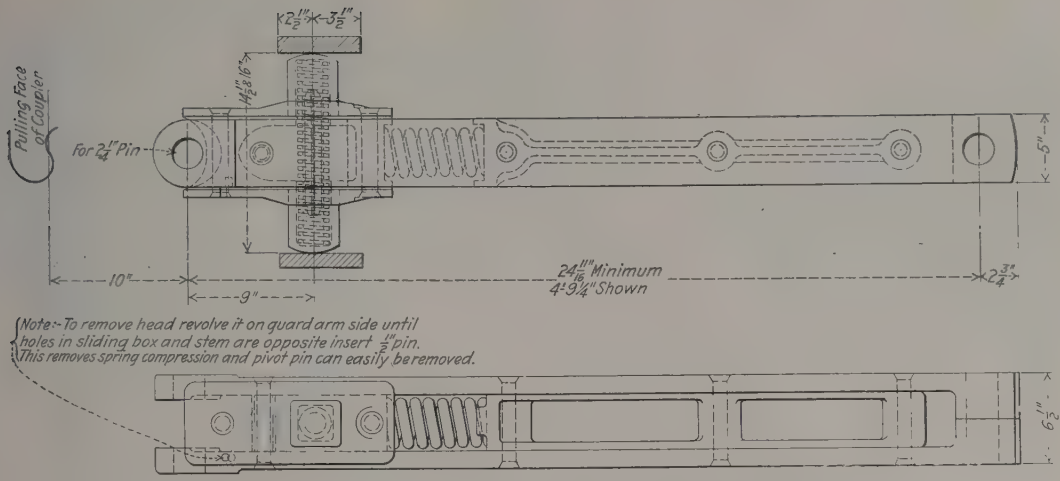

Pulling face of Coupler
For 1" Pin
10"
9"
24 1/16" Minimum
4'-9 1/4" Shown
Note:-To remove head revolve it on guard arm side until holes in sliding box and stem are opposite insert 1" pin. This removes spring compression and pivot pin can easily be removed.

Fig. 1302—Coupler Stem for Pitt Passenger Coupler. The McConway & Torley Company.

(See also Page 585.)

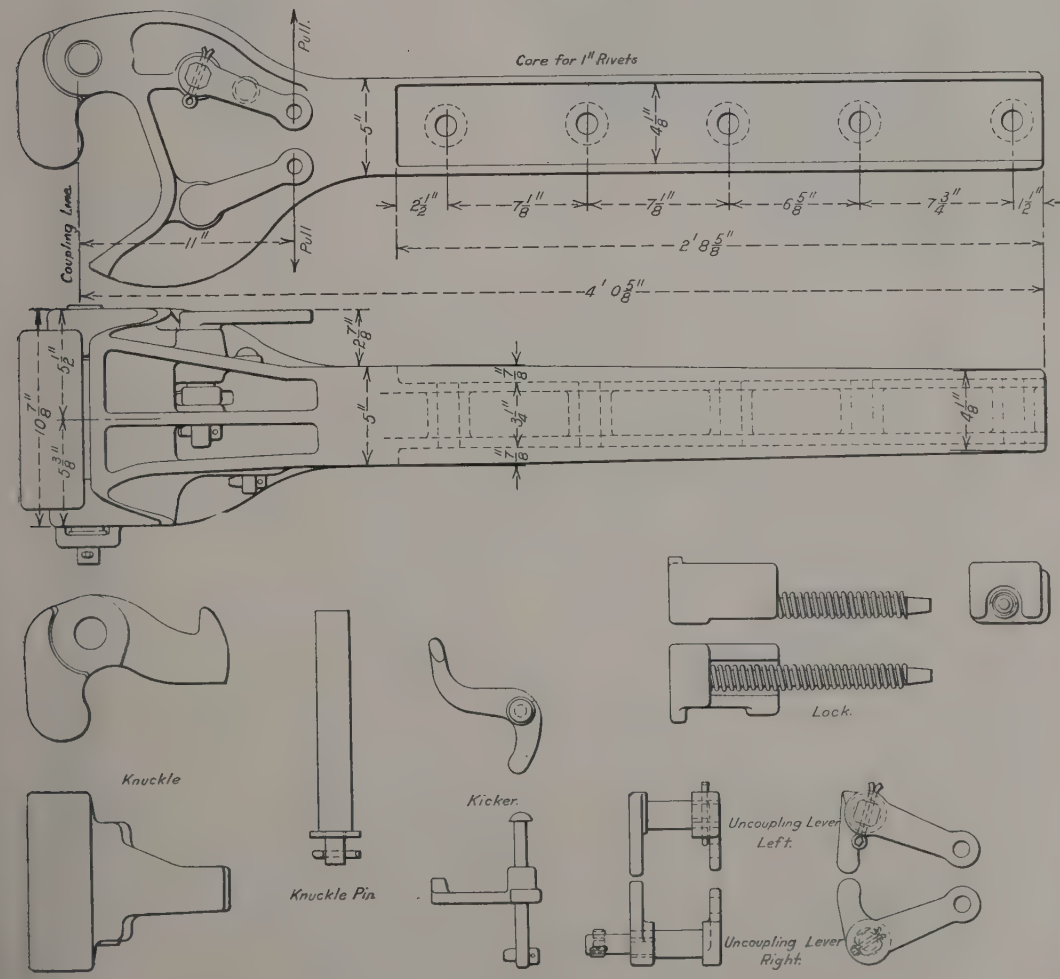
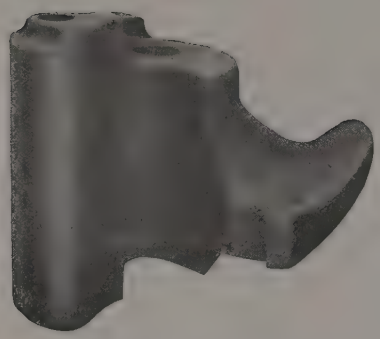


Fig. 1303—Double Top Operated Passenger Coupler. Gould Coupler Company.

(See also Page 955.)



Coupler Knuckle.

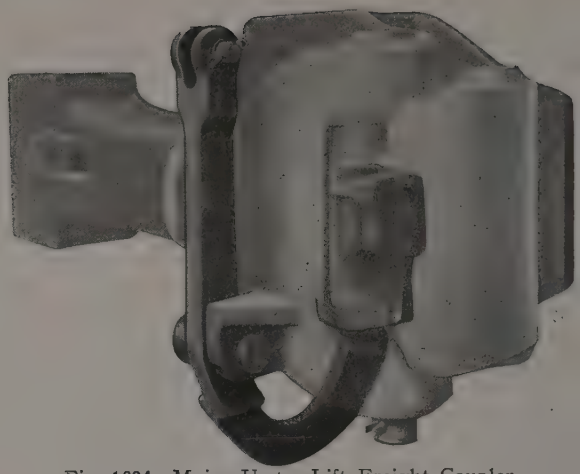
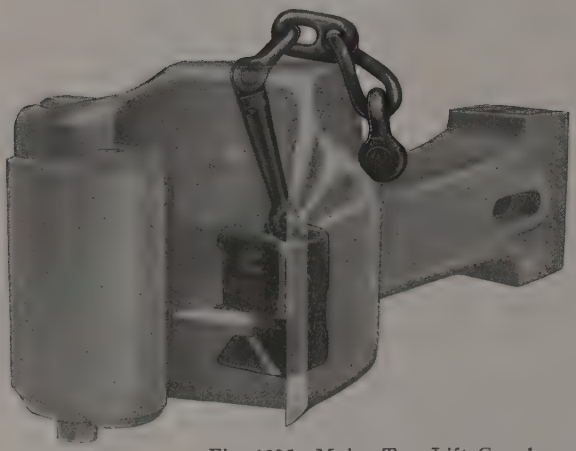


Fig. 1304—Major Under Lift Freight Coupler.
Buckeye Steel Castings Company.



Coupler Lock

Fig. 1305—Major Top Lift Coupler. Buckeye Steel Castings Company.
(*See also Page* 599.)

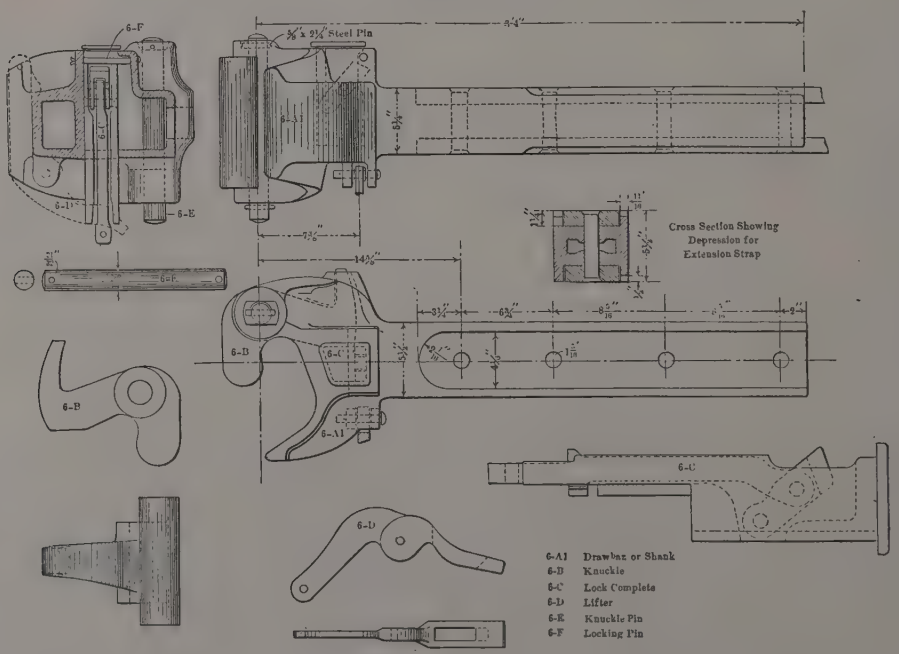


Fig. 1306—National Passenger Coupler No. 6A1 and Parts. National Car Coupler Company.

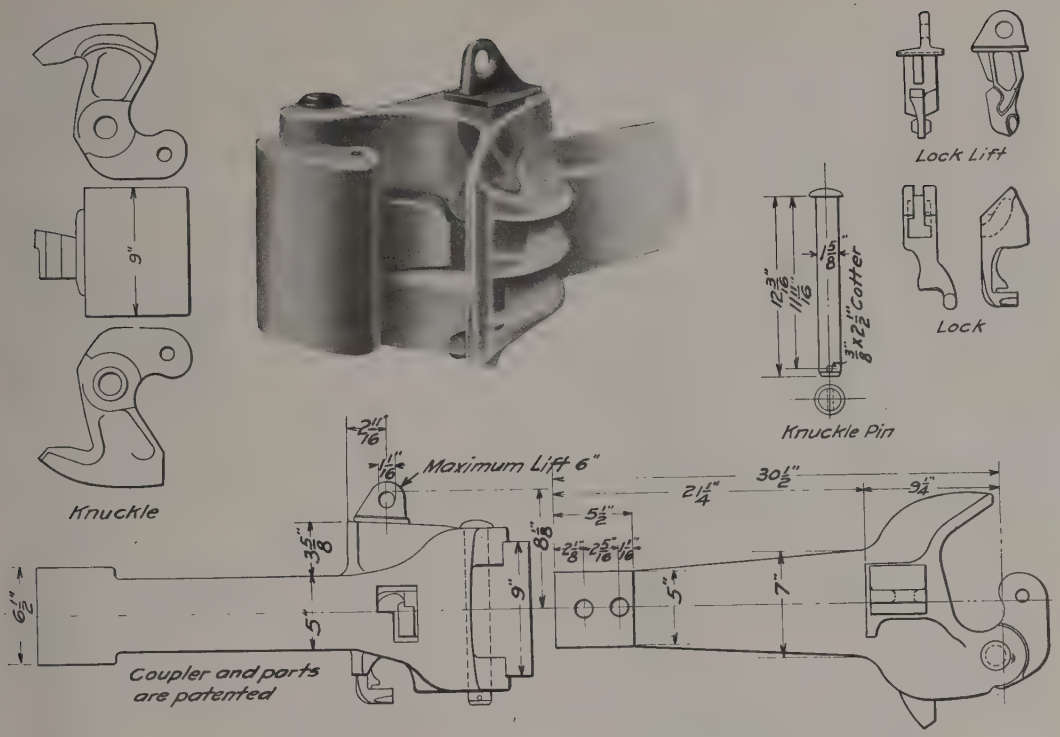


Fig. 1307—Latrobe Freight Coupler and Parts.

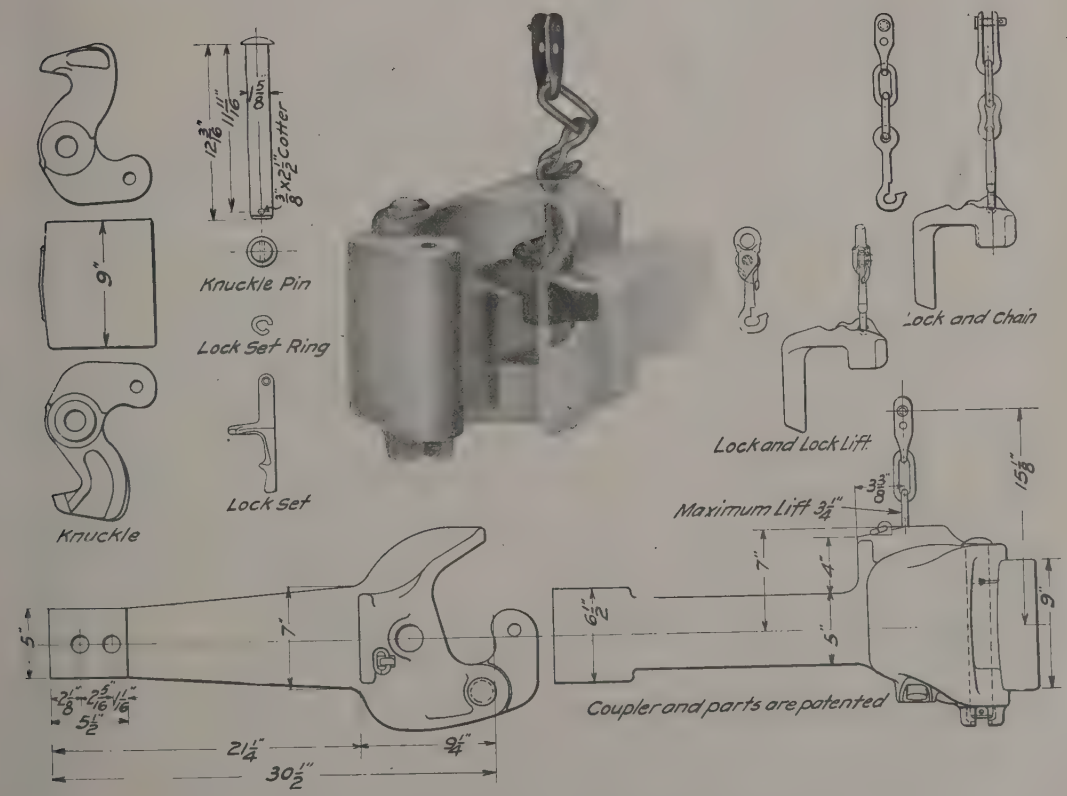


Fig. 1308—Tower Freight Coupler and Parts.

The National Malleable Castings Company.

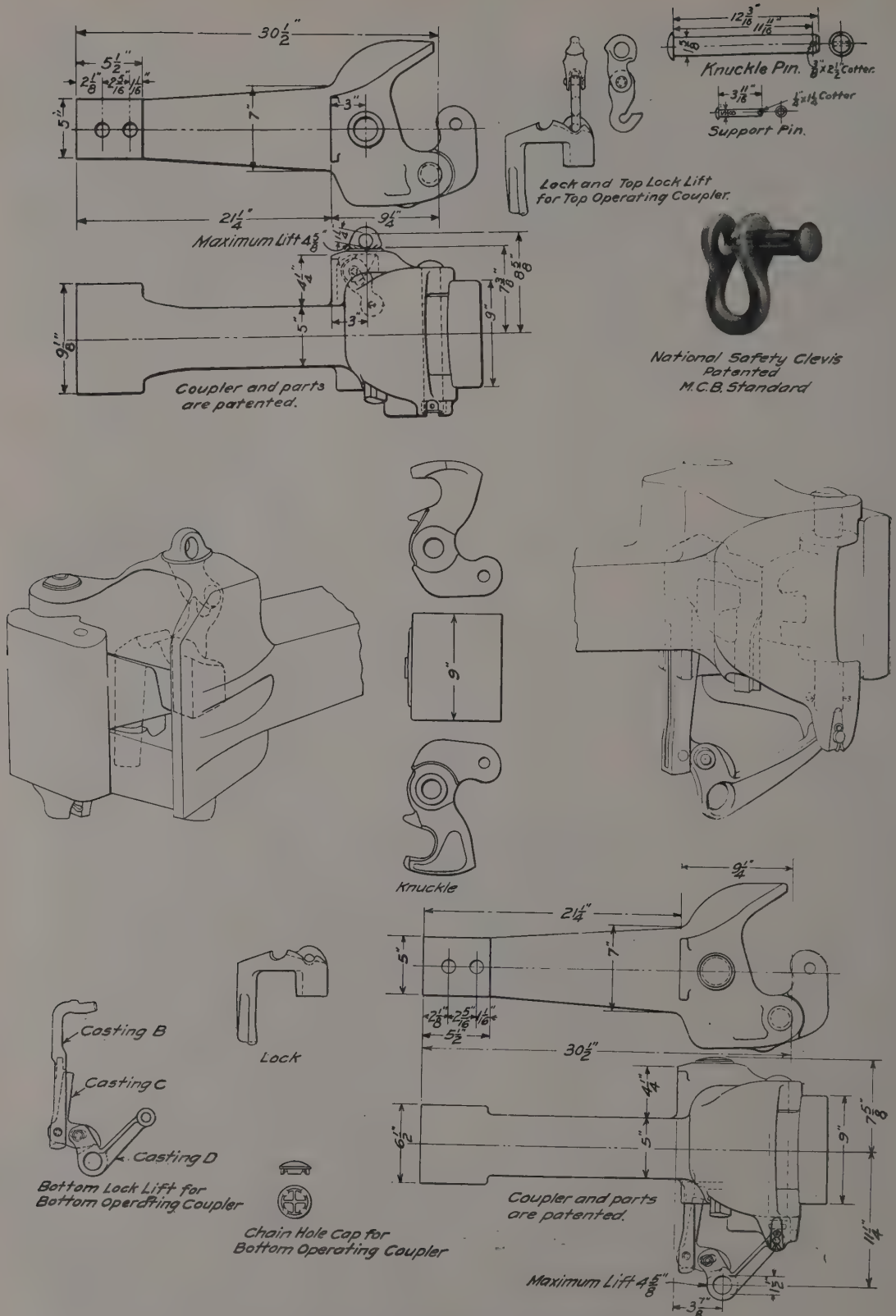


Fig. 1369—Sharon Top and Bottom Operating Freight Coupler.

The National Malleable Castings Company.

(*See also Page* 591.)

The Sharon Coupler

That the Sharon Coupler has gained, through many years of competitive service on the leading railroad systems, throughout the world, an enviable place among the present day couplers, as well as a high reputation, among railroad men, for dependability and ease of operation, is ample proof of its value as an automatic coupling device for both passenger and freight equipment. Endless study and research, looking toward the improvement of this coupler, have characterized the policy of the manufacturers, to the end that the Sharon coupler is one of the foremost couplers in use today.

Only the highest quality of open hearth steel is used in the manufacture of the coupler head and parts which, by the scientific distribution of metal are designed to give the maximum amount of strength and rigidity per pound weight of coupler. Special knuckles made of "Naco" steel will be furnished for Sharon couplers if desired; this is a specially heat treated steel possessing more than double the strength of ordinary open hearth steel.

Various types of the Sharon coupler designed for either top, bottom, or side operation make this coupler adaptable for use on all classes of freight and passenger cars as well as locomotive pilots and tenders.

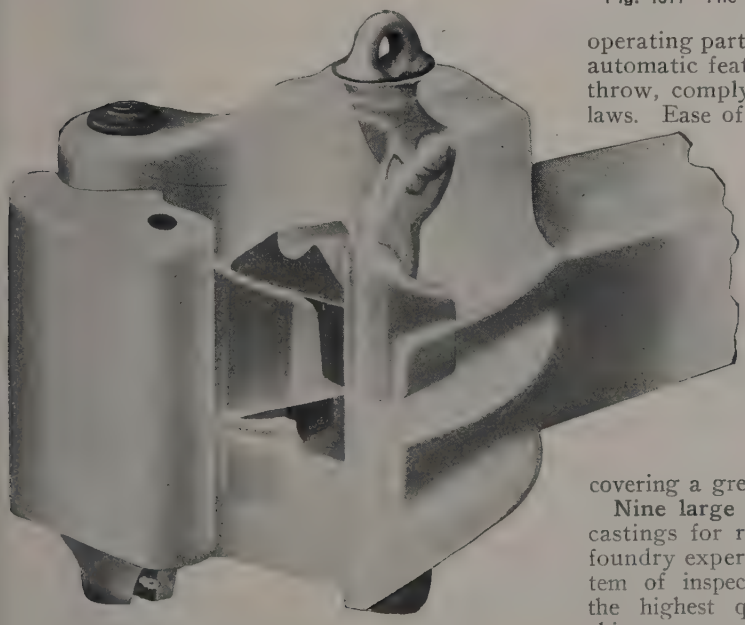


Fig. 1310—The Sharon Top Lift Coupler

Couplers for use with pilot and tender coupler pockets, are fitted with 6 in. by 6 in. shanks with steel bushing for a 2 in. pocket pin; and are also equipped with a wearing pad for use with extended floor pockets, unless otherwise ordered.

The operation of the Sharon coupler is simple, but positive and dependable; the lock itself serving as a knuckle thrower reduces the number of operating parts to the minimum. It embodies the automatic features of lock, lock-set and knuckle-throw, complying with all the Safety Appliance laws. Ease of operation is a salient feature of this coupler.

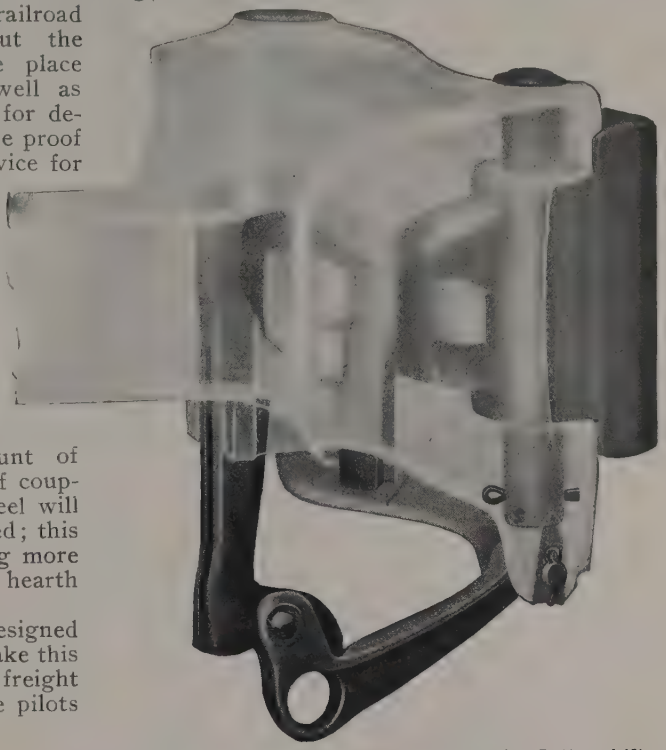


Fig. 1311—The Sharon Coupler Designed for Bottom Lift

Interchangeability of parts is an economic feature of this coupler which is of distinct benefit in reducing the number of parts necessarily kept in stock for repairs. All of the operating parts except the lock-lifter are interchangeable for all types of Sharon couplers.

Shanks and Butts of any standard design can be furnished by this company without delay, from a large stock of patterns covering a great number of different designs.

Nine large plants turn out a great variety of castings for railroad equipment. Fifty years of foundry experience together with a thorough system of inspection and tests are a guarantee of the highest quality of material and workmanship.

A. R. A. Standard "D" couplers, which are described on pages 569 to 573 are manufactured by The National Malleable Castings Company. The company also is in a position to supply repair parts for this coupler in any desired quantity and on short notice.

For other products and branch offices, see classified and alphabetical indexes.

THE NATIONAL MALLEABLE CASTINGS COMPANY, CLEVELAND, OHIO.

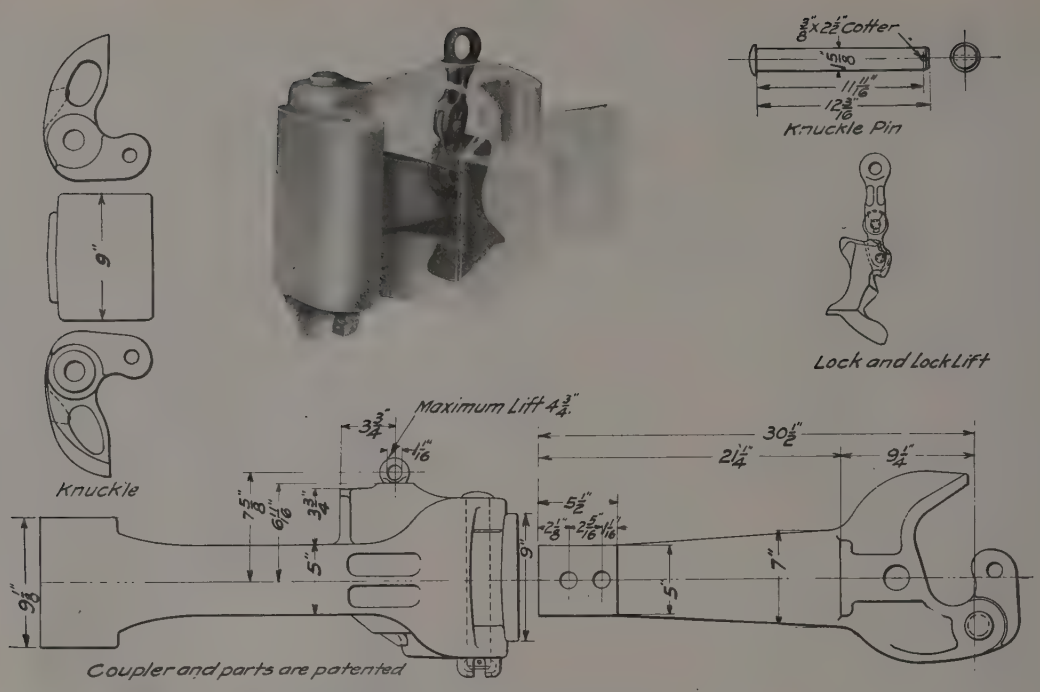


Fig. 1312—Climax Freight Coupler and Parts.

Fig. 1313—Munton Freight Coupler Parts.

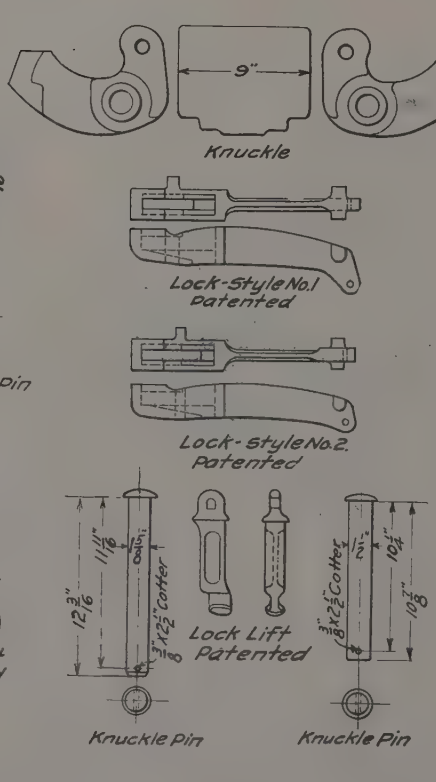


Fig. 1314—Chicago Freight Coupler Parts.

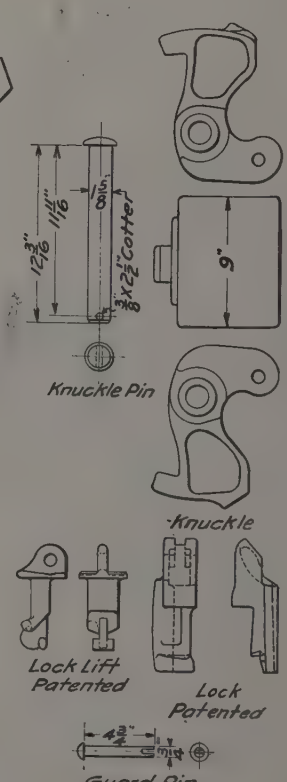


Fig. 1315—Melrose Freight Coupler Parts.

The National Malleable Castings Company.

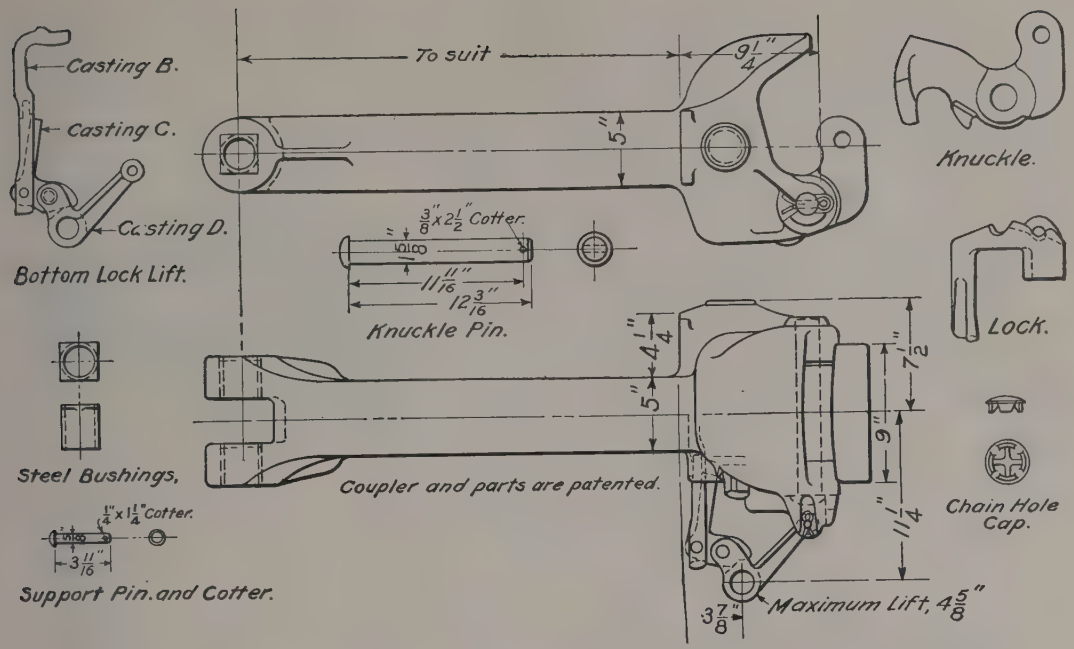


Fig. 1316—Sharon Passenger Coupler with Shank for Quadruple Shear Pivot Pin, and Parts.
(*See also Page* 591.)

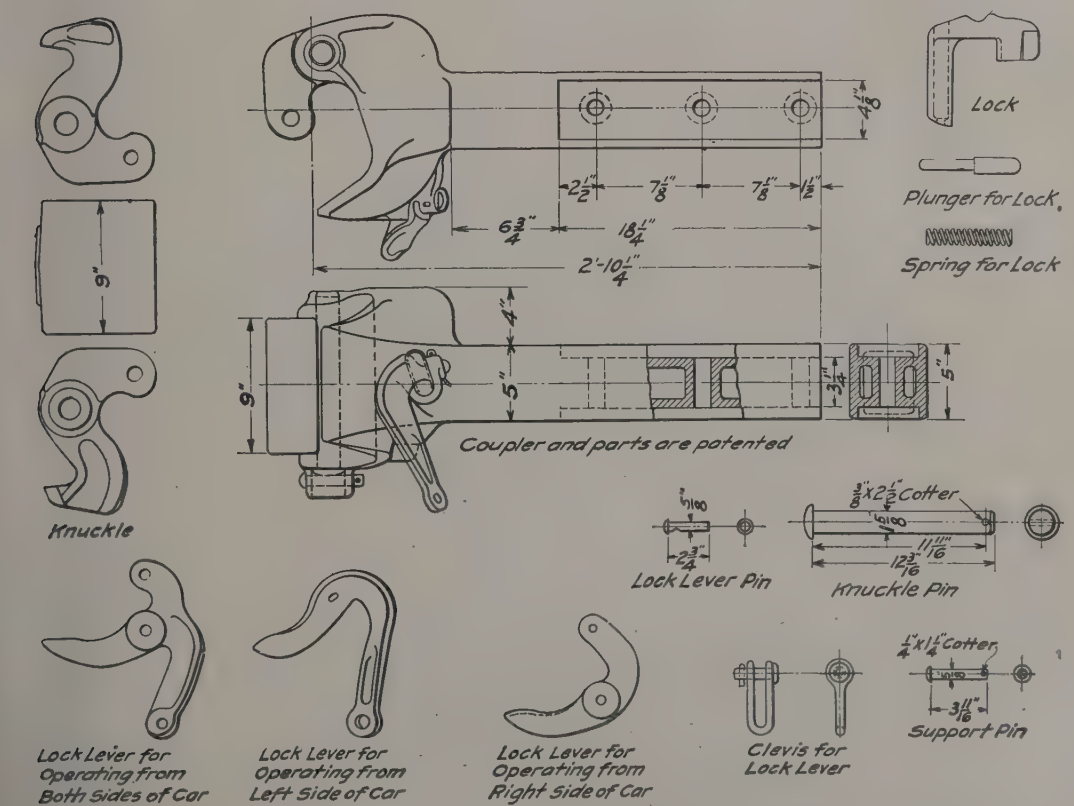


Fig. 1317—Tower Passenger Coupler and Parts.

The National Malleable Castings Company.

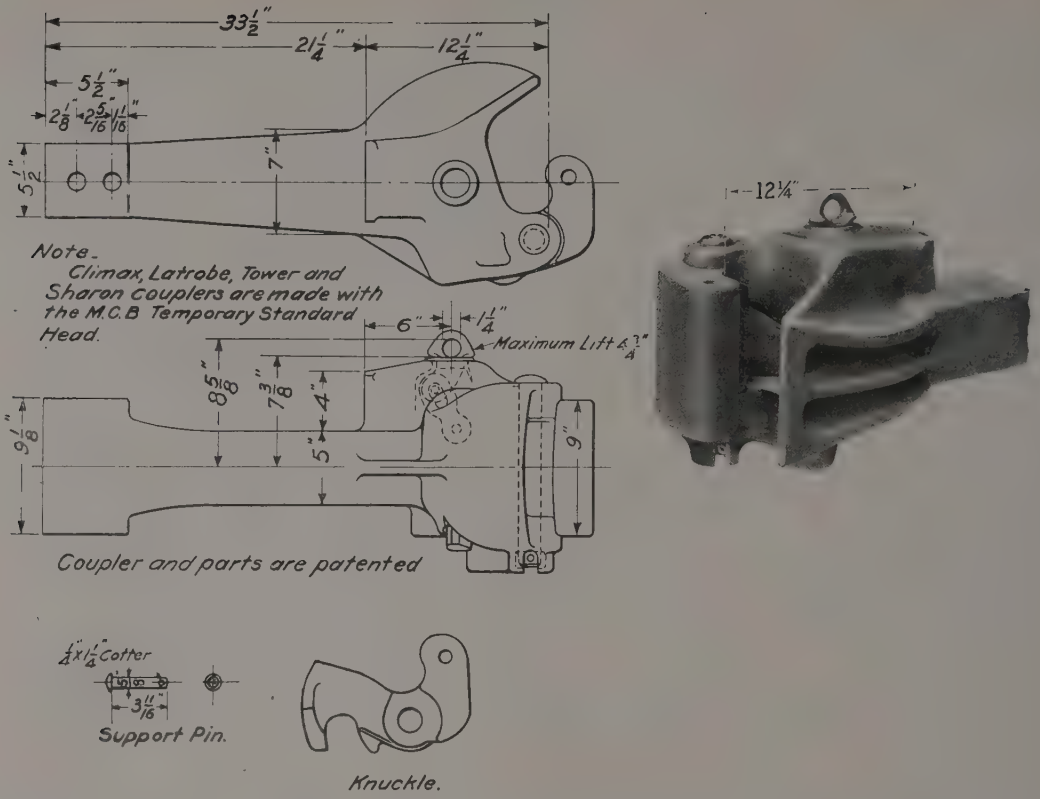


Fig. 1318—Sharon M. C. B. Temporary Standard Coupler Head. National Malleable Castings Company.

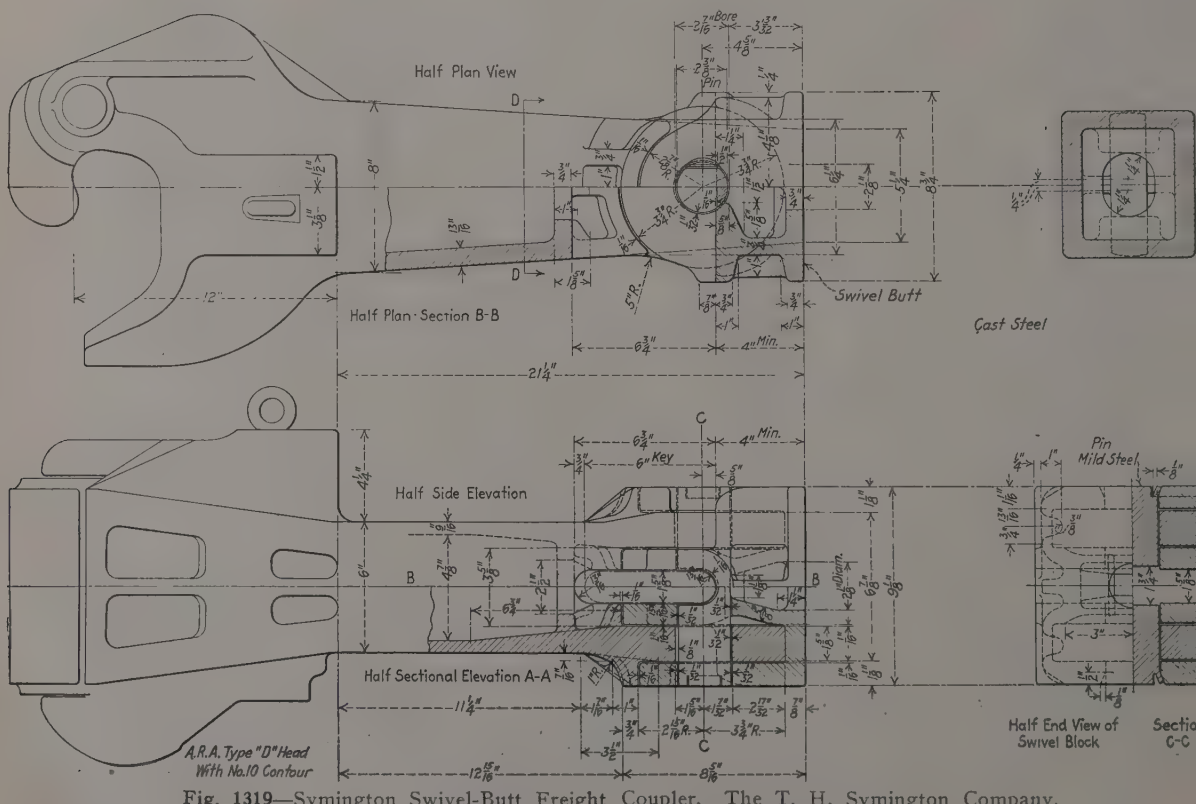


Fig. 1319—Symington Swivel-Butt Freight Coupler. The T. H. Symington Company.

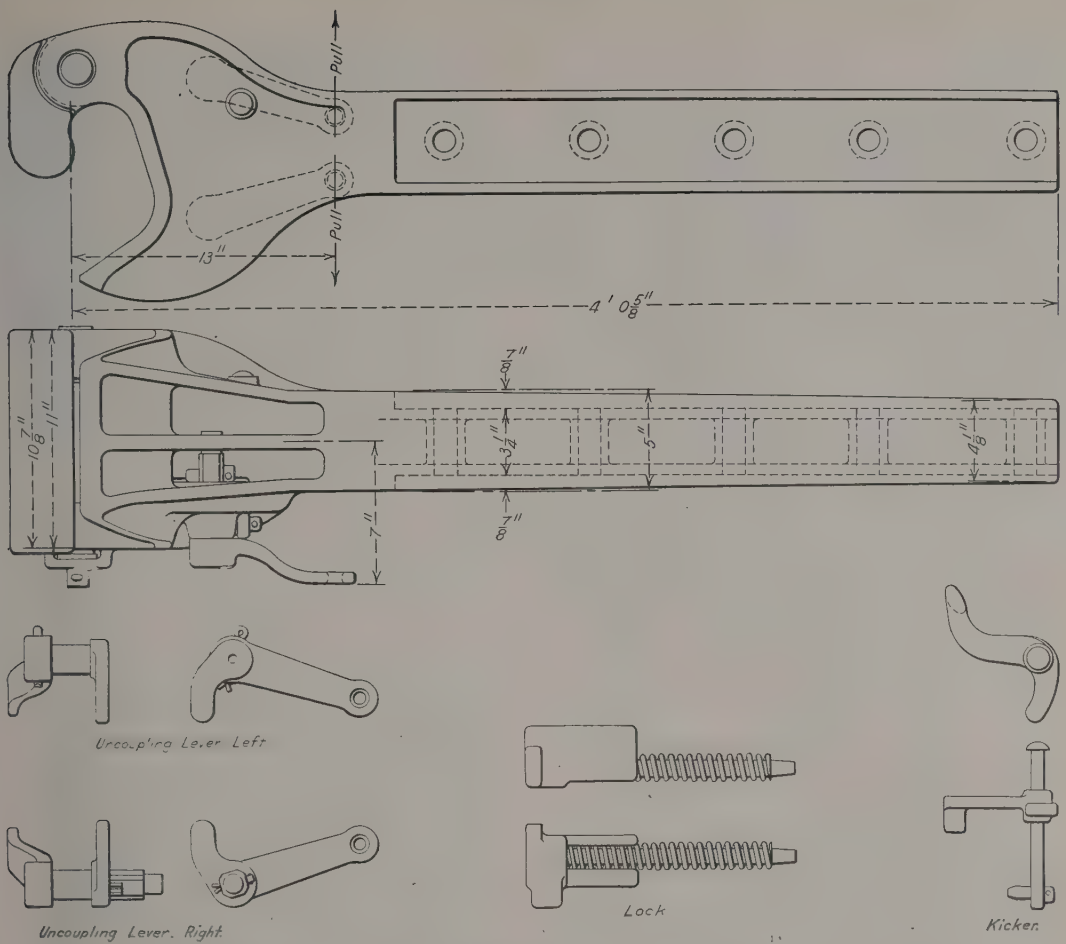


Fig. 1320—Double Bottom Operated Passenger Coupler. Gould Coupler Company.

(*See also Page 955.*)

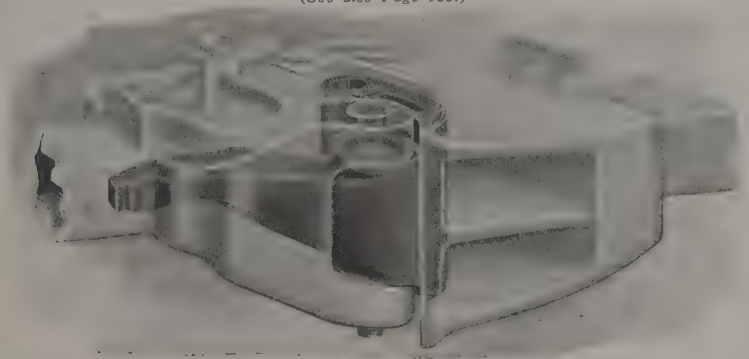


Fig. 1321—Gilman-Brown Emergency Knuckle. The Q. & C. Company.

Fig. 1322—Hinson Emergency Knuckle. National Car Coupler Company.

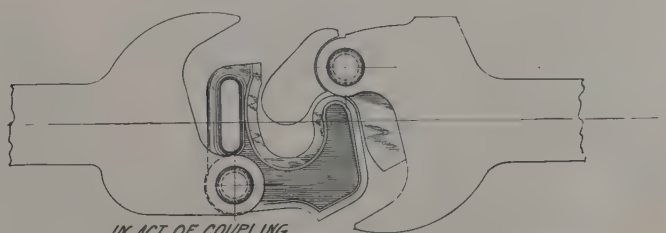


Fig. 1323—Application of Hinson Emergency Knuckle. National Car Coupler Company.

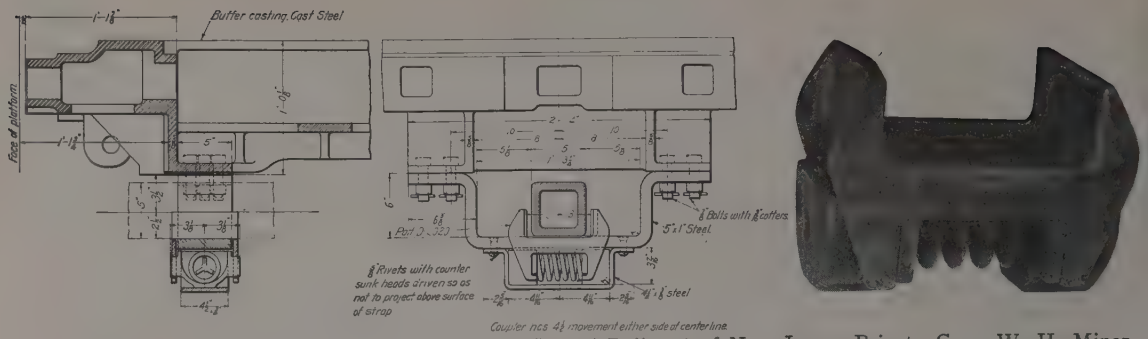

Buffer casting, Cast Steel
Face of platform
Bolts with cotters
5"x1" Steel
Rivets with countersunk heads driven so as not to project above surface of strap
Coupler has 4½ movement either side of center line

Fig. 1324—Miner Coupler Centering Device for Central Railroad of New Jersey Private Car. W. H. Miner.

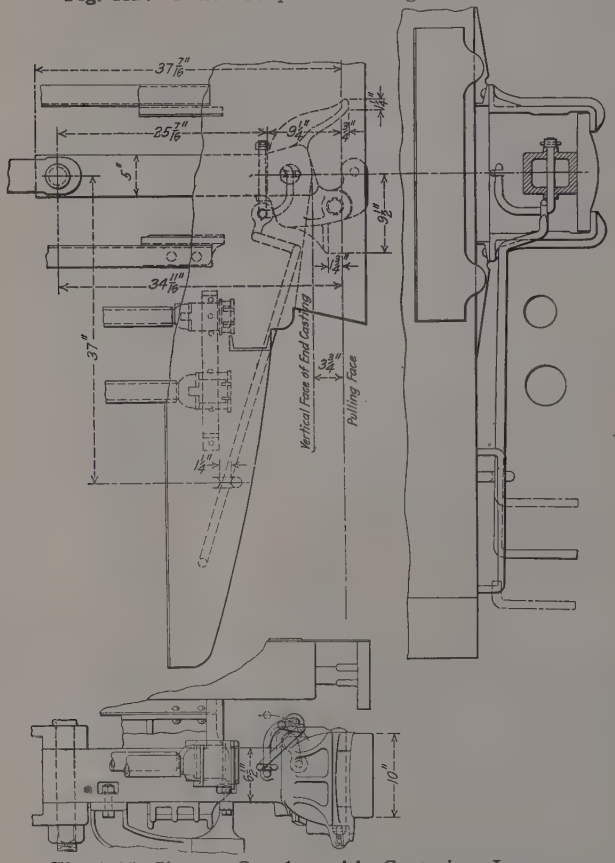


Fig. 1325—Sharon Coupler with Centering Lug on Side of Head, for Long Island Railroad Cars.

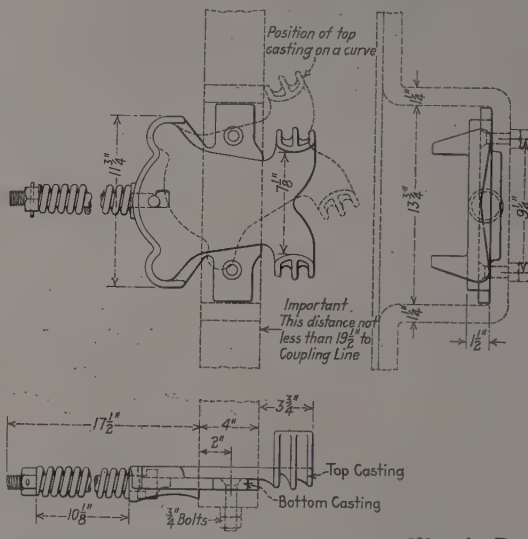

Position of top casting on a curve
Important. This distance not less than 19½" to Coupling Line
Top Casting
Bottom Casting
¾" Bolts

Fig. 1326—Chaffee Centering Device. Waugh Dra Gear Company.

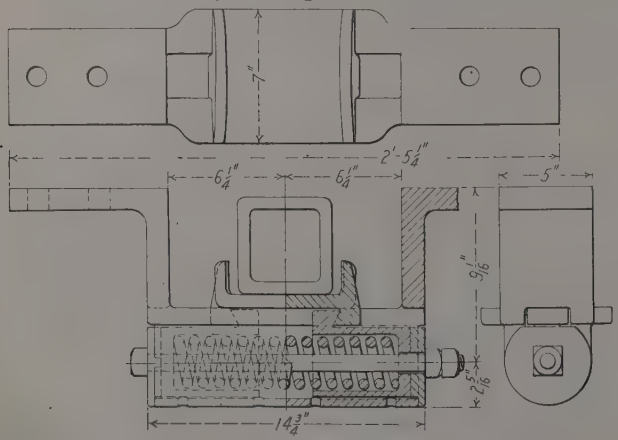
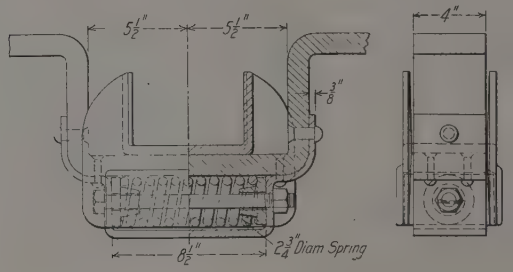


Fig. 1327—Combination Coupler Carrier and Centering Device. Gould Coupler Company.
(See also Page 955.)



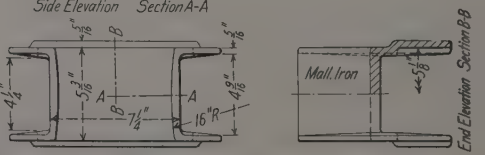


Fig. 1328—Yerk Centering Device. Waugh Draft Ge Company.

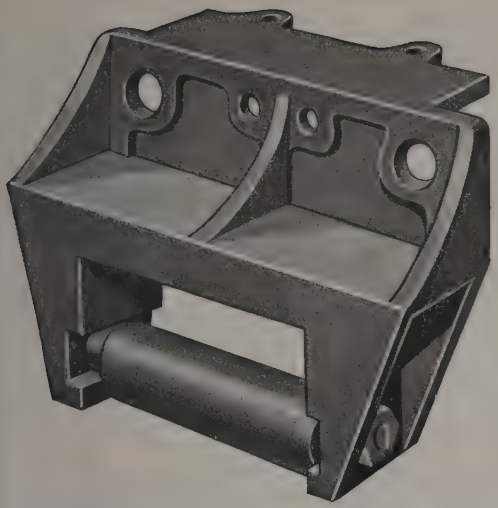


Fig. 1329—Flory Carry Iron for Wooden Cars.

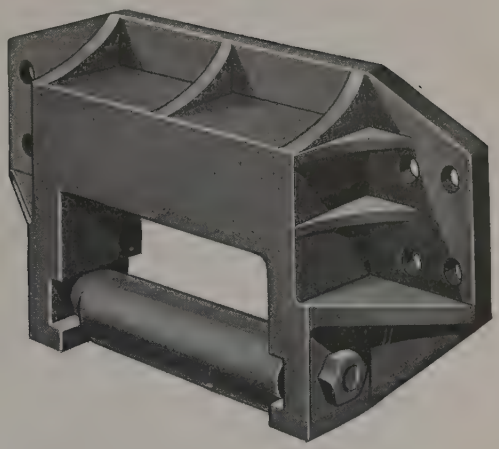


Fig. 1330—Flory Carry Iron for Steel Cars.

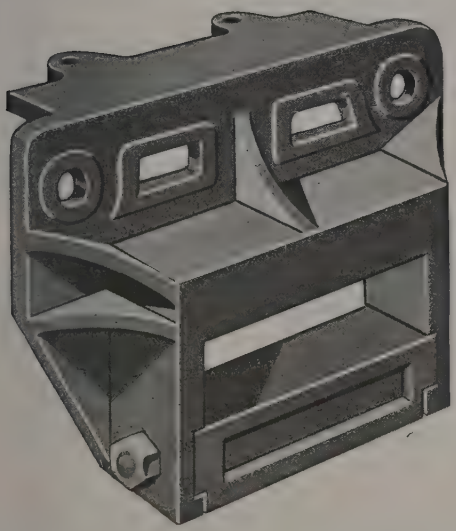


Fig. 1331—Lug-Supported Carry Iron for Wooden Cars.

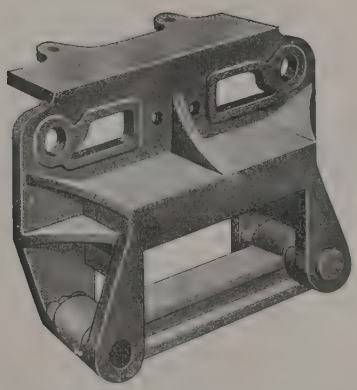


Fig. 1332—Flory Cast Steel Reversible Carry Iron and Striking Plate for Wooden Freight Cars.

Fig. 1333—Flory Cast Steel Reversible Carry Iron for Freight Couplers.

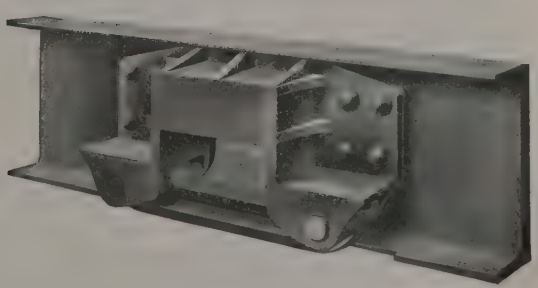


Fig. 1334—Flory Cast Steel Reverisble Carry Iron and Striking Plate for Steel Freight Cars.

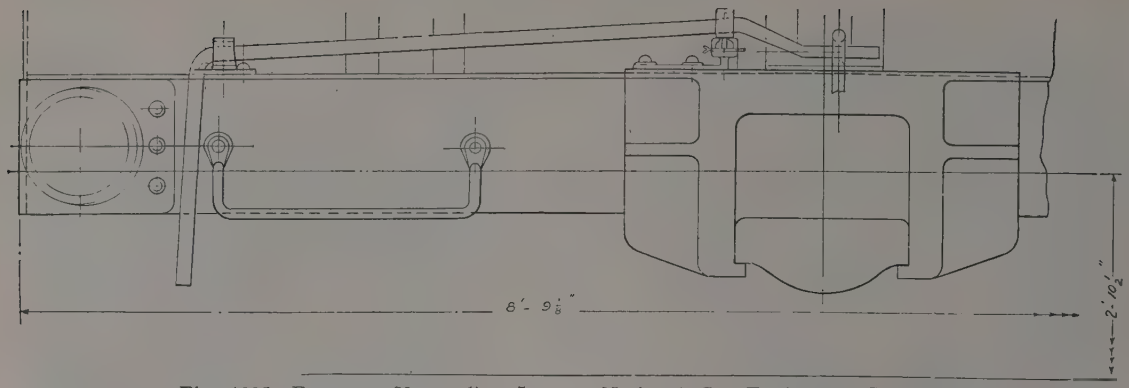


Fig. 1335—Economy Uncoupling Lever. National Car Equipment Company.
(See also Page 961.)

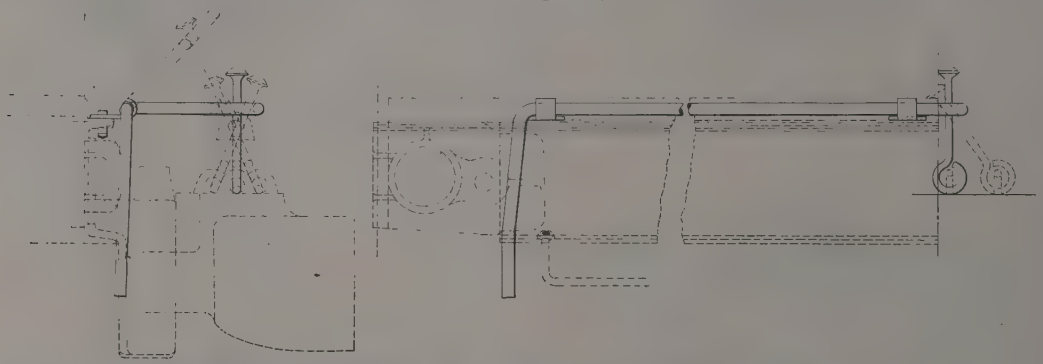


Fig. 1336—Application of Hutchins Uncoupling Lever. Hutchins Car Roofing Company.

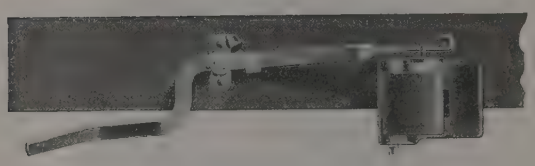


Fig. 1337—Carmer Release Rigging. Imperial Appliance Company.

Fig. 1338—Imperial Type "B" Release Rigging. Imperial Appliance Company.

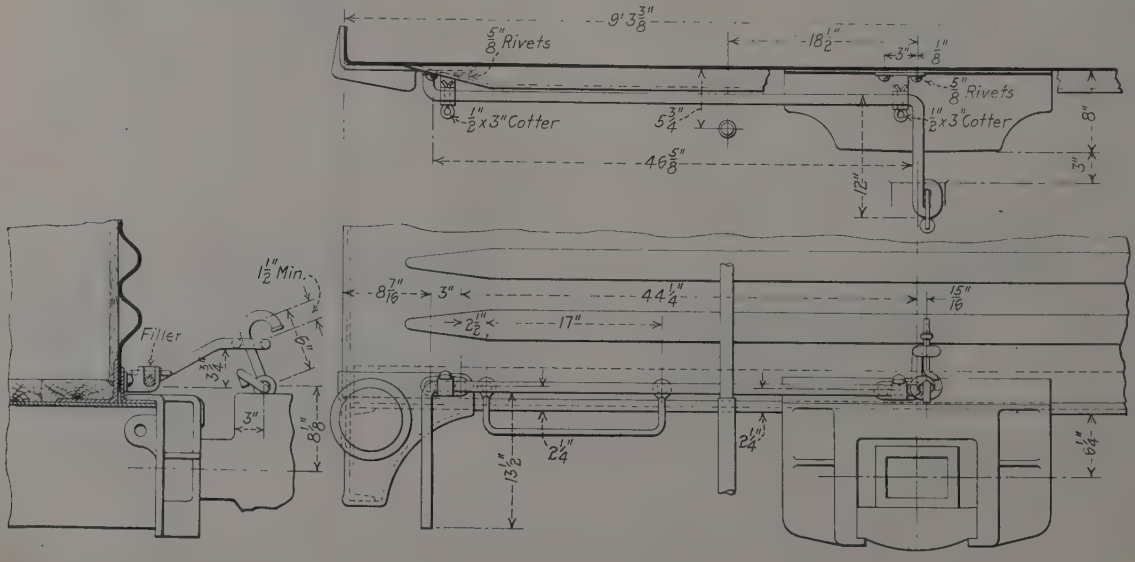


Fig. 1339—Application of Imperial Type "B" Coupler Release Rigging. Imperial Appliance Company.

Type "D" Coupler; Major Coupler; Buckeye Yoke

The A. R. A. Standard "D" Coupler—illustrated on pages 569 to 573—represents the culmination of years of painstaking effort on the parts of the Association, and the coupler manufacturers. The ample equipment of the Buckeye Steel Castings Company together with 25 years of experience as coupler manufacturers, place this company in a favorable position for supplying these couplers to the railroads.

The Major Coupler which is suitable for both passenger and freight equipment is manufactured by the Buckeye Steel Castings Company, a one-piece lock distinguishing it from couplers having "kickers"

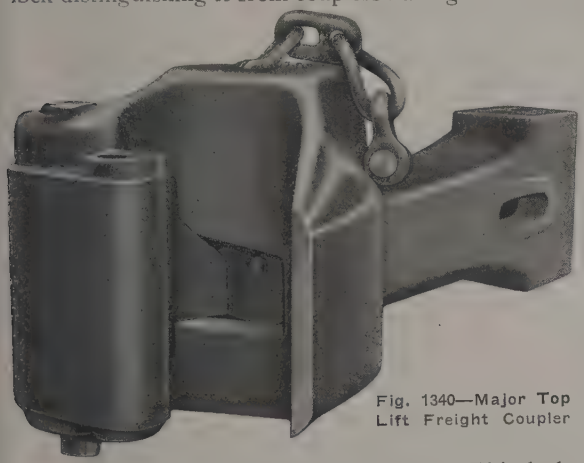


Fig. 1340—Major Top Lift Freight Coupler

or extra parts for opening the knuckle. This lock which is simply a short block contained entirely within the coupler head, performs all the functions of lock, knuckle opener and lock set. Raising the lock disengages the knuckle, and throws the knuckle to full open position. When the operating lever is in normal position, the lock rests upon the knuckle tail ready to lock positively whenever the knuckle is closed. Any style shank or operating mechanism is suitable.

Maximum strength for the coupler head and knuckle, and ease of operation are permitted by the one-piece Major lock which cannot bend, and when in locked position is in compression only. The pivot pin is relieved of the heavy pulling and buffing strains by shoulders on the knuckle and coupler head. The distribution of metal is such as to give a strong efficient coupler within the A. R. A. dimensions.

The underlift coupler is a modification of the standard toplift coupler. The hole in the top of the coupler is omitted and the lock is lifted from below by a bell crank lever, and the release rigging is entirely below the top of the coupler. This is advantageous on flat, end-door automobile and ballast cars where toplift rods are liable to damage by lading. The underlift type of coupler is also free from interference in operation from collection of dirt, snow, etc.

The Buckeye Cast Steel Coupler Yoke is a one-piece steel casting, designed to replace the forged

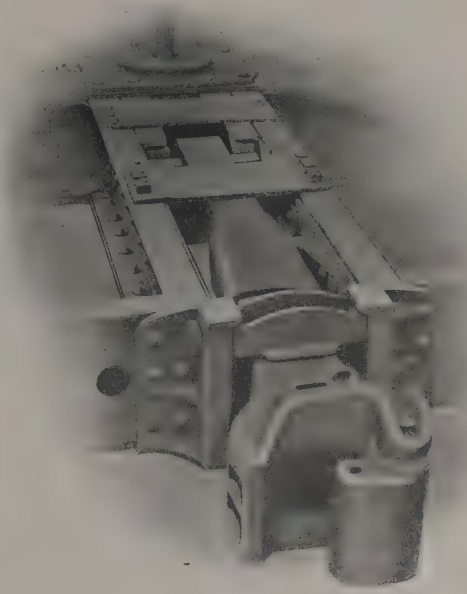


Fig. 1341—Inverted View of Buckeye Cast Steel Yoke Assembled with Coupler

riveted yoke commonly used. The coupler butt fits into a hooded head at the front end of the yoke, and is held by a standard A. R. A. key.

The key connection is stronger than the riveted construction, and both lateral and radial movement of the coupler are allowed. A new coupler may be applied without disturbing the draft gear.

Any type of spring or friction draft gear may be used with the Buckeye Cast Steel Yoke.

The heavy friction yoke illustrated is the type furnished by The Buckeye Steel Castings Company for the 60,000 United States Railroad administration cars and is also used exclusively on the tenders of the United States Standard Locomotives. It is designed to have an ultimate strength of 15 to 20 per cent higher than the standard Type "D" coupler and provides for a large key of 6 in. by 1½ in.

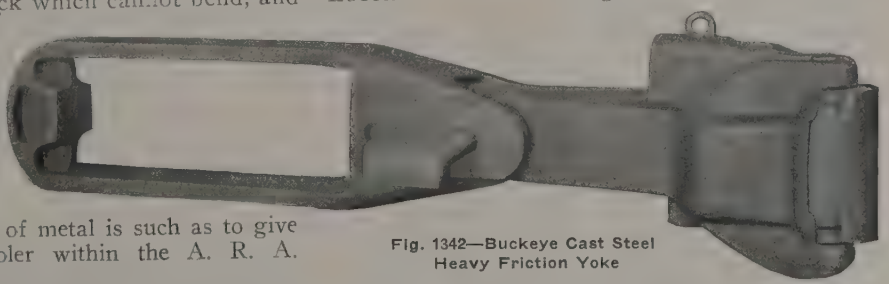


Fig. 1342—Buckeye Cast Steel Heavy Friction Yoke

This Yoke can be used with any type of draft gear requiring 24⅝ in. gear pocket and has been applied very extensively on cars built since the U. S. R. A. cars were placed in service.

For other products and branch offices, see classified and alphabetical indexes.

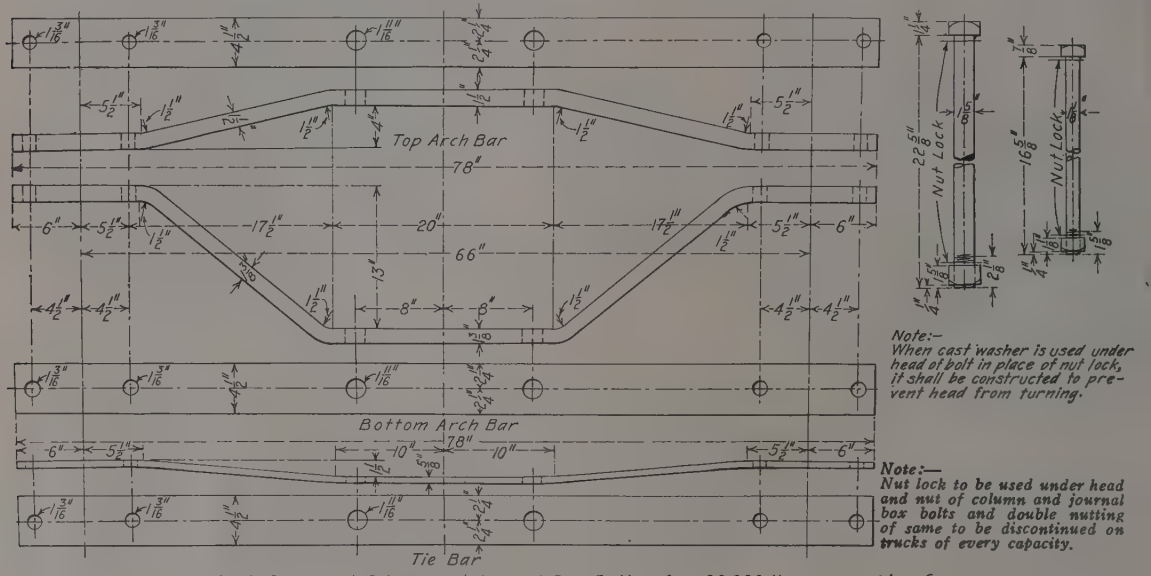
Car Trucks

CAR TRUCKS FOR USE ON AMERICAN RAILWAYS are built in accordance with general requirements specified by the American Railway Association as follows:

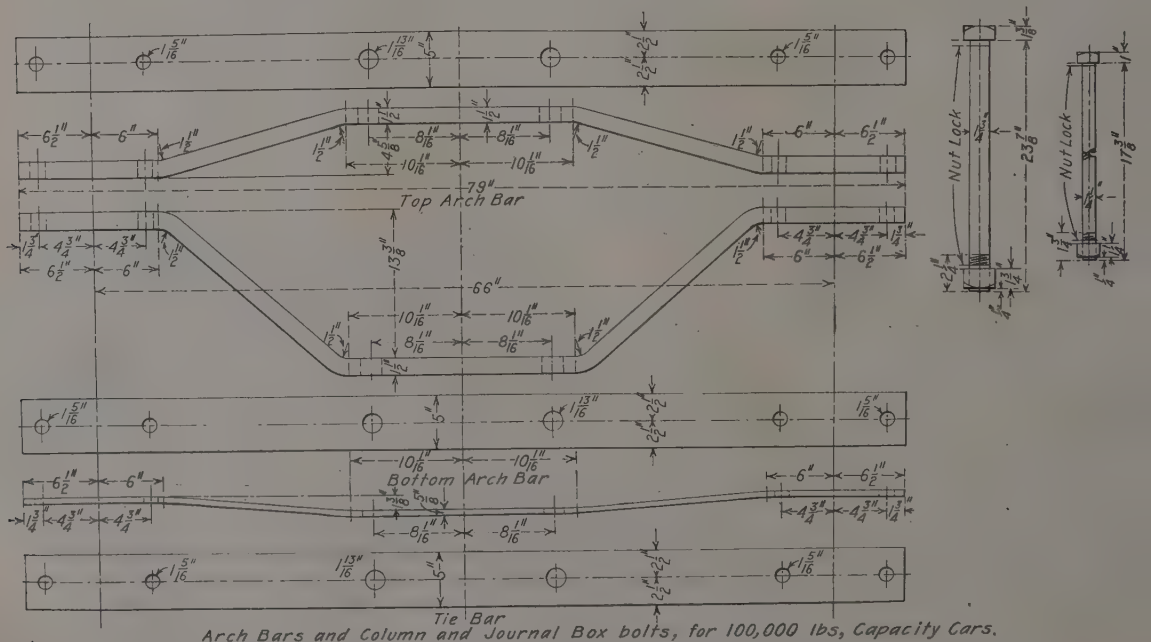
The standard distance between the backs of flanges of car, engine truck, driver and tender wheels at base line of tread shall be not less than 4 feet 5 3/32 in., nor more than 4 feet 5½ in.

Maximum allowable height of flange for cast iron wheels is 1½ in. Standard. Adopted, 1910.

In 1911 a recommended practice was adopted that for high

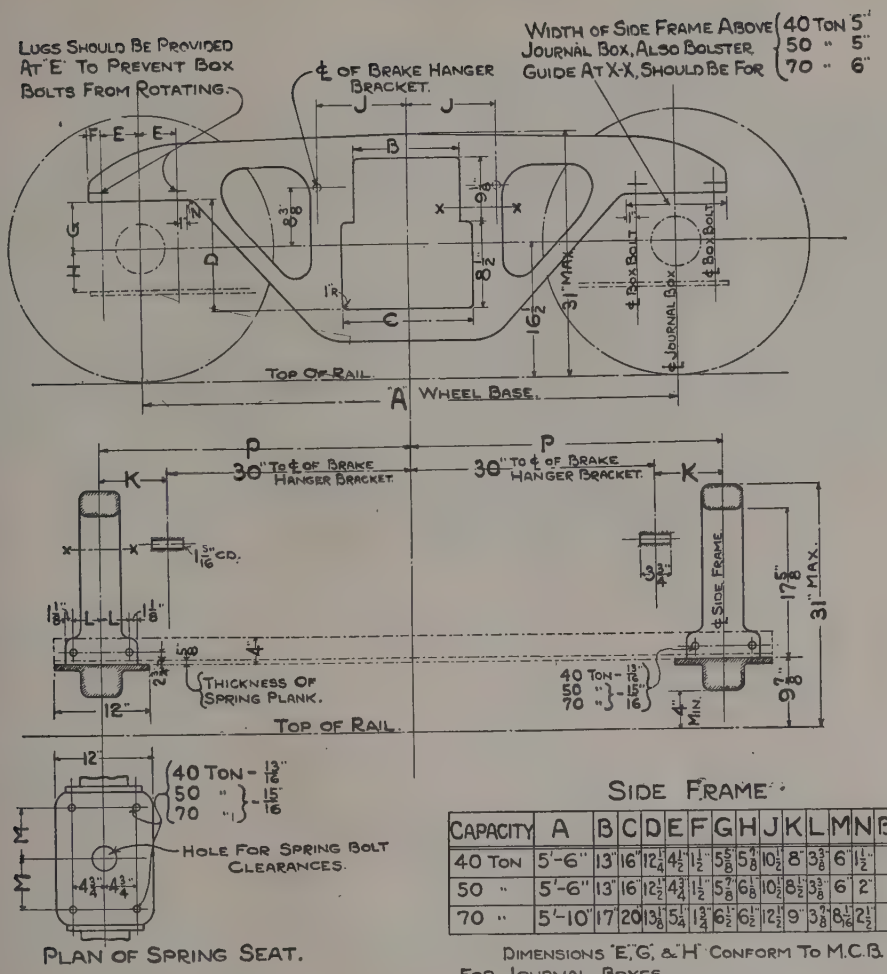

Top Arch Bar
78"
66"
Bottom Arch Bar
78"
Tie Bar
Nut Lock
Nut Lock
Note:—
When cast washer is used under head of bolt in place of nut lock, it shall be constructed to prevent head from turning.
Note:—
Nut lock to be used under head and nut of column and journal box bolts and double nutting of same to be discontinued on trucks of every capacity.

Arch Bars and Column and Journal Box Bolts, for 80,000 lbs, Capacity Cars



Arch Bars and Column and Journal Box bolts, for 100,000 lbs, Capacity Cars.

FIG. 1343—A. R. A. STANDARD ARCH BARS AND COLUMN AND JOURNAL BOX BOLTS.


Lugs Should Be Provided At "E" To Prevent Box Bolts From Rotating.
℄ of Brake Hanger Bracket.
Width of Side Frame Above Journal Box, Also Bolster, Guide At X-X, Should Be For 40 Ton 5" 50 " 5" 70 " 6"
Top of Rail.
A Wheel Base.
30" To ℄ of Brake Hanger Bracket.
Thickness of Spring Plank.
℄ Side Frame
31" Max.
40 Ton - 13/16" 50 " - 15/16" 70 " - 15/16"
Hole For Spring Bolt Clearances.
Plan of Spring Seat.

Side Frame.

Capacity	A	B	C	D	E	F	G	H	J	K	L	M	N	Box Bolts
40 Ton	5'-6"	13"	16"	12¼"	4½"	1½"	5⅝"	5⅞"	10½"	8"	3⅜"	6"	1½"	1⅛"
50 "	5'-6"	13"	16"	12½"	4¾"	1½"	5⅞"	6⅛"	10½"	8½"	3⅜"	6"	2"	1¼"
70 "	5'-10"	17"	20"	13⅜"	5¼"	1¾"	6½"	6½"	12½"	9"	3⅞"	8⅛"	2½"	1⅜"

Dimensions "E," "G," & "H" Conform To M.C.B. Standard For Journal Boxes.
"F" Is A Minimum Dimension.

Fig. 1344—A. R. A. Recommended Practice for Truck Sides, Cast Steel, Limiting Dimensions for 80,000, 100,000 and 140,000 lb. Capacity Cars.

capacity cars built in the future, and likely to be equipped with steel wheels, that provision be made in the construction of car and trucks to permit the use of wheels varying in diameter from 33 inches to 30 inches.

Wrought steel wheels shall be of the following diameters: 33 in., 36 in. or 38 in., and the centers shall be of 28 in., 31 in. or 33 in. diameter, respectively. Standard. Adopted, 1914.

In 1920 a standard practice was adopted to designate axles, journal boxes and contained parts by letter as follows:

3¾x7 in. axle, journal box and contained parts, to be designated by the letter A.

4¼x8 in. axle, journal box and contained parts, to be designated by the letter B.

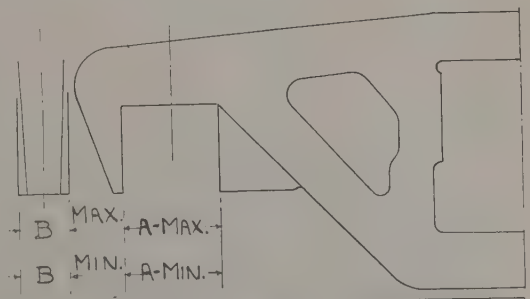
5x9 in. axle, journal box and contained parts, to be designated by the letter C.

5½x10 in. axle, journal box and contained parts, to be designated by the letter D.

6x11 in. axle, journal box and contained parts, to be designated by the letter E.

6½x12 in. axle, journal box and contained parts, to be designated by the letter F.

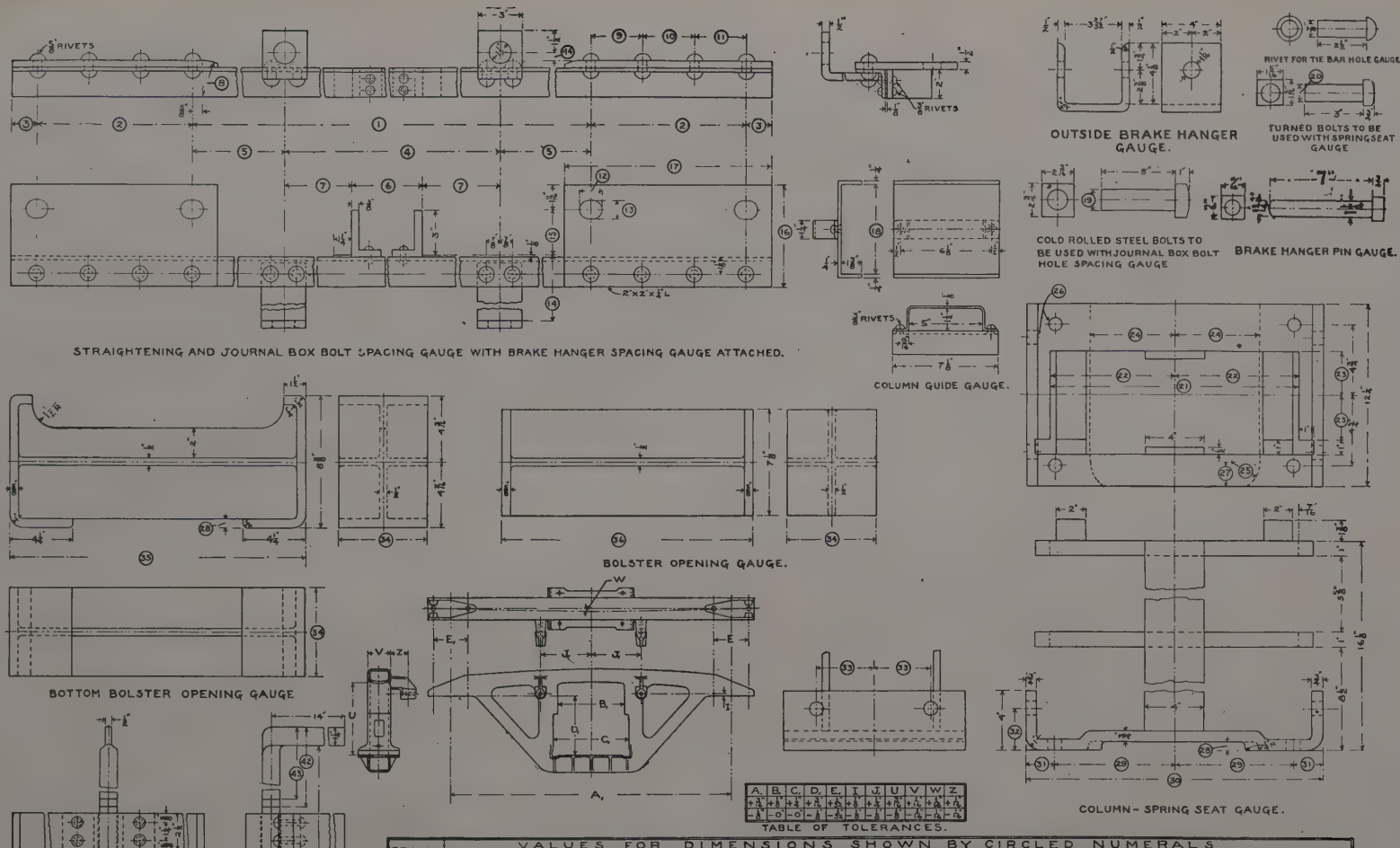
In the same manner the classifications 2A, 2B, 2C, etc.,



Capacity	Truck Frame				Journal Box			
	A		B		A		B	
	Max	Min	Max	Min	Max	Min	Max	Min
40 Ton	9 3/16"	9 1/16"	3 5/16"	3 9/16"	9"	8 15/16"	3 3/4"	3 11/16"
50 Ton	9 3/16"	9 1/16"	3 5/16"	3 9/16"	9"	8 15/16"	3 3/4"	3 11/16"
70 Ton	10 1/16"	10 1/16"	5 7/16"	5 7/16"	10 1/16"	10 1/16"	6 1/16"	6"

Fig. 1345—A. R. A. Recommended Practice for Limiting Dimensions for Pedestal Jaws and Box for Cast Steel Truck Sides.

were adopted for two axle trucks and 3A, 3B, 3C, etc., for three axle trucks, the letters designating the axle used and the figures designating the number of axles in each truck.


STRAIGHTENING AND JOURNAL BOX BOLT SPACING GAUGE WITH BRAKE HANGER SPACING GAUGE ATTACHED.
OUTSIDE BRAKE HANGER GAUGE.
RIVET FOR TIE BAR HOLE GAUGE.
TURNED BOLTS TO BE USED WITH SPRING SEAT GAUGE
COLD ROLLED STEEL BOLTS TO BE USED WITH JOURNAL BOX BOLT HOLE SPACING GAUGE
BRAKE HANGER PIN GAUGE.
COLUMN GUIDE GAUGE.
BOLSTER OPENING GAUGE.
BOTTOM BOLSTER OPENING GAUGE
COLUMN - SPRING SEAT GAUGE.
TABLE OF TOLERANCES.
A B C D E I J U V W Z
+ 1/16 + 1/16 + 1/16 + 1/16 + 1/16 + 1/16 + 1/16 + 1/16 + 1/16 + 1/16
- 1/8 - 0 - 0 - 1/8 - 1/8 - 1/8 - 1/8 - 1/8 - 1/8 - 1/8
DRILL
RIVETS

VALUES FOR DIMENSIONS SHOWN BY CIRCLED NUMERALS

FRAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
40-TON	4'-9"	9"	1⅛	2⅛	18	12⅝	4⅝	1⅛	3"	3"	3"	1⅛	1⅛	7⅛	2⅝	6⅝	12"	5¼	1⅛	⅝	12⅛	6¼	2⅝	3½	3½	1⅛	2⅛	⅝	6"	16"	1⅛	2⅛	3⅛	5"	MAX. 10⅛ MIN. 9⅝	MAX. 1⅝ MIN. 1⅜	5'-6"	2'-9"	MAX. 9⅜ MIN. 8⅞	MAX. 1⅝ MIN. 1⅜	MAX. 2⅝ MIN. 2⅜	MAX. 2⅝ MIN. 2⅜	2⅛
50- "	4'-8⅝	9⅛	1⅛	2⅛	17⅞	12⅝	4⅝	2"	3⅛	3⅛	3⅛	1⅛	1⅛	8⅛	2⅝	6⅝	12⅛	5¼	1⅛	⅝	12⅛	6¼	2⅝	3½	3½	1⅛	2⅛	⅝	6"	16"	2"	2⅛	3⅛	5"	MAX. 10⅛ MIN. 9⅝	MAX. 1⅝ MIN. 1⅜	5'-6"	2'-9"	MAX. 9⅜ MIN. 8⅞	MAX. 1⅝ MIN. 1⅜	MAX. 2⅝ MIN. 2⅜	MAX. 2⅝ MIN. 2⅜	2⅛
70- "	4'-11⅝	10⅛	1⅛	2⅝	17⅞	16⅝	4⅝	2⅝	3⅛	3⅛	3⅛	1⅛	1⅛	8⅛	3⅛	6⅝	14"	6⅛	1⅛	⅝	16⅛	8⅛	3⅛	5⅛	5⅛	1⅛	2⅛	⅝	8⅛	20"	1⅛	2⅛	3⅛	6"	20⅛	20"	17⅛	5'-10"	2'-11"	10⅛	10⅛	1⅛	10⅛	1⅛

Fig. 1346— A. R. A. Recommended Practice for Gages for Cast Steel Truck Sides for 80,000, 100,000 and 140,000 lb. Capacity Freight Cars.

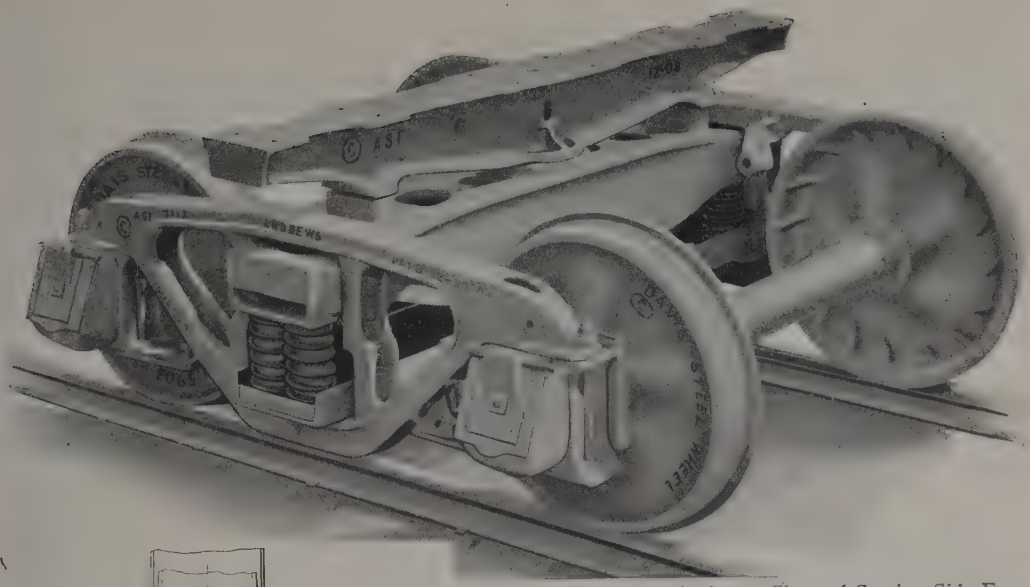


Fig. 1347—Andrews Channel Section Side Frame Truck. American Steel Foundries.
(See also Page 631.)

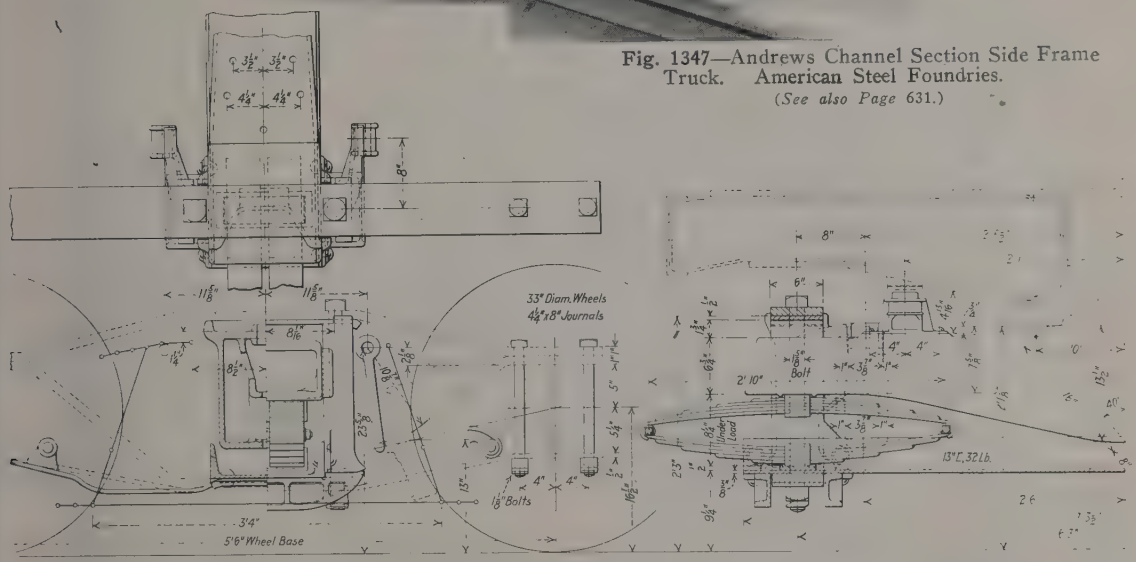


Fig. 1348—General Arrangement of Four-Wheel Truck. Standard Steel Car Company.

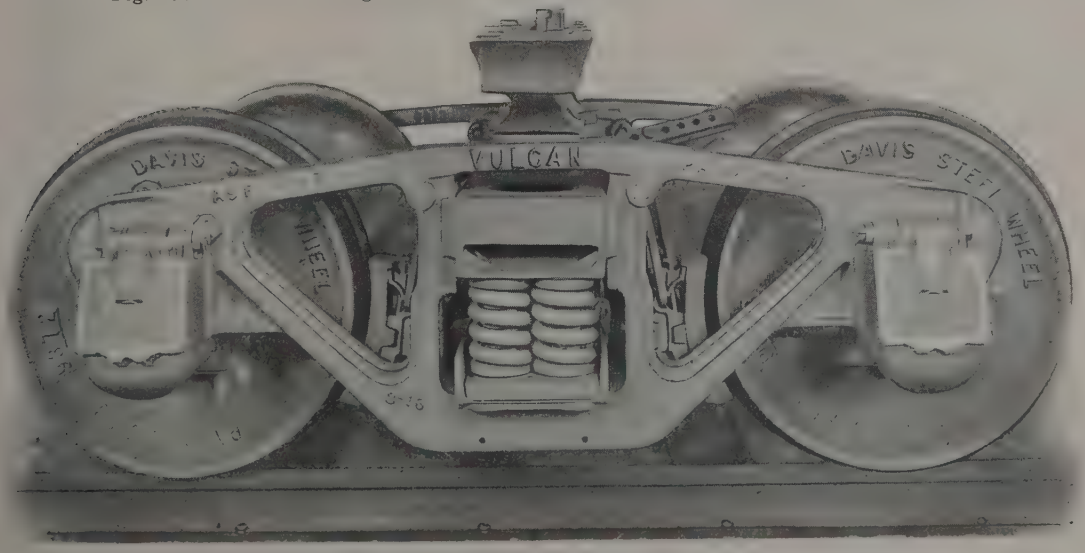


Fig. 1349—Vulcan Cast Steel Side Frame Truck. American Steel Foundries.
(See also Page 631.)

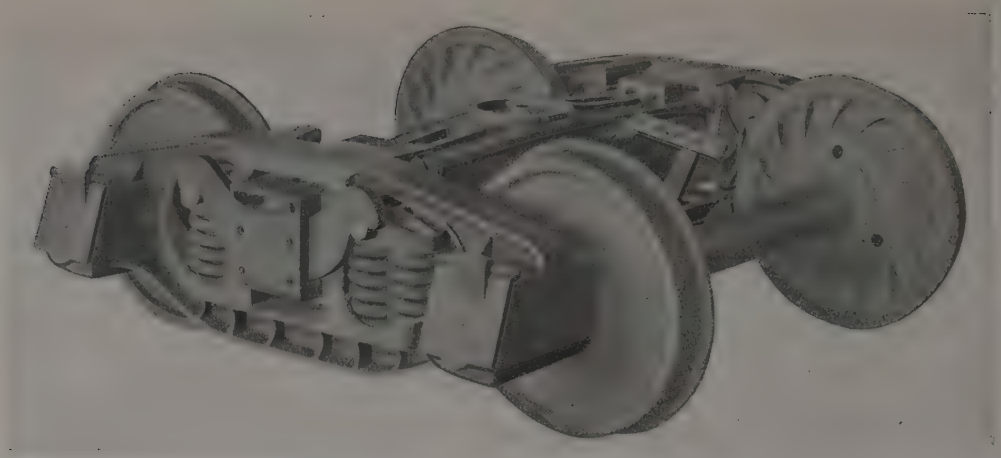


Fig. 1350—Bettendorf 70-Ton Capacity Equalized Truck with "U" Section Side Frames. The Bettendorf Company.
(*See also Page* 605.)

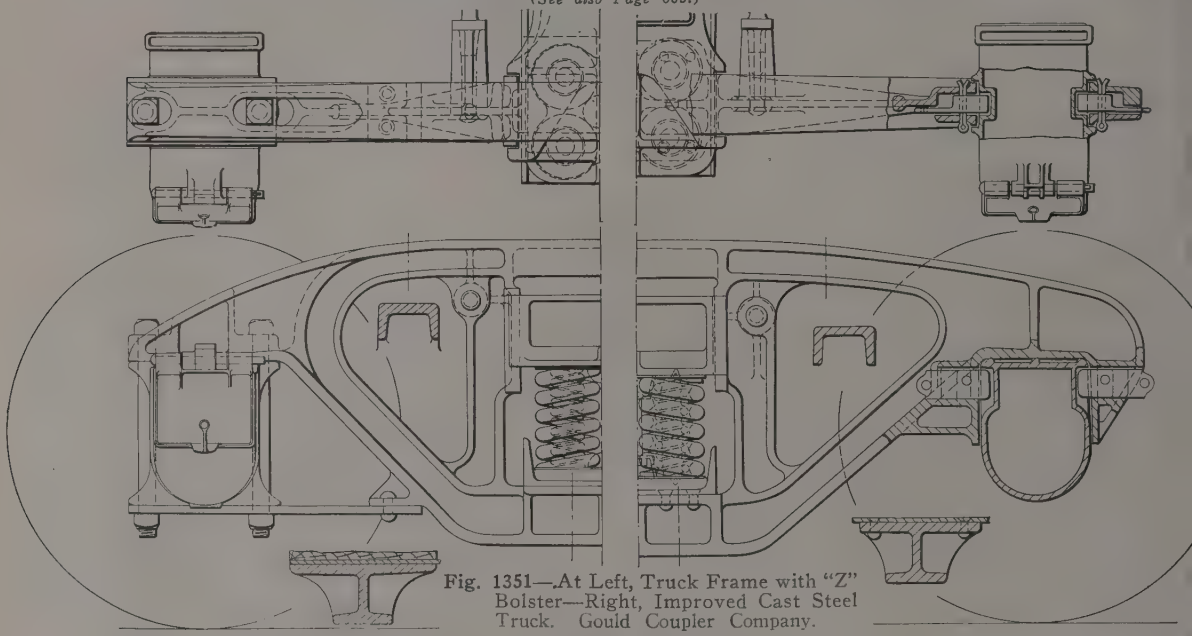


Fig. 1351—At Left, Truck Frame with "Z" Bolster—Right, Improved Cast Steel Truck. Gould Coupler Company.
(*See also Page* 955.)

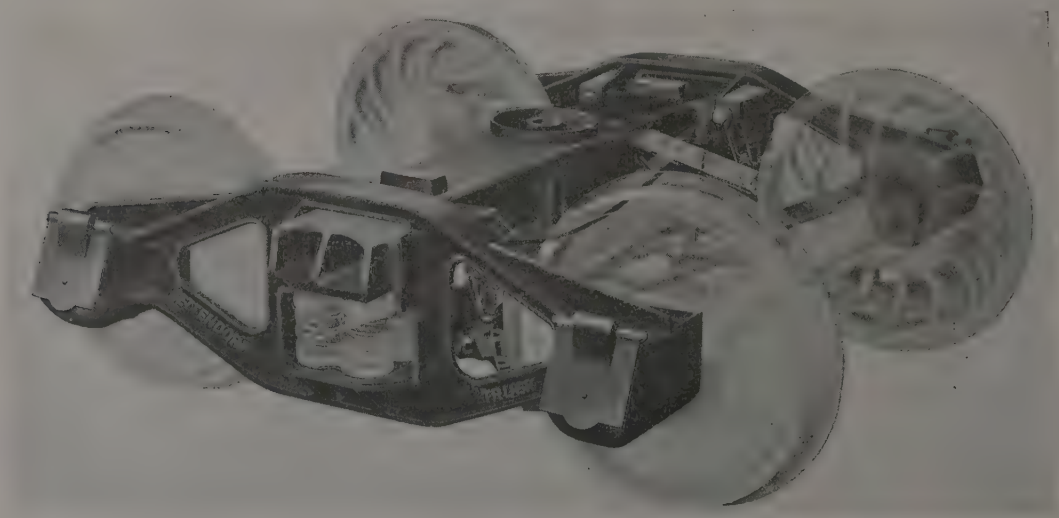


Fig. 1352—Bettendorf Truck with "T" Section Side Frame. The Bettendorf Company.
(*See also Page* 605.)

The Bettendorf Truck

The Bettendorf freight car truck has been designed with a thorough scientific knowledge of the service conditions encountered in modern railway practice and with an appreciation of the fact that in any car truck assembly, it is always very desirable to keep the number of loose or detachable parts at a minimum; a multiplication of separate parts in a truck increases to a proportionate extent the possibility that some one part will eventually fail.

All bolts, nuts, nut locks, columns and other loose parts common to the ordinary truck, are dispensed with. The journal boxes are combined in one casting with the side frame and the 41 pieces of the usual arch bar structure become one, in the Bettendorf Truck.

In the Bettendorf design the journal boxes being cast integral with the frame, perfect alignment is maintained when once established; this is accomplished by the Bettendorf method of squaring and testing. Flange, collar and brass end-wear are thus all reduced to a minimum.

The side frames are made of basic open hearth cast steel. Each frame is tested with a proof load four times as great as it carries in service.

The one-piece side frame truck has the advantage of flexibility, and thus can adjust itself to uneven track. This reduces the possibility of derailment and prevents excessive flange wear. It also shows a saving of from 600 to 1,000 lb. per car over the United States Railroad Administration's design of arch-bar truck.

Truck maintenance costs are materially reduced by the use of Bettendorf Freight Car Truck. Compared with the arch-bar truck designed by the United States Railroad Administration for use on the standard freight cars built during the time the railways were under government control, the Bettendorf Truck has 96 fewer parts, or there are only 6 parts to be maintained on the Bettendorf truck as against 102 on the United States Railroad Administration's truck. The saving in maintenance of the Bettendorf truck over the U. S. R. A. truck is readily apparent. Investigations that have been made clearly prove that this is true; a record was once kept of the amount of reparrs made to a few important parts of arch-bar trucks on 1,000 freight cars that would be entirely obviated had Bettendorf trucks been used. In these 1,000 cars it was found necessary to repair: 524 journal box bolts; 992 column bolts; 895 spring planks; 108 journal boxes; 39 malleable iron columns, and 160 arch bars.

A very important consideration in connection with the cost of repairing freight car trucks, is the time consumed in their dismantling and assembling. The Bettendorf Truck can be dismantled and assembled in less time than it requires to remove and replace a pair of journal boxes in the ordinary truck.

In dismantling a truck of the ordinary type it is of course necessary to disconnect numerous bolted fastenings. After a truck has been in service for a more or less extended period, bolts become corroded with rust, the threaded ends are often damaged and the entire bolt sometimes bent or distorted so that the removal of a nut usually requires considerable time and patience. It is often necessary in trucks where journal boxes are bolted in place to chip or burn the head of a bolt off before wheels can be removed.

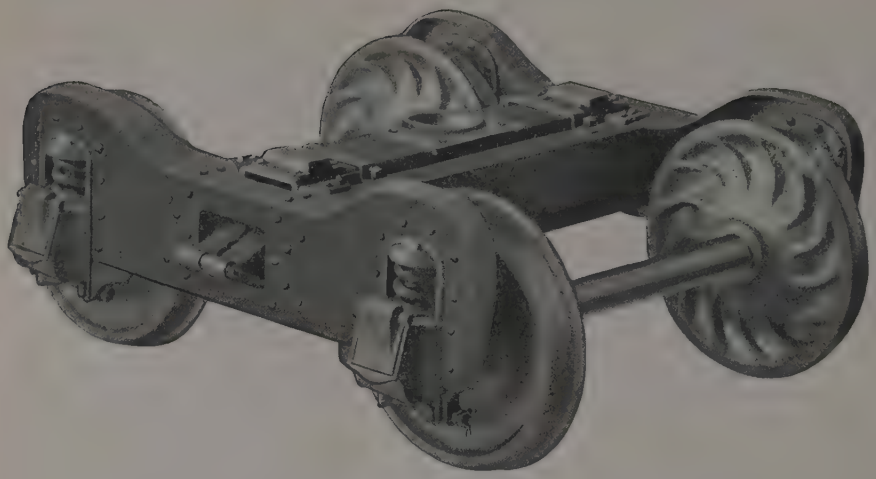
Fig. 1353—Bettendorf Freight Car Truck with "U" Section Side Frames

Thoroughly modern steel foundry appliances and patented continuous annealing furnaces of the best possible design have been provided for the manufacture of Bettendorf steel trucks. Approved methods of testing and chemical analysis have also been adopted both in the selection of raw material and in the final processes of manufacture to insure the highest possible quality of the finished product.

The plant, under one ownership, control and supervision, has all the essentials of a completely modern establishment devoted entirely to the manufacture of railroad equipment.

For other products and branch offices, see classified and alphabetical indexes.

THE BETTENDORF COMPANY, BETTENDORF, IOWA



Parts of Fox Truck Fig. 1255.

- A *Side*
- B *Transom*
- C *Transom Reinforcing Angle*
- D *Pedestal Angle*
- E *Pedestal Wearing Piece*
- F *Pedestal Bolt*
- G *Spring Plank*
- H *Spring Plank Hanger*
- I *Spring Plank Hanger Pin*
- K *Lower Spring Plank Hanger Pin*
- L *Pedestal Bracket*
- M *Pedestal Spreader and Transom Connection*

Fig 1354—Fox Pressed Steel Truck. Pressed Steel Car Company.

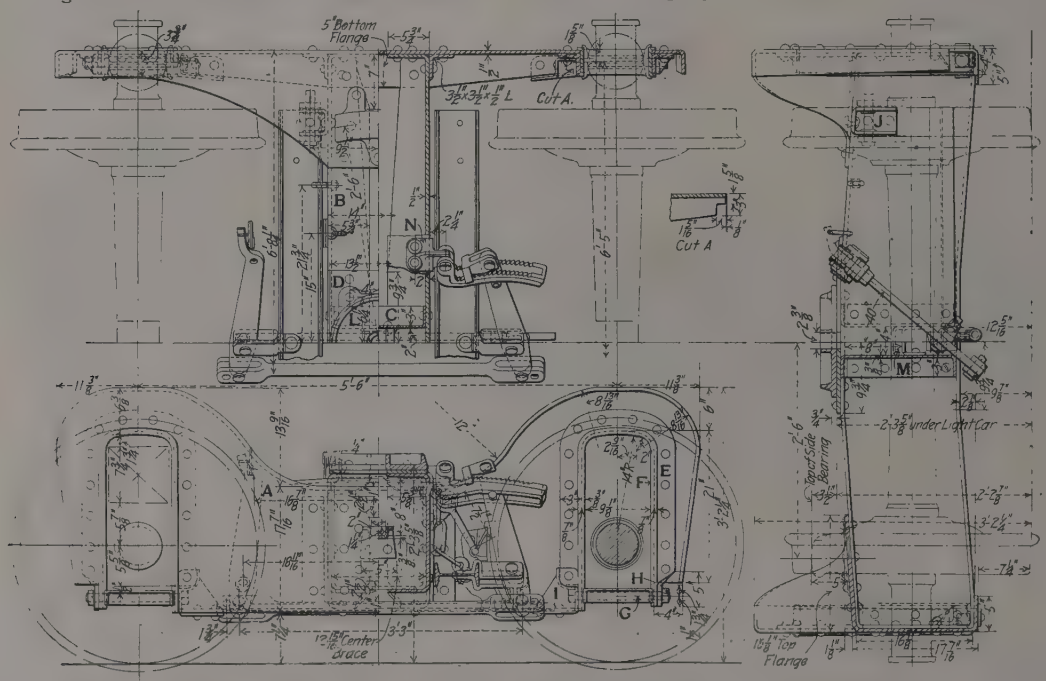


Fig. 1355—Fox Truck for 50-Ton Capacity Car. Pressed Steel Car Company.

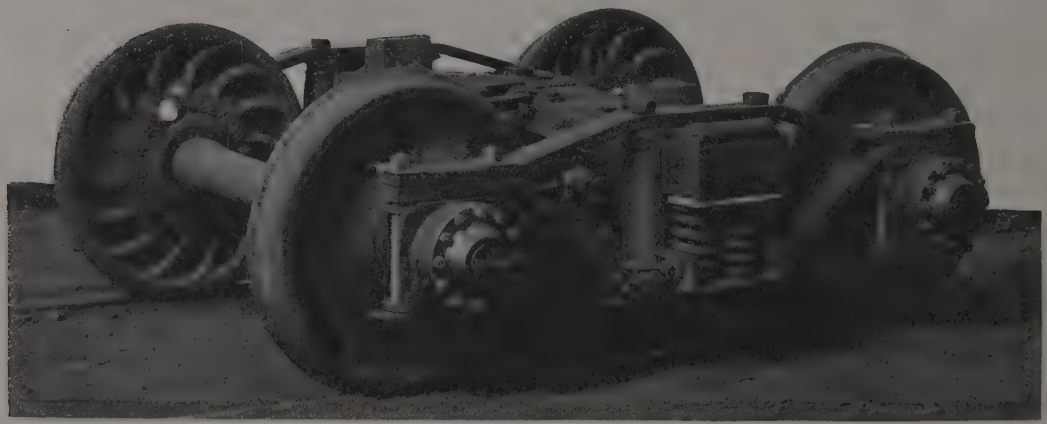


Fig. 1356—Arch Bar Truck Equipped with Stafford Roller Bearings. Stafford Roller Bearing Car Truck Corporation.

(*See also Page* 607.)

Stafford Roller Bearings for Car Trucks

The development of the Stafford Roller Bearing was the result of careful study of the requirements of such a bearing; the application of sound mechanical principles and a determination to solve the problem that had, for so many years, baffled mechanical engineers.

The Stafford Roller Bearing for freight and passenger cars consists of two rows of solid chrome steel rollers mounted in a substantial steel frame. These are staggered in such a manner as to give a continuous supporting surface for the weight carried.

The successful combination of these two vital features—solid rollers and staggered arrangement—gives to the assembled bearing the essentials that have been lacking in many attempts to overcome friction in railroad car journals by means of roller bearings. The mechanical correctness of the idea

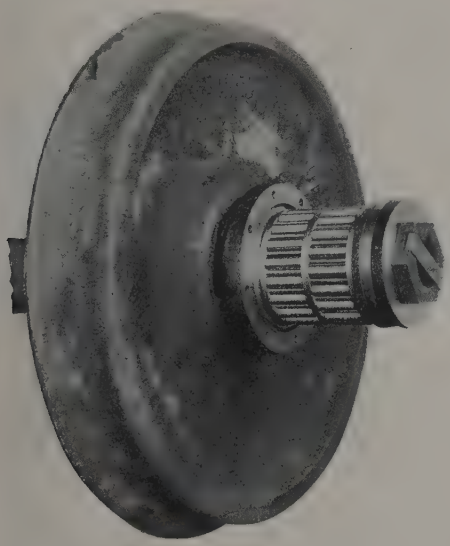


Fig. 1357—Assembly of Stafford Roller Bearing, with thrust Bearing and thrust plates, and method of locking on axle.

is at once obvious; the weight of the car and its load is constantly supported on solid steel. The motion of the rollers literally "rolls the friction away" and journal attrition is reduced very greatly.

At no point is there contact between the adjacent surfaces of the rollers. They are held in perfect alignment in the rigid steel frame or cage. No part of the assembly is subject to excessive strain or wear and it is conservatively estimated that the Stafford Roller Bearing will stand up under twelve years of continuous service.

The load radius converges upon a quarter segment of the bearing, and so completely is friction eliminated that it would be possible to operate the bearings under heavy load and at high speed without the use of any lubricant whatever.

As proper lubrication naturally adds to the life of the bearing provision is made for its use and a single application—about 2½ lb. to each box—lasts for a minimum of two years. The lubricant is completely sealed against dust, dirt and grit, and, as the elimination of friction precludes the possibility of overheating, there is nothing to cause the oil to deteriorate.

The Stafford Roller Bearing will not run hot;

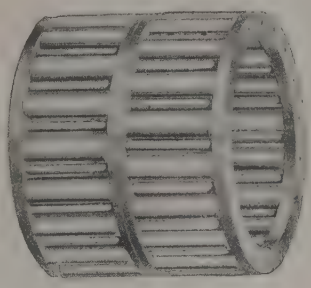


Fig. 1358—Roller Bearing

Fig. 1359—Adjusting Nut Lock and Screws

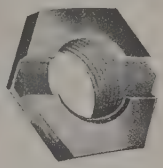


Fig. 1360—Adjusting Nut

there being practically no friction there can be no overheating. Exhaustive tests have demonstrated conclusively that journal heating is positively eliminated.

An indicator, plainly visible from a distance of 90 ft., shows at a glance the amount of lubricant in each box, making it unnecessary to open the box for inspection. The renewal of waste and "dope" as required with the ordinary journal bearing is completely eliminated.

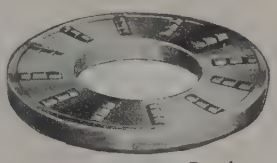


Fig. 1361—Thrust Bearing

End thrust is effectively taken care of by means of a frictionless thrust bearing and two thrust plates, thus eliminating friction and wear from this source.

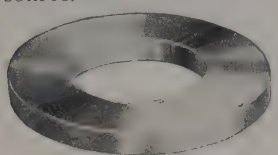


Fig. 1362—Thrust Bearing Outer Plate

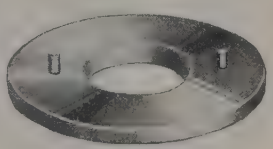


Fig. 1363—Thrust Bearing Inner Plate

The application of the Stafford Roller Bearing to the railroad car journal is very readily made; the complete assembly fits compactly into a specially designed box no larger than the type now in use. Placing the bearings on present equipment requires only turning down of journals to receive the bearings and lock nuts.

No collars are necessary and, as the inside diameter of the bearing conforms with the A. R. A. standard maximum wearing limits, it is wholly practicable to use the bearings in connection with journals and axles that have been scrapped because of their worn condition.

The Stafford Roller Bearing is simple in its mechanical construction and there is practically nothing to get out of order, or to wear away and cause delays. It is built to give long service under the most strenuous conditions.

For other products and branch offices, see classified and alphabetical indexes.

STAFFORD ROLLER BEARING CAR-TRUCK CORP., LAWTON, MICH.

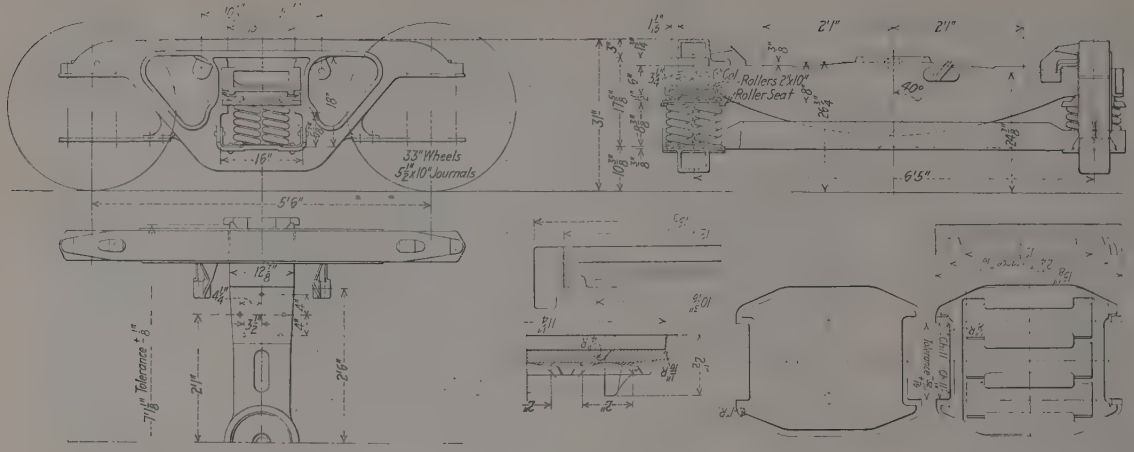


Fig. 1364—Barber 50-Ton Truck Showing Application of Barber Lateral Motion Device, Also Diagram of Roller Seat.

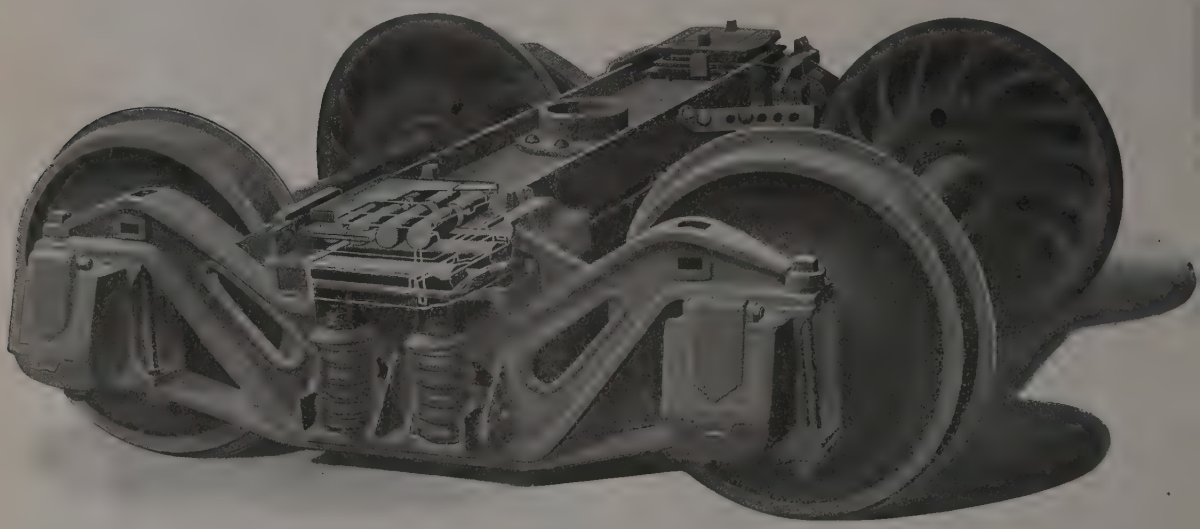


Fig. 1365—Barber Double Action 50-Ton Truck.

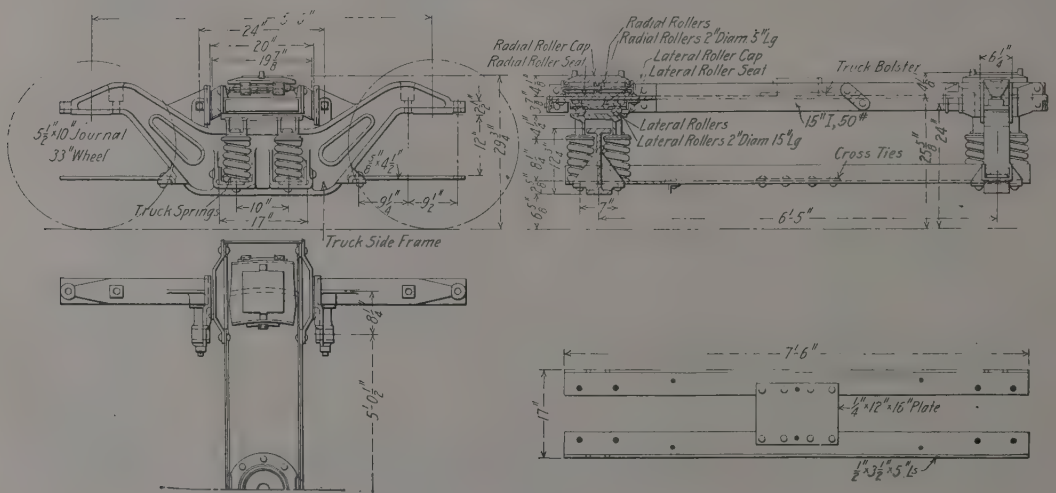


Fig. 1366—Barber Double Action Freight Truck for 50-Ton Capacity Cars.

Standard Car Truck Company

(*See also Page* 609.)

Barber Lateral Motion Truck Device

The function of Barber Lateral Motion Truck devices as applied to freight car equipment is to provide a reliable and simple means to accommodate the lateral movement of a car body, without imposing excessive stress upon wheel flanges, truck side frames or upon any of the adjacent parts. A suitable design of lateral motion truck is provided for all passenger, mail, express, baggage, dining and sleeping cars. Facilities to accommodate lateral motion are absolutely essential in passenger car service, to improve riding qualities, to reduce the shock from side-lurching and to eliminate a common cause of derailment. In fact, it is a safety feature which not only is desirable but quite necessary.

If such a device is admitted to be indispensable on passenger equipment, it should be of great benefit in freight service, especially in view of the constantly increasing capacity of freight cars and the present necessity for high speed traffic movement.

Fig. 1367—Barber Lateral Motion Device Dismantled

The Barber Lateral Motion Truck Device is applicable to any of the well known types of freight car truck frames, and has been made standard on many of the most important roads of the United States.

Records compiled by railroads that have used the Barber Lateral Motion Truck Device for many years, indicate that the life of wheels, journals, brasses and all truck details, has been greatly prolonged and that very substantial savings are effected by the use of this equipment in freight service.

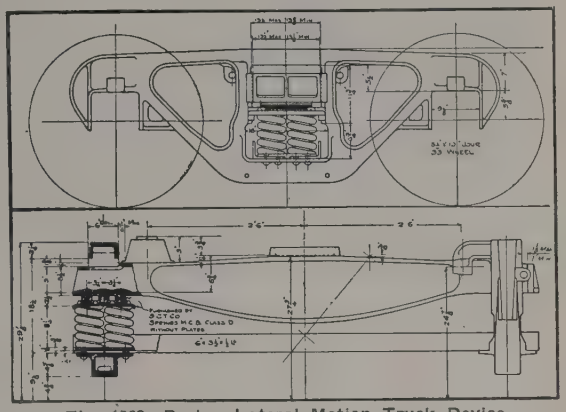


Fig. 1368—Barber Lateral Motion Truck Device

The Barber Double Action Lateral and Radial Motion Truck—Fig. 1370—is especially adapted for heavy cars of 70 tons or greater capacity. The entire load is carried at four points, and is concentrated directly over the centers of the truck side frames, through a combination of lateral and radial motion rollers. The construction shown in Fig. 1369 provides for free curvature of the trucks and prevents any of the load being carried at the center of the bolsters. Barber cast steel side frames are used with a rolled steel I-beam bolster. This truck is also made in arch bar form equipped with special interlocking columns.

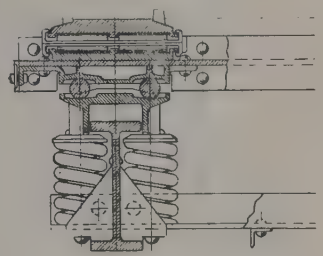


Fig. 1369—Section Showing Lateral Radial Motion Rollers

Fig. 1370—Barber Double Action Roller Bearing Lateral and Radial Motion Truck

The Standard Car Truck Company's trucks and devices have been gradually developed to meet the ever increasing requirements of railroad service. All material is carefully inspected and tested before leaving the factory. Steel used in the manufacture of rollers and other parts is of high grade and is thoroughly heat-treated to insure maximum wearing qualities.

For other products and branch offices, see classified and alphabetical indexes.

STANDARD CAR TRUCK COMPANY, CHICAGO, ILL.

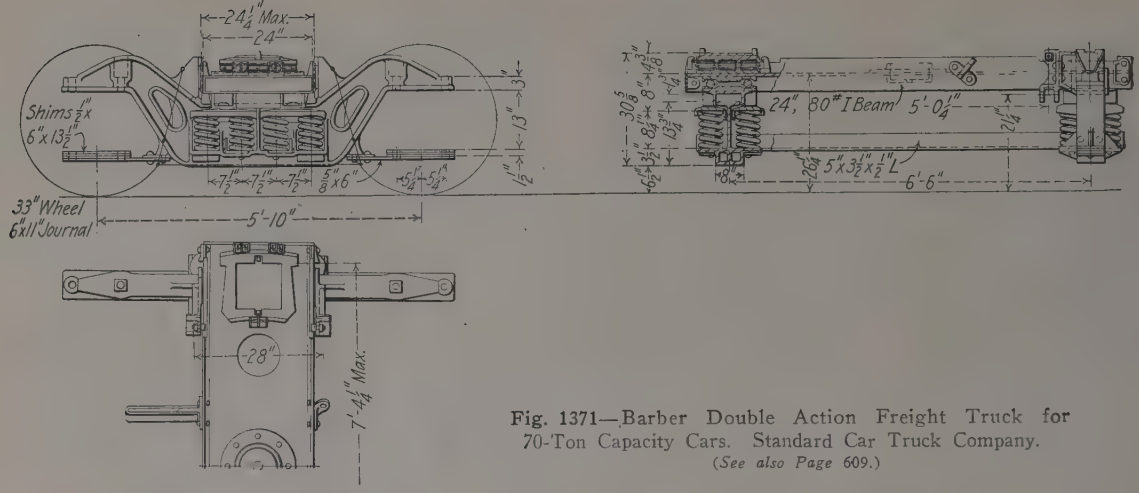


Fig. 1371—Barber Double Action Freight Truck for 70-Ton Capacity Cars. Standard Car Truck Company.
(*See also Page* 609.)

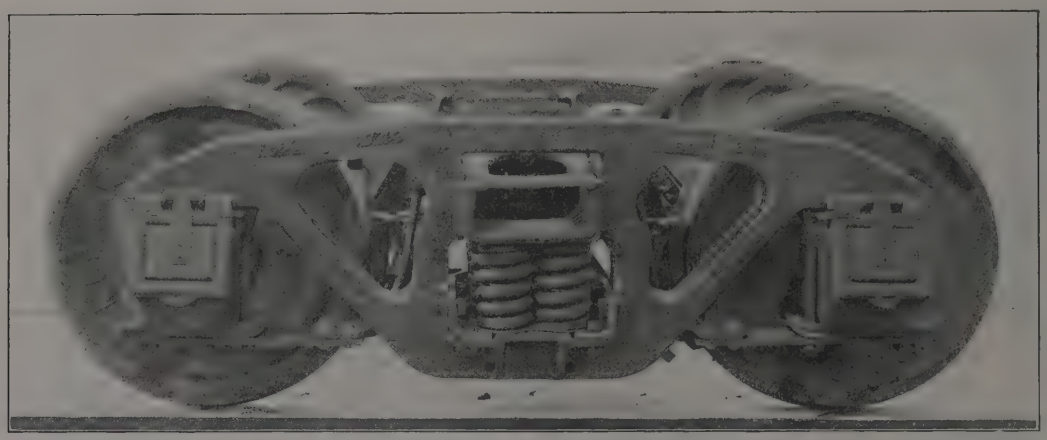


Fig. 1372—Pennsylvania Railroad 70-Ton Capacity Truck with Crown Cast Steel Side Frame.

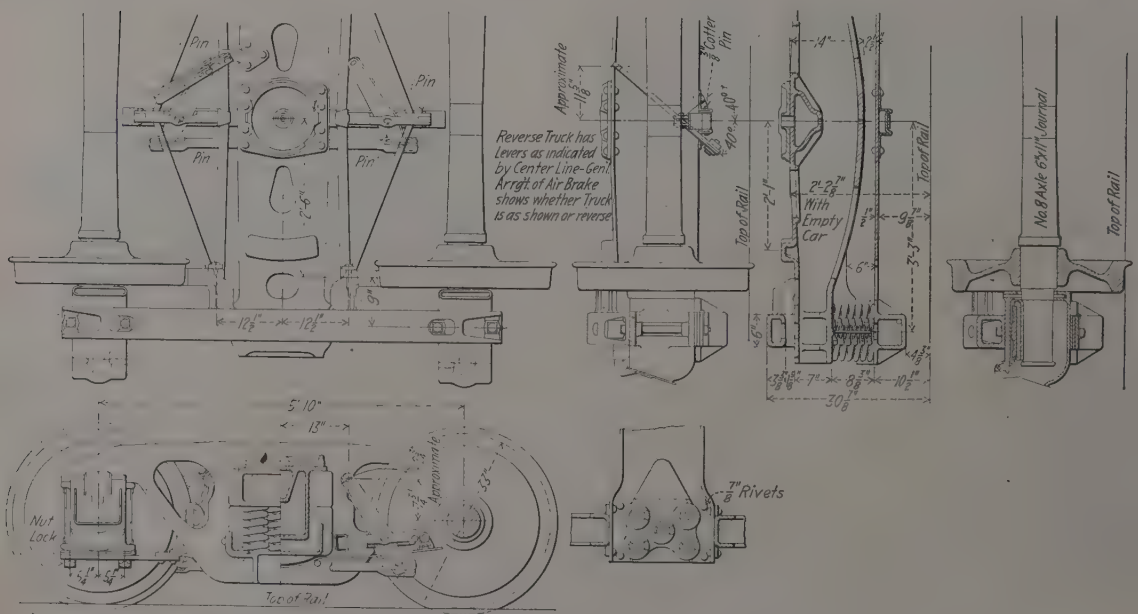


Fig. 1373—Pennsylvania Railroad 70-Ton Capacity Truck with Crown Cast Steel Side Frame.

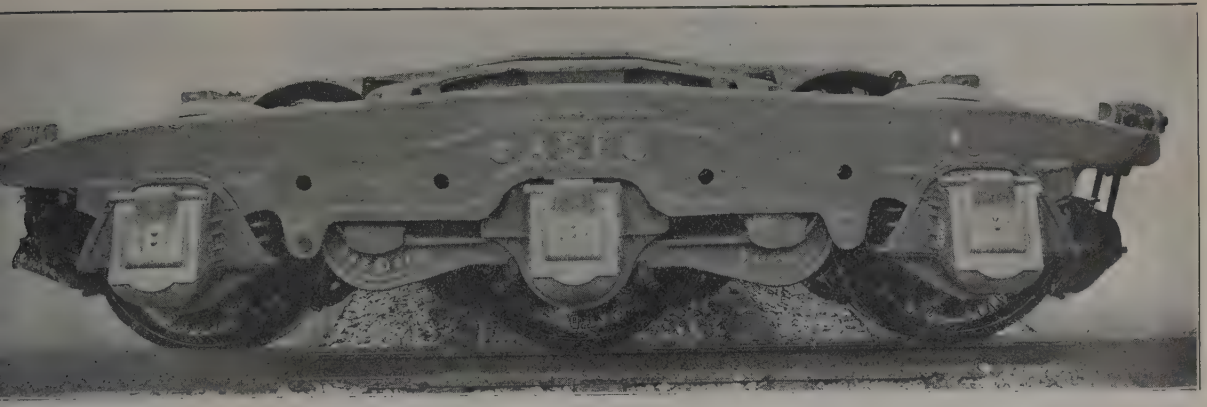


Fig. 1374—Lamont Six-Wheel Truck. American Steel Foundries.

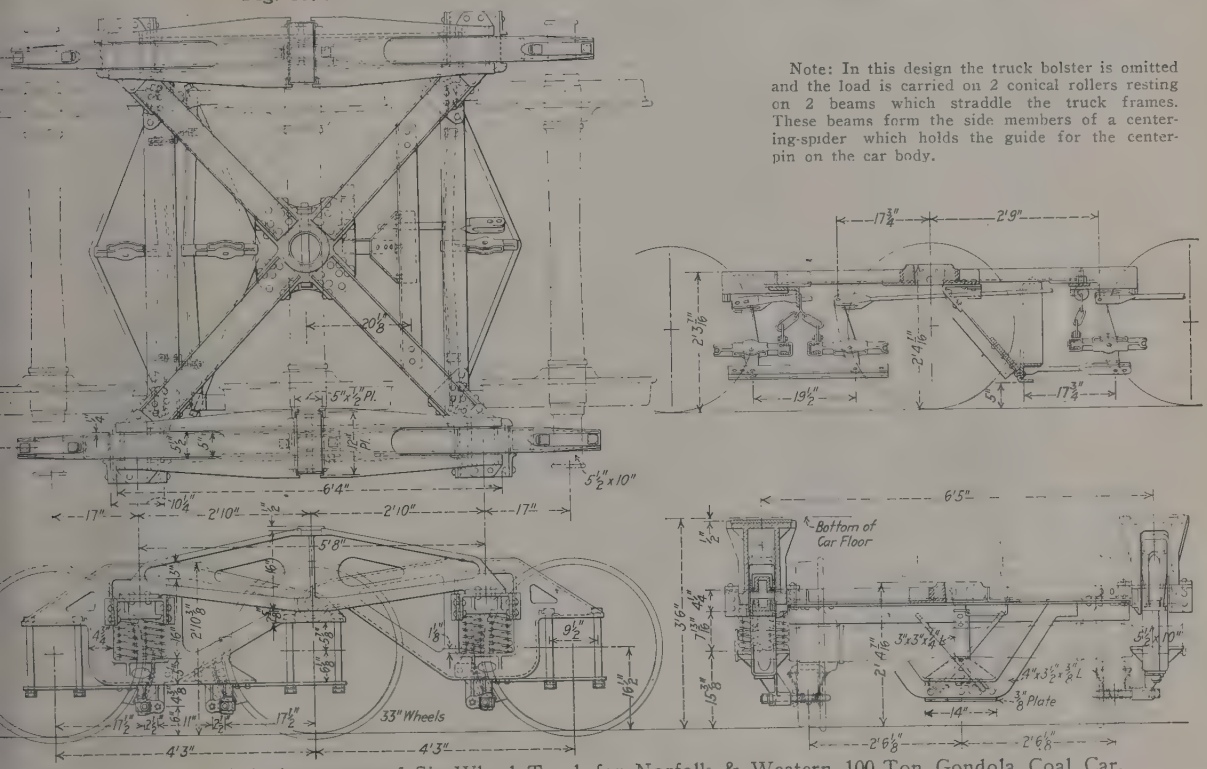

Note: In this design the truck bolster is omitted and the load is carried on 2 conical rollers resting on 2 beams which straddle the truck frames. These beams form the side members of a centering-spider which holds the guide for the center-pin on the car body.
6'4"
5'8"
4'3"
33" Wheels
6'5"
Bottom of Car Floor
2'9"
2'6½"

Fig. 1375—General Arrangement of Six-Wheel Truck for Norfolk & Western 100-Ton Gondola Coal Car.

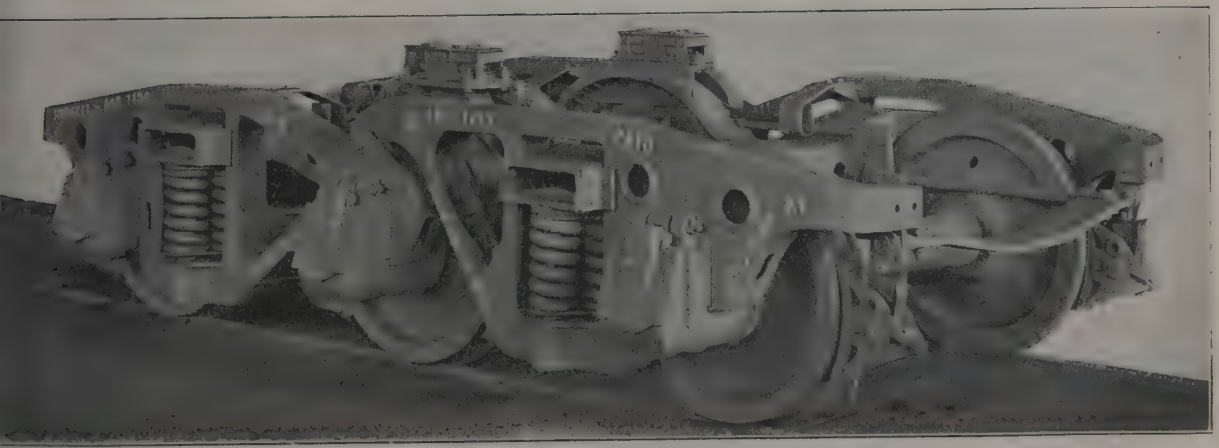


Fig. 1376—Lewis Six-Wheel Truck. American Steel Foundries.

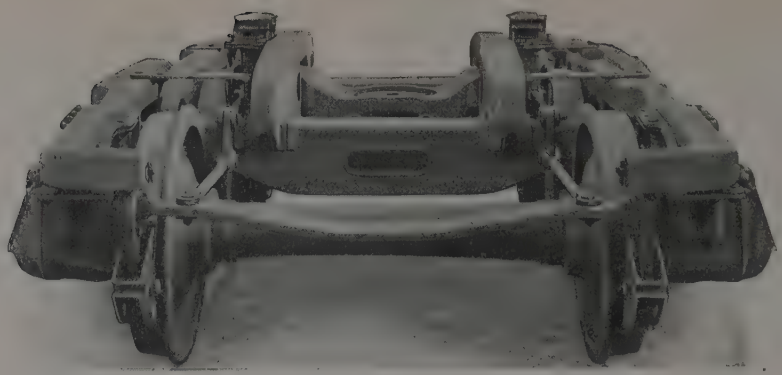


Fig. 1377—End View of Buckeye Equalized Six-Wheel Truck for 120-Ton Car.

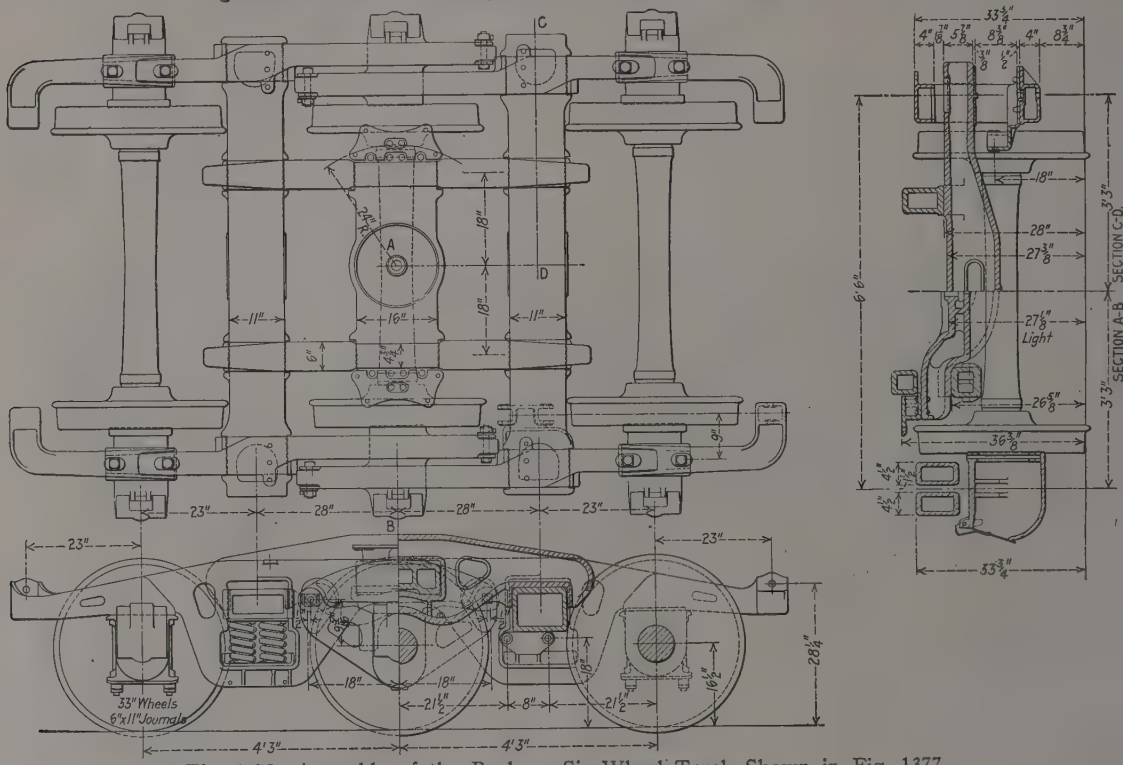


Fig. 1378—Assembly of the Buckeye Six-Wheel Truck Shown in Fig. 1377.

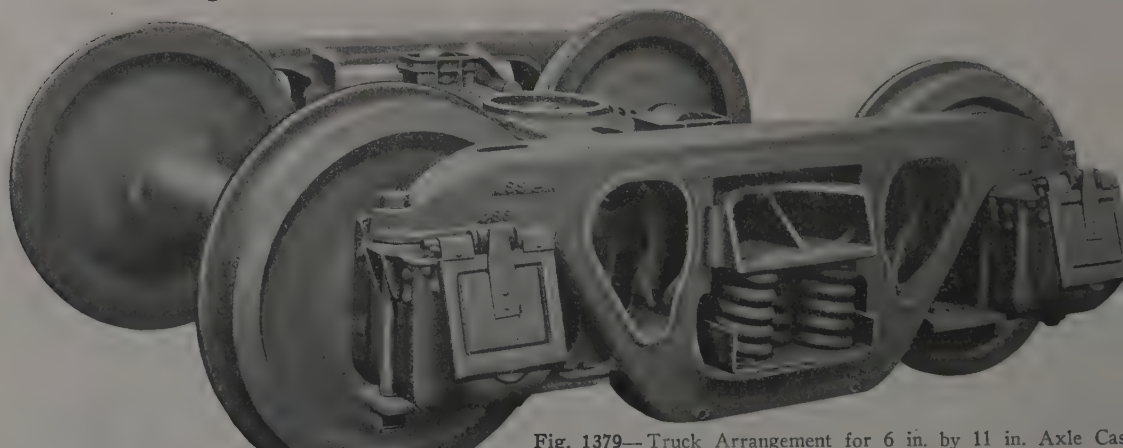


Fig. 1379—Truck Arrangement for 6 in. by 11 in. Axle Cas
Steel Truck Bolsters and Truck Side Frames, for U. S
R. A. Freight Cars.

The Buckeye Steel Castings Company.

(*See also Page* 613.)

The Buckeye Six-Wheel Truck

The increase of freight car capacities to 100 and 120 tons per car has made it desirable to add another pair of wheels in each truck and this has complicated uch problems as equalization, spring arrange- ıent, and side frame construction. However, all equirements of efficient high-capacity freight quipment are met by a six-wheel truck which as been developed by the Buckeye Steel Cast- ıgs Company.

This design contains a number of unusual fea- ures, a notable accomplishment being the avoid- nce of the load carrying members subjected olely to tension. In the Buckeye truck the arts that carry the loads are designed and as- embled so that they perform the functions of eams rather than that of hangers. The various arts are also of such size and are arranged that hey may be readily assembled or taken apart vithout special facilities. These operations re- uire only two men and the use of only a jack in ddition to ordinary tools. All parts are easily ccessible for inspection. The springs are ar- anged in groups of four each, located in the olster opening of the side frames, making them lainly visible.

Facilitating the routine work of upkeep is important and the Buckeye truck in its present form is a remarkable advance in this respect. Such light repairs as changing bolsters, axles, and springs require only those tools used in connection with the four-wheel truck repairing.

From a maintenance point of view, a noteworthy feature of the Buckeye six-wheel truck is the simple method by which the middle pair of wheels can be removed. First the brake pins are removed, then the bolts in the end of the equalizer arms after which the two longitudinal bolsters are disengaged from one transverse bolster by tilting them upward, releasing an end pair of wheels. Jacks are then placed under the spring seats and the equalizer bolts are removed, thus relieving the center axle.

The replacement of the transverse bolster is facilitated by the bolster opening in the frame, designed similar to that in a four-wheel truck frame. The spring seat casting which carries the bracket for the inside brake beam is separate from the frame. Hence, by jacking up the longitudinal

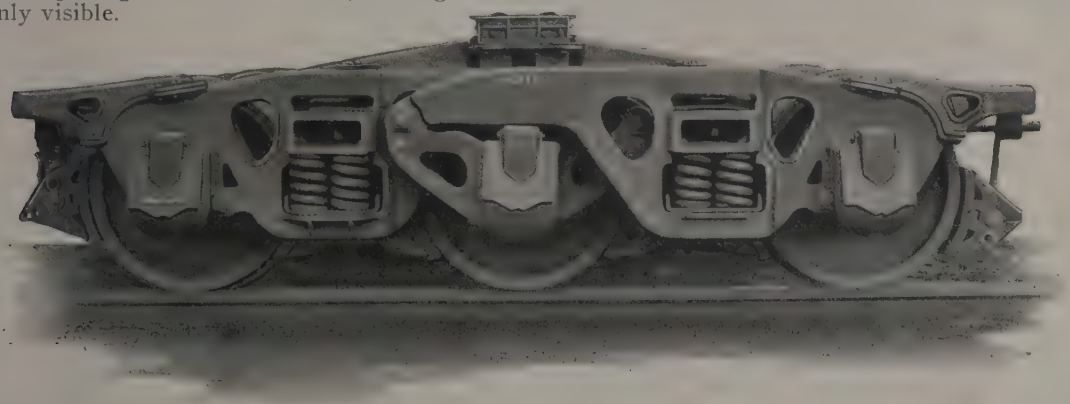


Fig. 1380—A Side View of the Buckeye Six-Wheel Truck

Equalization of the load is accomplished by ısing an equalizer which engages the middle jour- ıal and by designing the side frame castings so hat two-thirds of each spring load is supported by the attendant outside axle, and one-third by one arm of the equalizer. Therefore, each jour- ıal of a truck receives one-third of the total spring load on that side, and furthermore, the equalizer precludes the possibility of any of the springs receiving unequal loads on the same side of the truck. An extremely short wheel base—8 ft. 2 in.—is made possible by the Buckeye type of equalizing.

Extreme flexibility in operation is a direct re- sult of the method of equalization; all the flexibil- ty of the four-wheel truck is retained by this six- wheel arrangement. The very easy movements are readily apparent as the wheels pass over low track joints or crossovers. The truck operates readily over the very uneven track, switches, and inclines such as are encountered at mines and bolsters and removing the springs and spring seat castings, the transverse bolster can be replaced in a manner similar to that used with four-wheel trucks.

Storekeeping is facilitated by having all side frame castings exactly alike through the use of separately constructed spring seats and brake hanger castings. The advantage is reflected in handling stocks of repair parts, and the first cost of the truck is reduced.

Clasp brakes are used on Buckeye six-wheel trucks. Unusually satisfactory brake action is obtained by suspending the brake rigging from parts of the truck which are independent of the spring travel.

The claims of superiority of the Buckeye six-wheel trucks are further emphasized by the fact that the component castings are of such size that railroads and car building companies do not have to provide special facilities for handling these parts.

For other products and branch offices, see classified and alphabetical indexes.

BUCKEYE STEEL CASTINGS COMPANY, COLUMBUS, OHIO

Fig. 1381—Six-Wheel Truck for 90-Ton Capacity Norfolk & Western Gondola Car. American Steel Foundries.

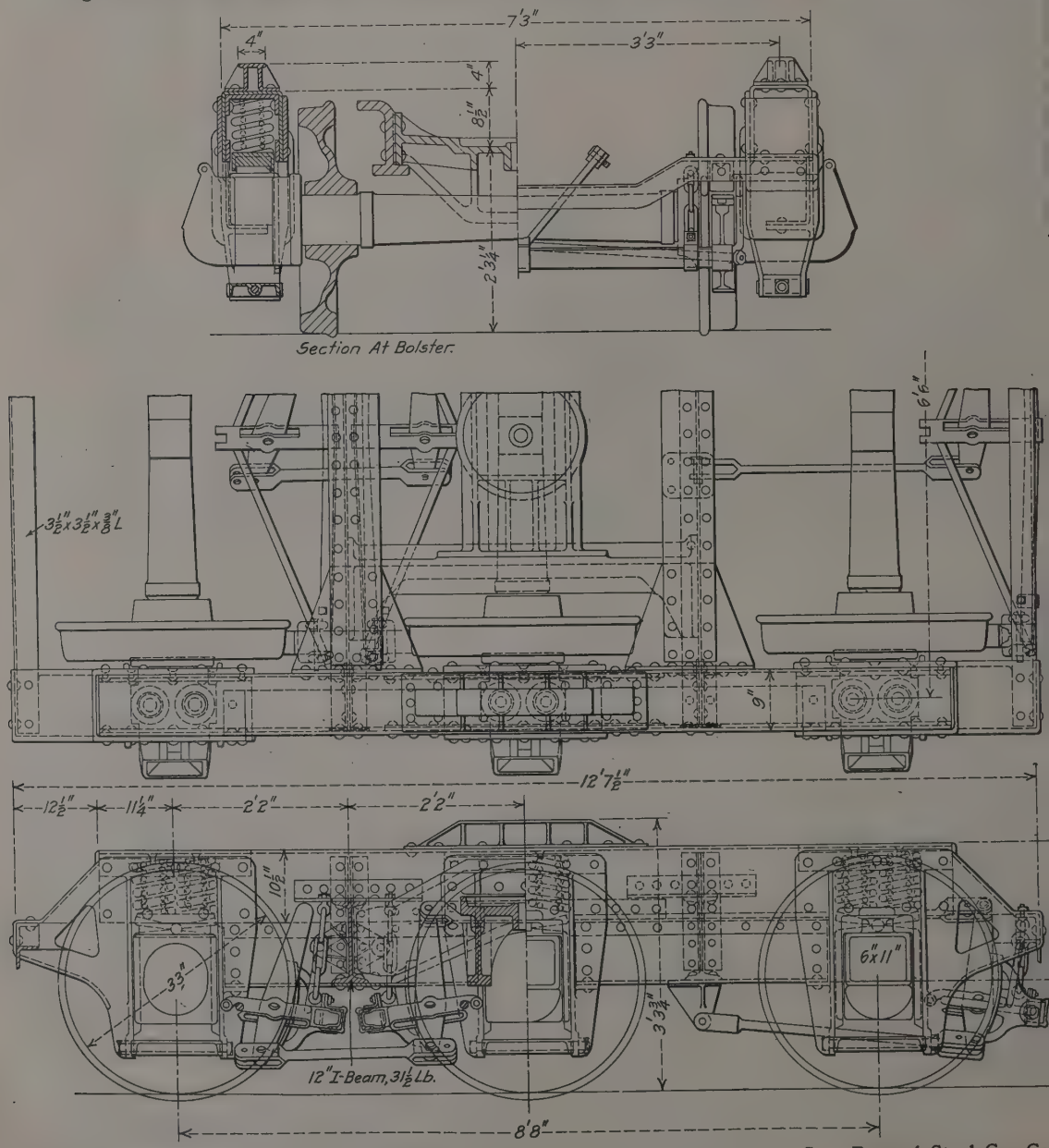


Fig. 1382—Built-Up Six-Wheel Truck for Woodward Iron Company's 100-Ton Hopper Car. Pressed Steel Car Co

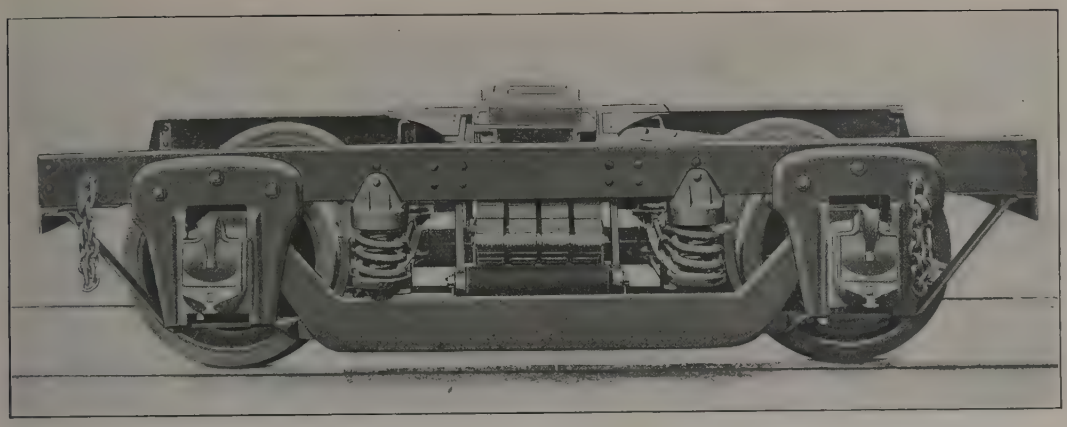


Fig. 1383—Four-Wheel Truck with Rolled Steel Frame. American Car & Foundry Company.

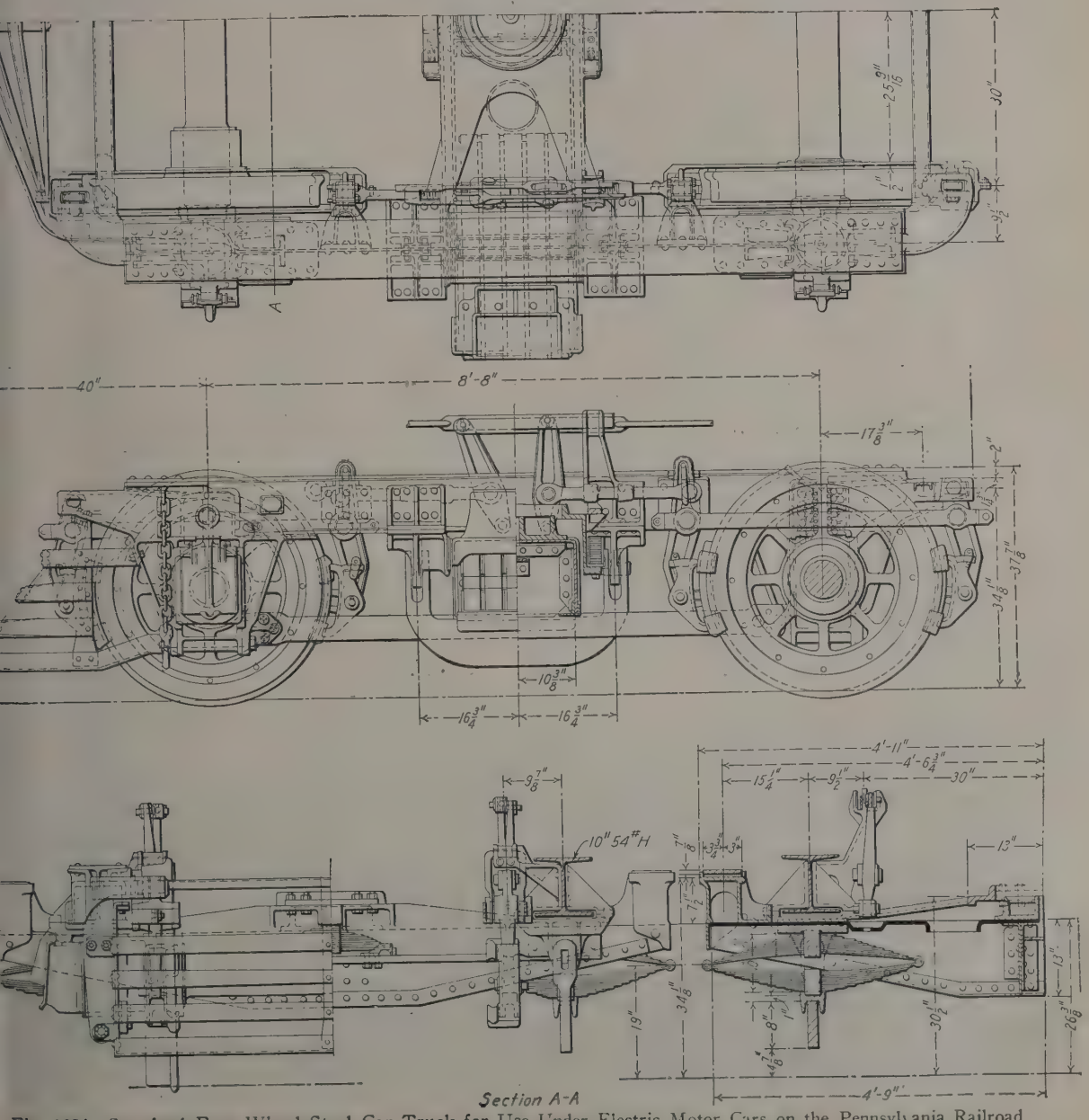


Fig. 1384—Standard Four-Wheel Steel Car Truck for Use Under Electric Motor Cars on the Pennsylvania Railroad.

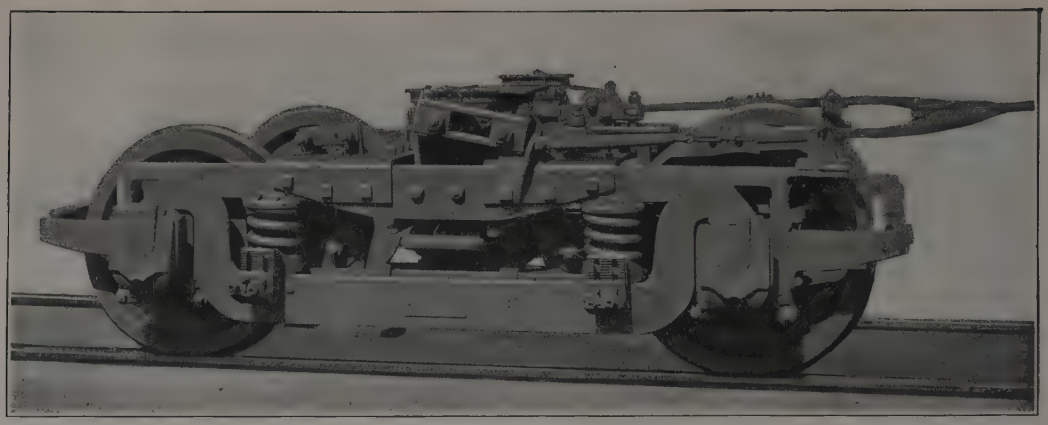


Fig. 1385—Brill-27 A. R. A.-3 Truck for Boston Elevated and Subway Service. The J. G. Brill Company.

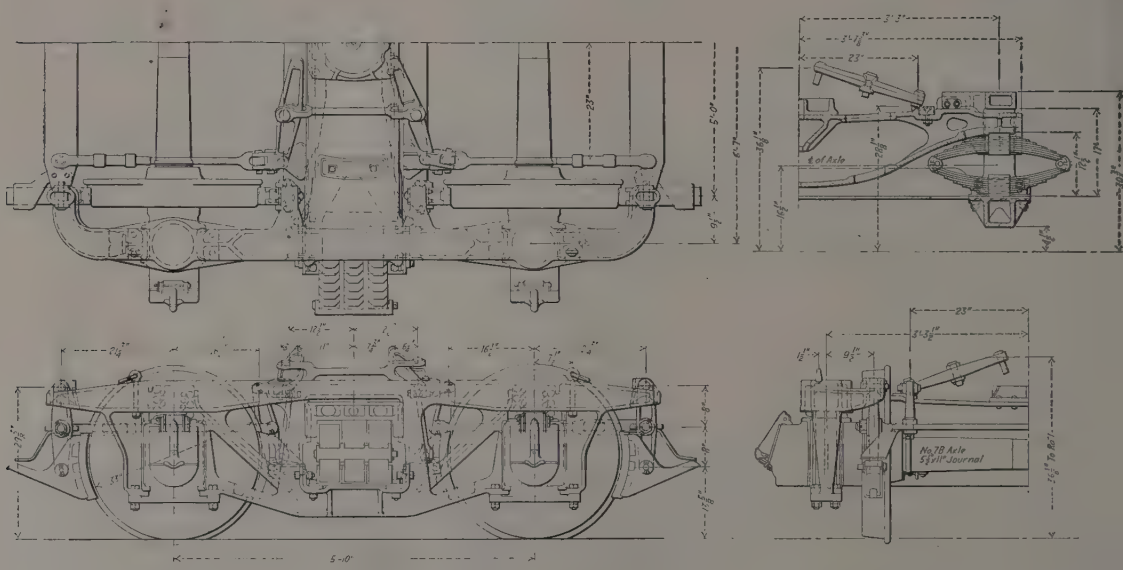


Fig. 1386—Four-Wheel Steel Truck Class No. 9 for Pennsylvania Railroad Passenger Cars.

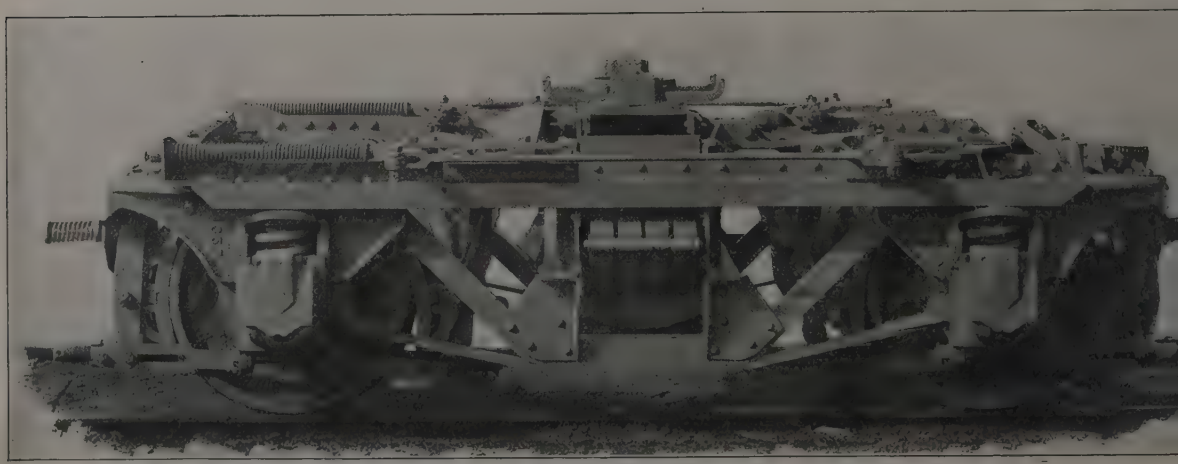


Fig. 1387—Pressed Steel Truck for Erie All-Steel Suburban Car.

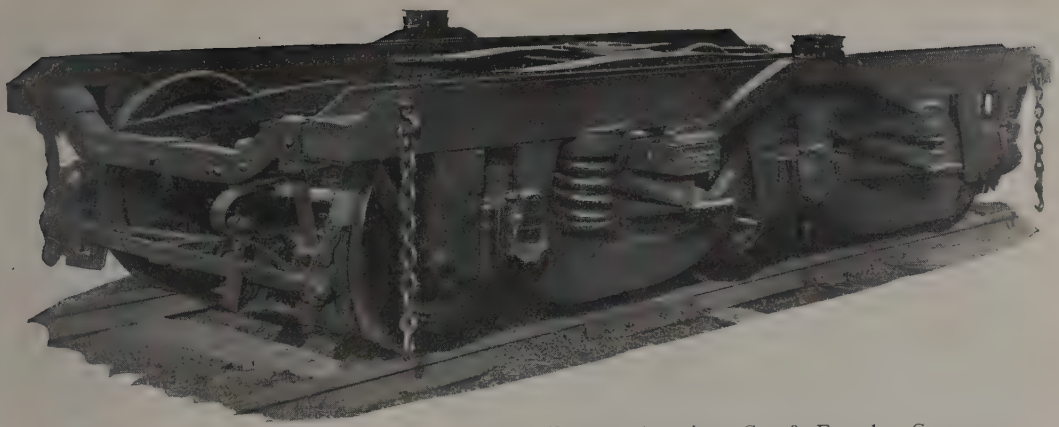


Fig. 1388—Six-Wheel Truck with Rolled Steel Frame. American Car & Foundry Company.

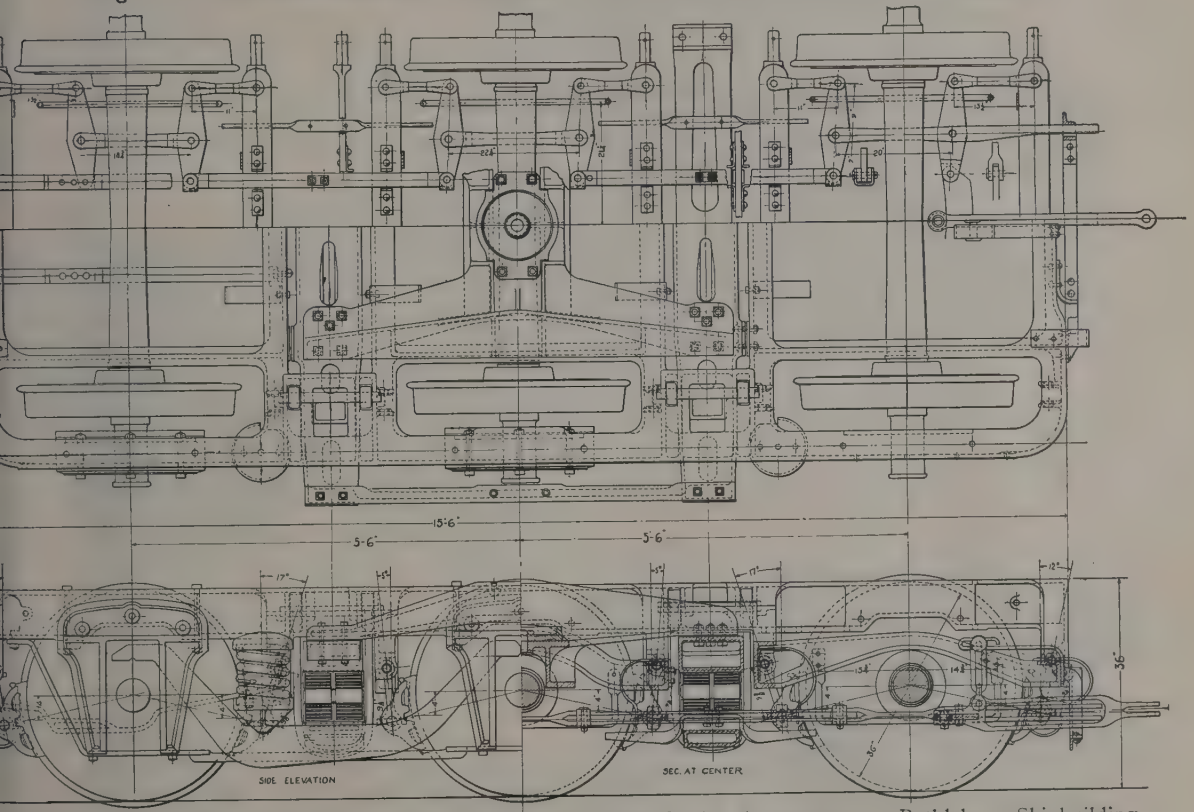


Fig. 1389—Philadelphia & Reading Six-Wheel Truck with Clasp Brake Arrangement. Bethlehem Shipbuilding Corporation, Ltd.

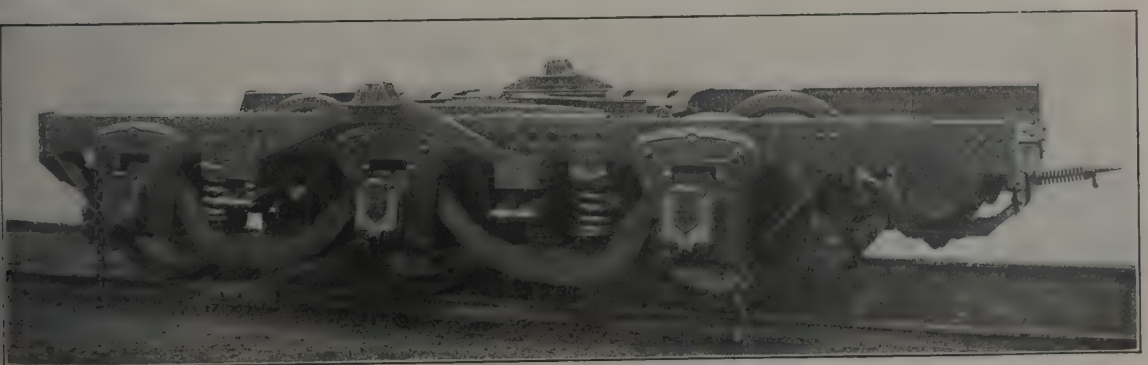


Fig. 1390—Six-Wheel Passenger Car Truck for Atlantic Coast Line. American Car & Foundry Company.

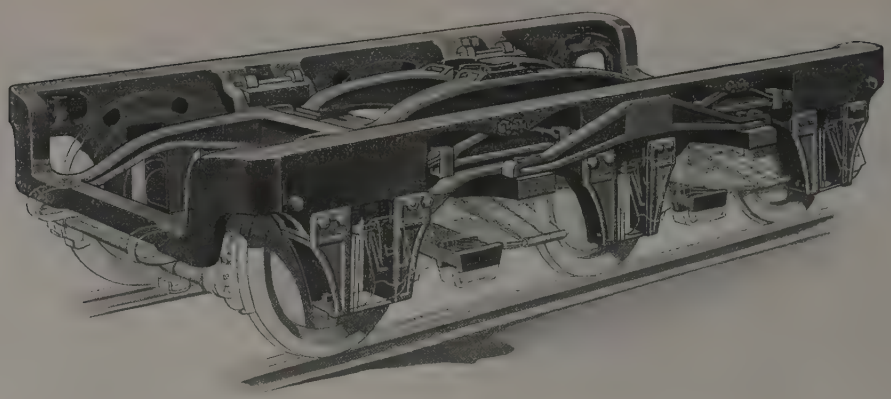


Fig. 1391—Six-Wheel Top Equalizer Truck.

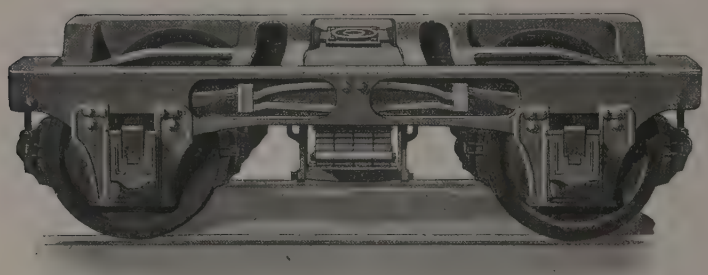


Fig. 1392—Four-Wheel Top Equalizer Truck.

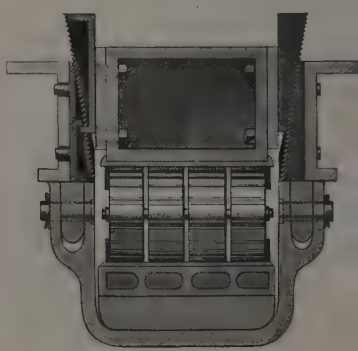


Fig. 1393—Automatic Adjustable Chafing Plate for Passenger Trucks.

Fig. 1394—Commonwealth Steel Company's Four-Wheel Cast Steel Truck.

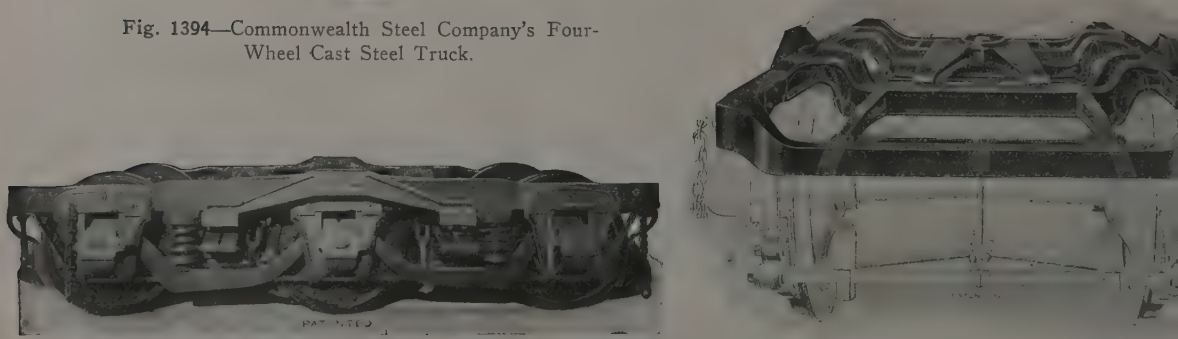


Fig. 1395—Commonwealth Steel Company's Six-Wheel Cast-Steel Truck.

Commonwealth Steel Company.

(*See also Page* 619.)

Commonwealth Car Trucks

The complexity of the problems of passenger car truck design resulting from increasingly severe service, has led to the adoption of cast steel for truck construction, and the development of the different types of Commonwealth patented passenger car trucks.

Commonwealth four wheel trucks have swing bolsters, and the frame is made in one piece from high grade open hearth cast steel. Provision has been made for bolting the pedestal jaws to the frame, or they can be cast integral, and the side members contain pockets which serve as equalizer spring caps. The spring plank and the bolster are cast as single complete units, from the same steel as the frame.

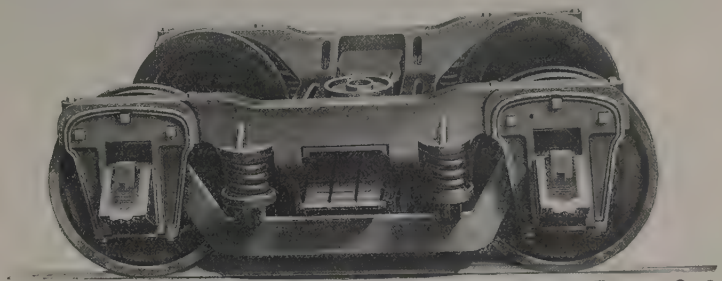


Fig. 1397—Commonwealth Four-Wheel Truck for Refrigerator Express Cars (Patented)

Commonwealth six-wheel trucks are manufactured in two different styles which differ in the type of equalizer rigging which is used. One

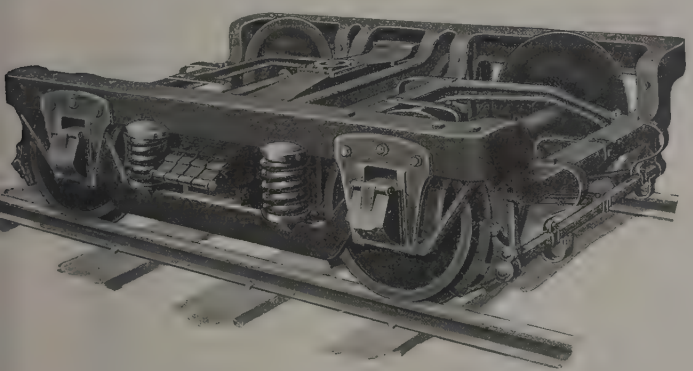


Fig. 1396—Commonwealth Four-Wheel Clasp Brake Passenger Truck (Patented)

type is known as the top equalizer type; the other, as the bottom equalizer type. As in the case of four-wheel trucks, the frame of both these types is made in a single piece from high grade open hearth cast steel. The pedestal jaws can be cast integral with the frame or, if desired, the bolted type of pedestal jaw can be used. In the top equalizer type of truck, recesses are cast in the frame and accommodate both the equalizers and the equalizer springs.

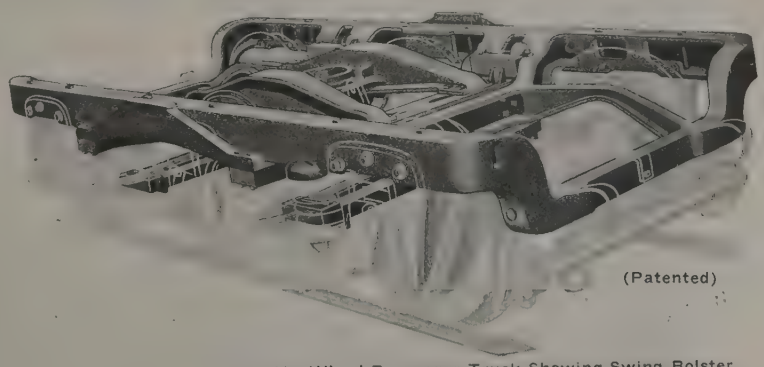
Either single or clasp brakes can be used with Commonwealth passenger trucks for which brake hanger brackets are cast integral with the frame and provision is made for the accommodation of all standard makes of Journal boxes, equalizers, and springs.

The advantages of Commonwealth construction are common to both the six-wheeled and the four-wheel trucks. Th use of one strong frame cast in a single piece eliminates hundreds of small parts which in ordinary built-up trucks add to the cost of maintenance. The use of cast steel makes possible the designing of the cross-sections of all members of the trucks, with correct proportions for the stresses to which they are subjected. Where unusual clearance must be obtained without sacrificing strength, irregular contour can be used.

The perfection of alinement which is possible with Commonwealth trucks is an attractive feature. The wheel pieces are planed at the sides and underneath, in a single operation; the pedestal bolt holes are drilled accurately; and the pedestal wearing surfaces are hardened by a special process. All holes and hangers are steel bushed where subject to wear, and adequate provisions are made for firmly securing axle generators.

An important feature of the top equalizer Commonwealth truck is the placing of brake shoes and beams where they are in full view, and can be easily applied, inspected, or removed. This feature enables the detection of any defects before they have become serious enough to cause an accident.

Safety, strength, durability and economy are combined in Commonwealth passenger car trucks. The long-lived service of this equipment and the low cost for repairs and replacements are other valuable features which have led to their successful use in the most exacting passenger train service.



(Patented)

Fig. 1398—Commonwealth Six-Wheel Passenger Truck Showing Swing Bolster Arrangement and Cast Steel Frame

For other products and branch offices, see classified and alphabetical indexes.

COMMONWEALTH STEEL COMPANY, ST. LOUIS, MISSOURI

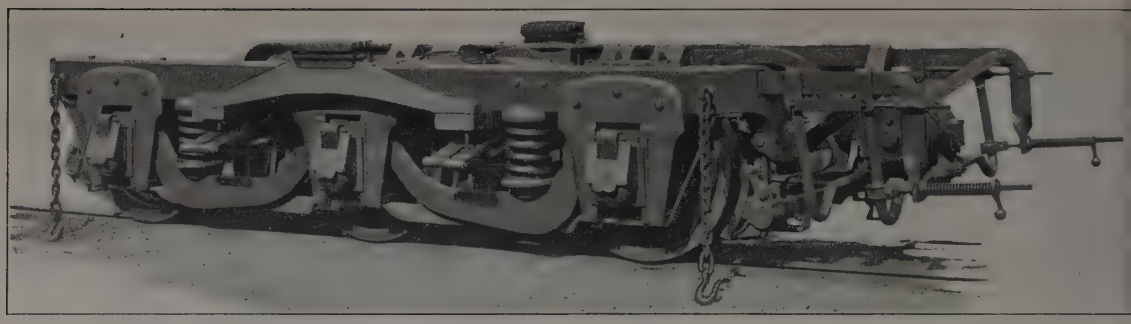


Fig. 1399—Six-Wheel Passenger Truck. Bethlehem Shipbuilding Corporation, Ltd.

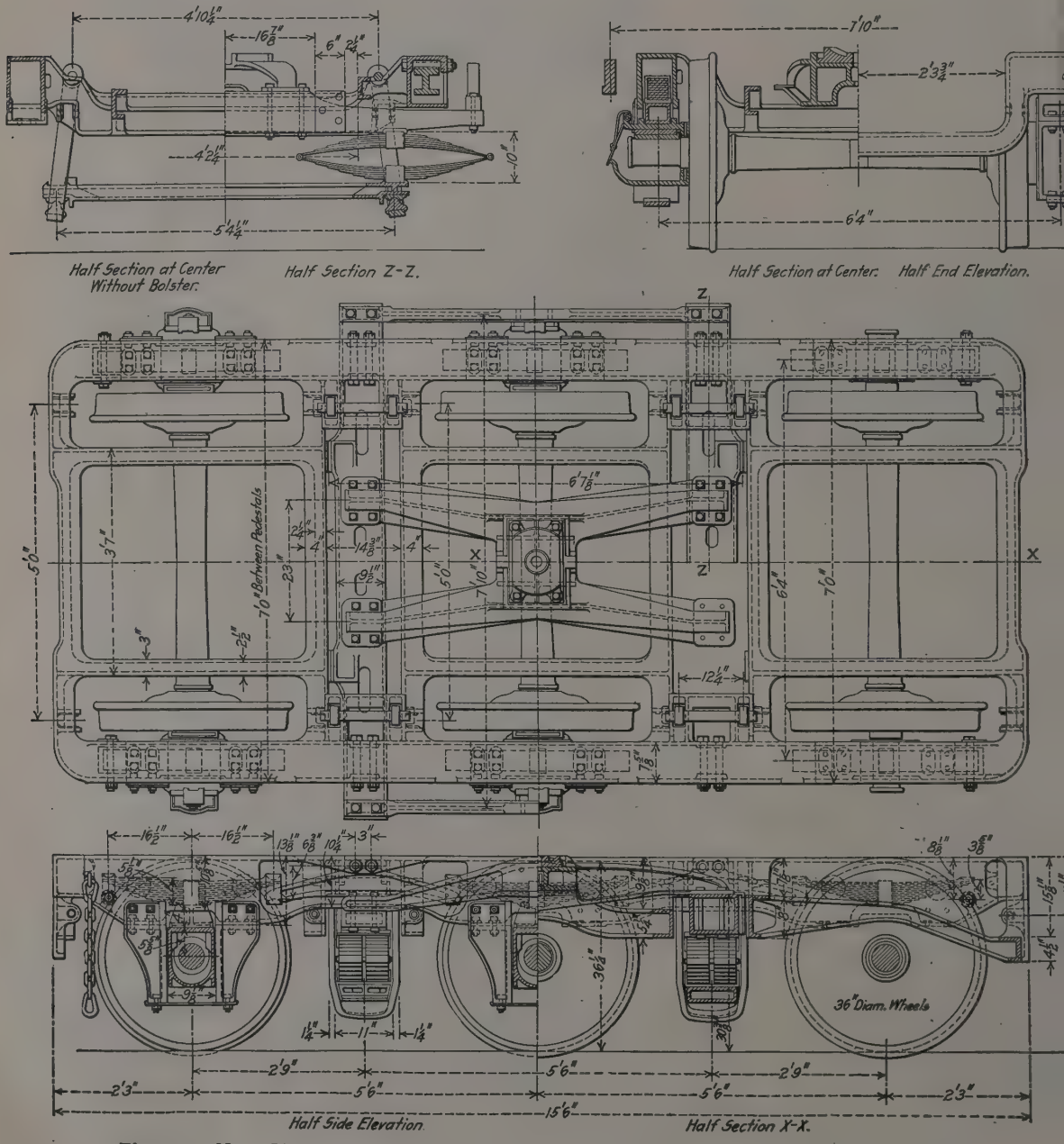


Fig. 1400—New York Central Six-Wheel Truck with Top Equalizer Clasp Brake Arrangement.

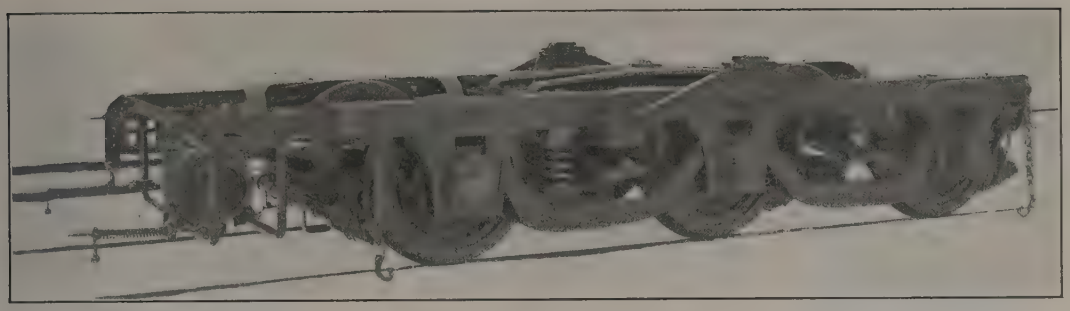


Fig. 1401—Six-Wheel Truck with Commonwealth Cast Steel Frame. The Harlan Works of the Bethlehem Shipbuilding Corporation.

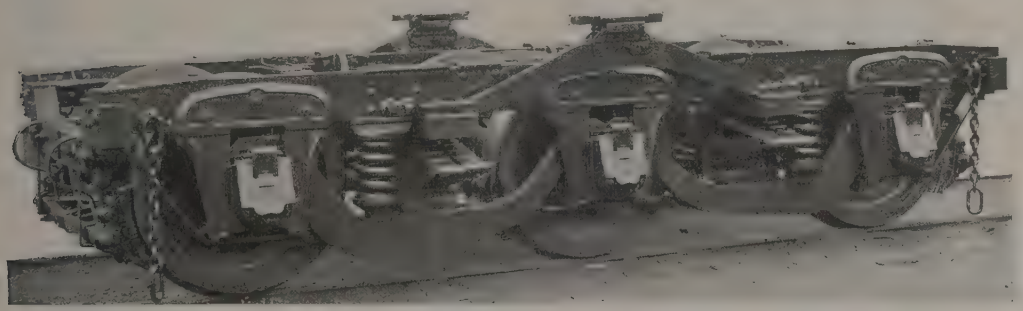


Fig. 1402—Six-Wheel Steel Truck. Bethlehem Shipbuilding Corporation, Ltd.

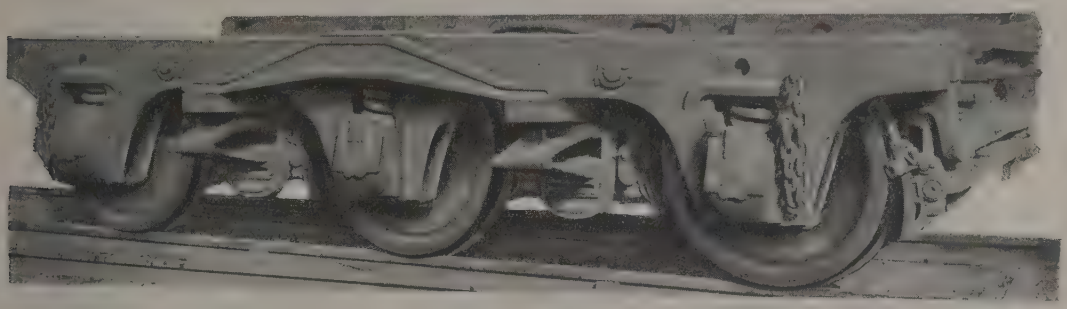


Fig. 1403—Six-Wheel Steel Truck. The Pullman Company—Pullman Plant.

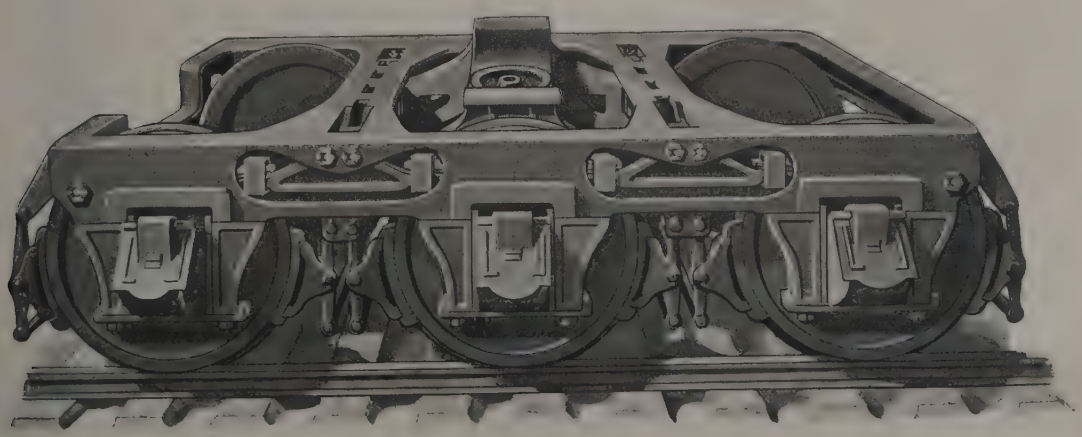


Fig. 1404—Commonwealth Six-Wheel Passenger Truck. Commonwealth Steel Company.

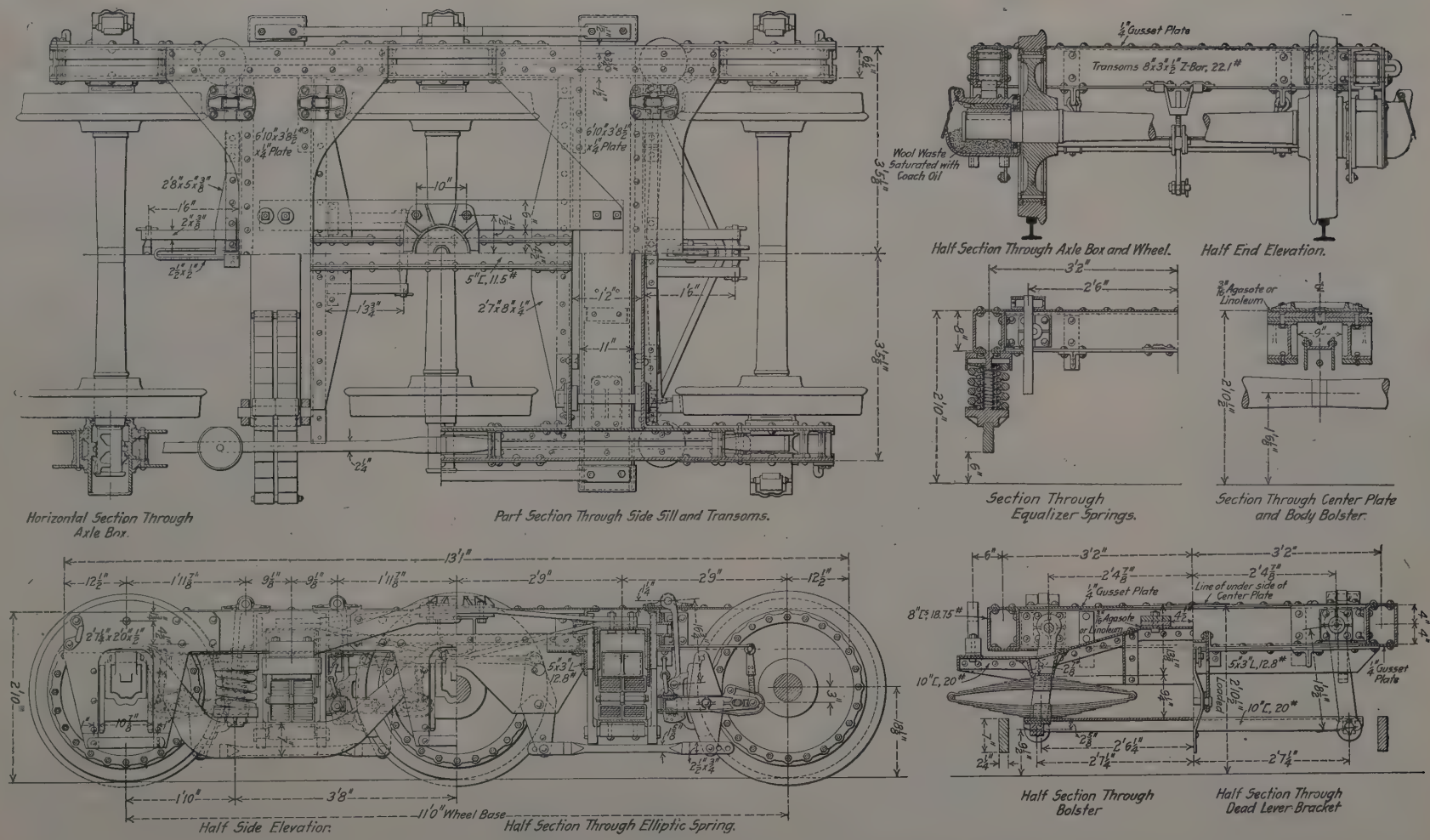

Horizontal Section Through Axle Box.
Part Section Through Side Sill and Transoms.
Half Section Through Axle Box and Wheel.
Half End Elevation.
Section Through Equalizer Springs.
Section Through Center Plate and Body Bolster.
Half Side Elevation.
Half Section Through Elliptic Spring.
Half Section Through Bolster
Half Section Through Dead Lever Bracket
Wool Waste Saturated with Coach Oil
Transoms 8"x3½"x½" Z-Bar, 22.1#
1¼" Gusset Plate
5"C, 11.5#
10"C, 20#
8"C, 18.15#
5"x3"L, 12.8#
11'0" Wheel Base

Fig. 1405—Six-Wheel All-Steel Truck for Canadian Pacific Passenger Service.

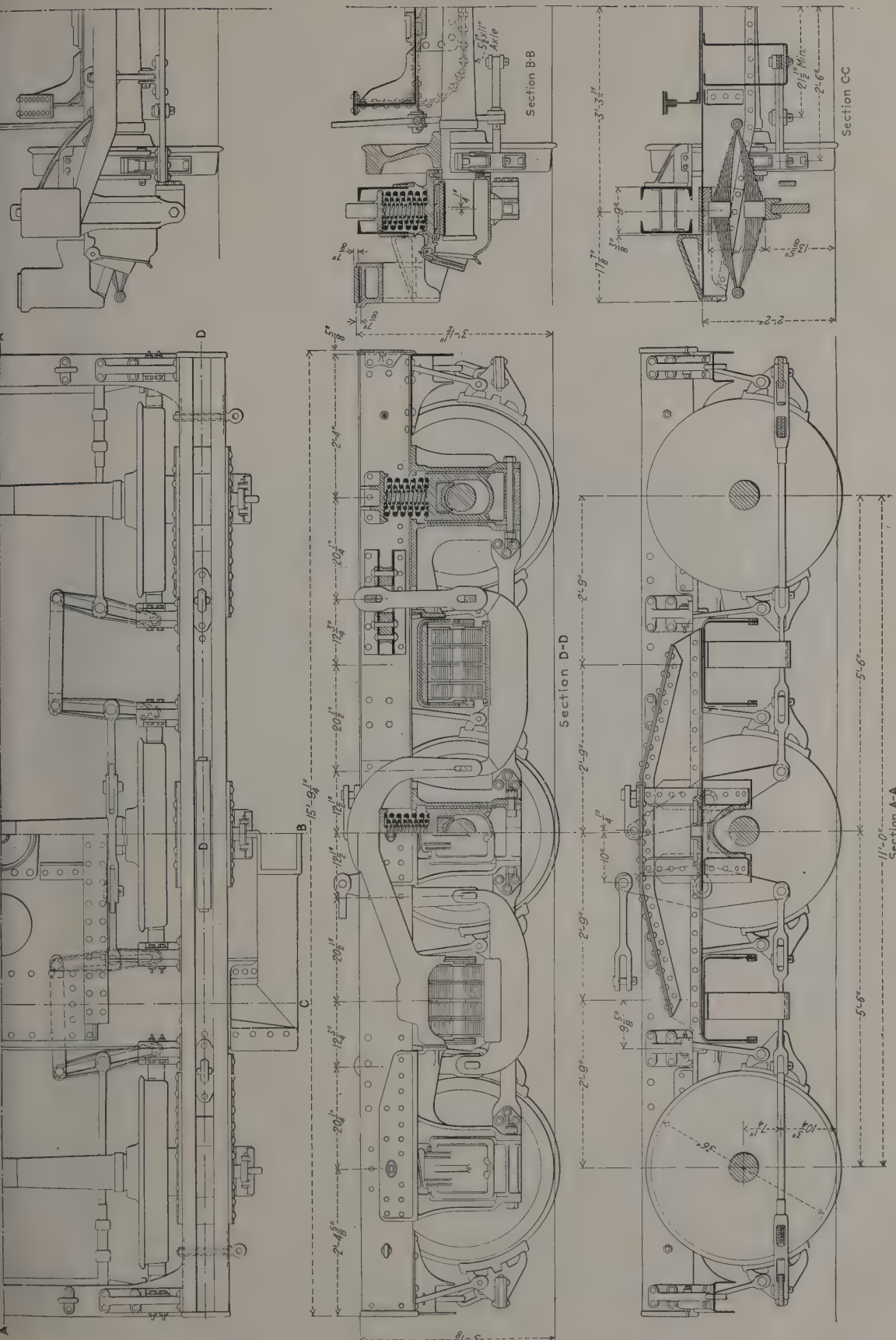


Fig. 1406—Six-Wheel Class C Passenger Car Truck. Pennsylvania Railroad.

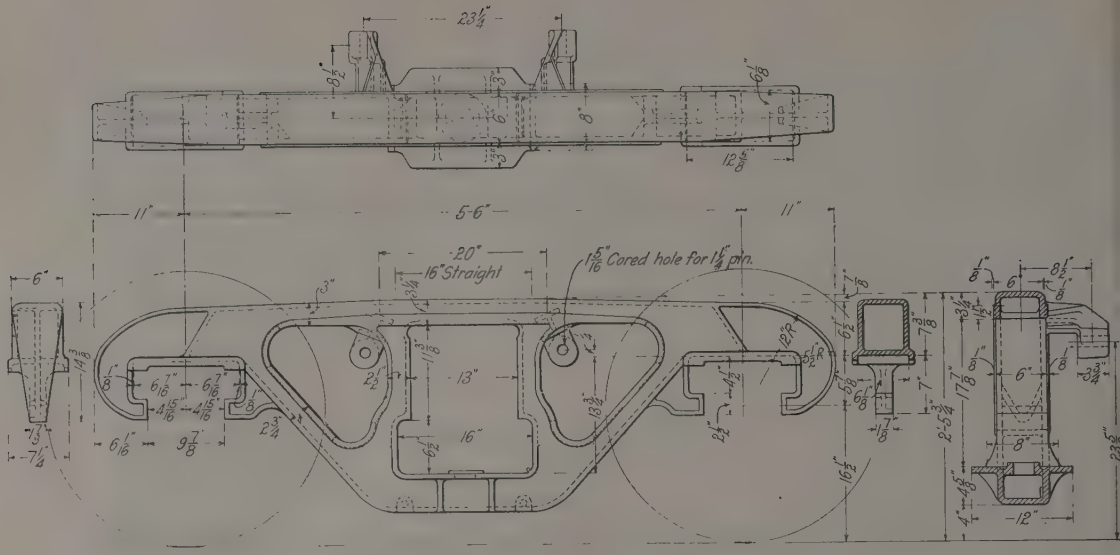


Fig. 1407—Universal Cast Steel Truck Side Frame.

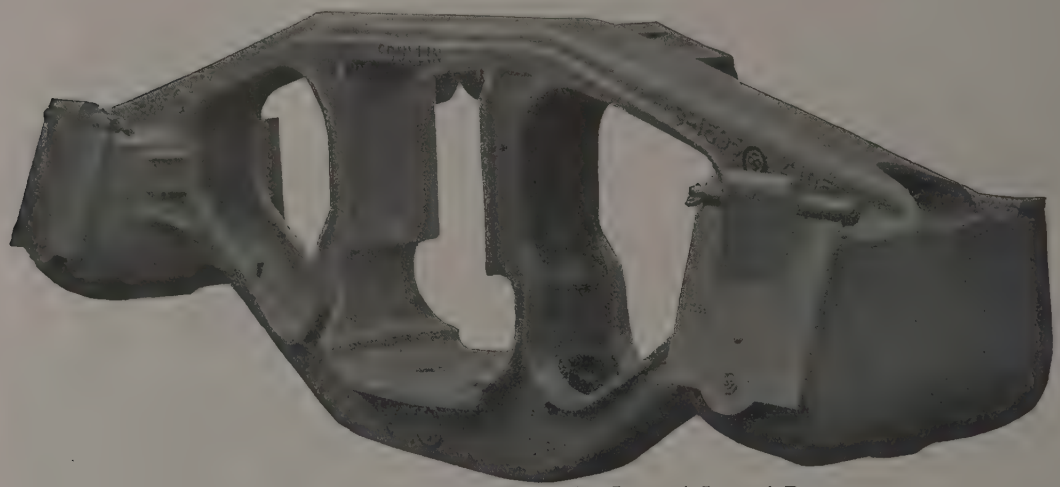


Fig. 1408—Cast Steel Side Frame with Integral Journal Boxes.

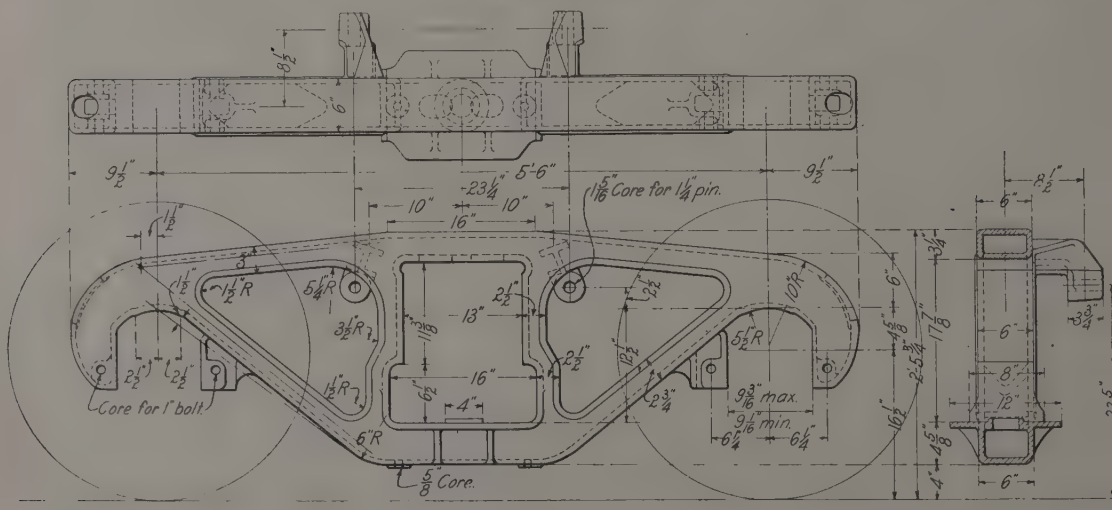


Fig. 1409—Doerr Cast Steel Truck Side Frame.
Scullin Steel Company.

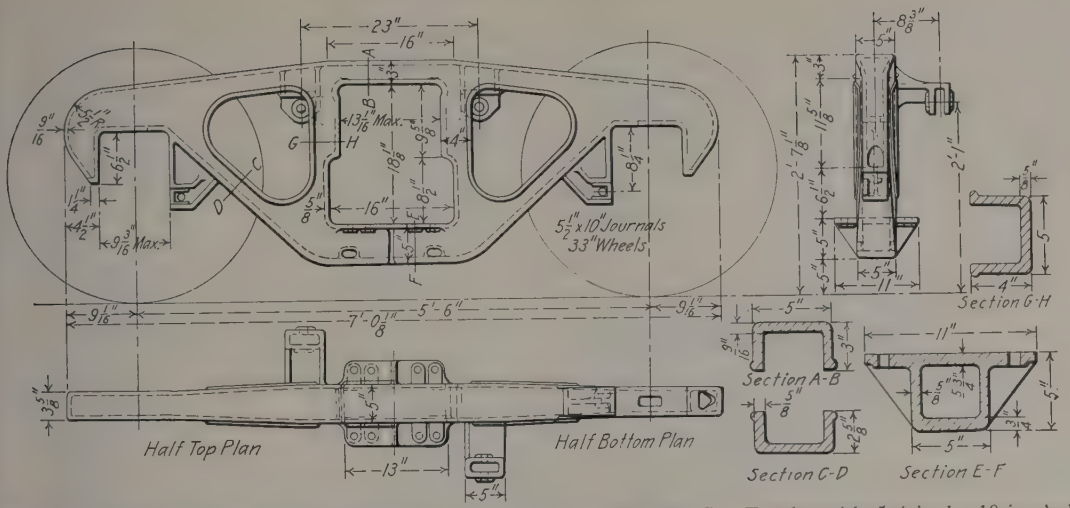


Fig. 1410—Buckeye Channel Section Pedestal Side Frame for Freight Car Trucks with 5½ in. by 10 in. Axles.

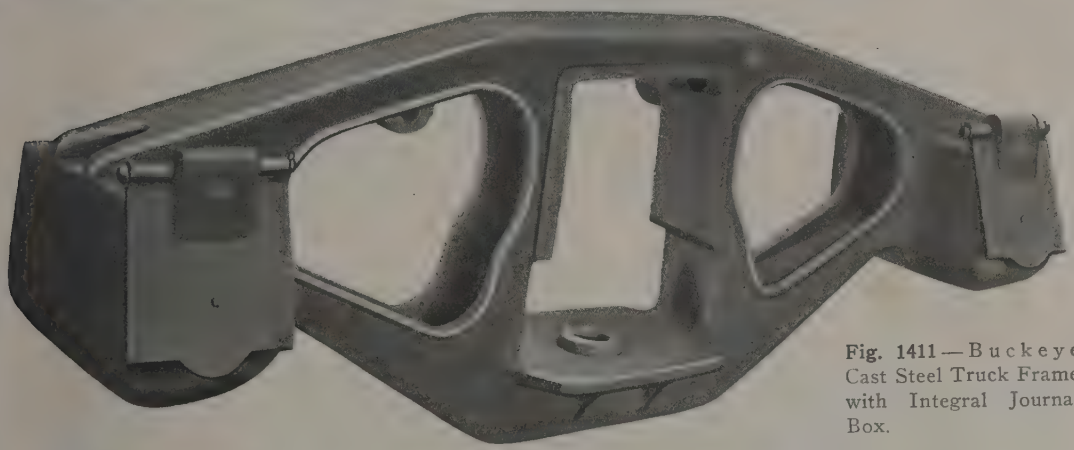


Fig. 1411—Buckeye Cast Steel Truck Frame with Integral Journal Box.

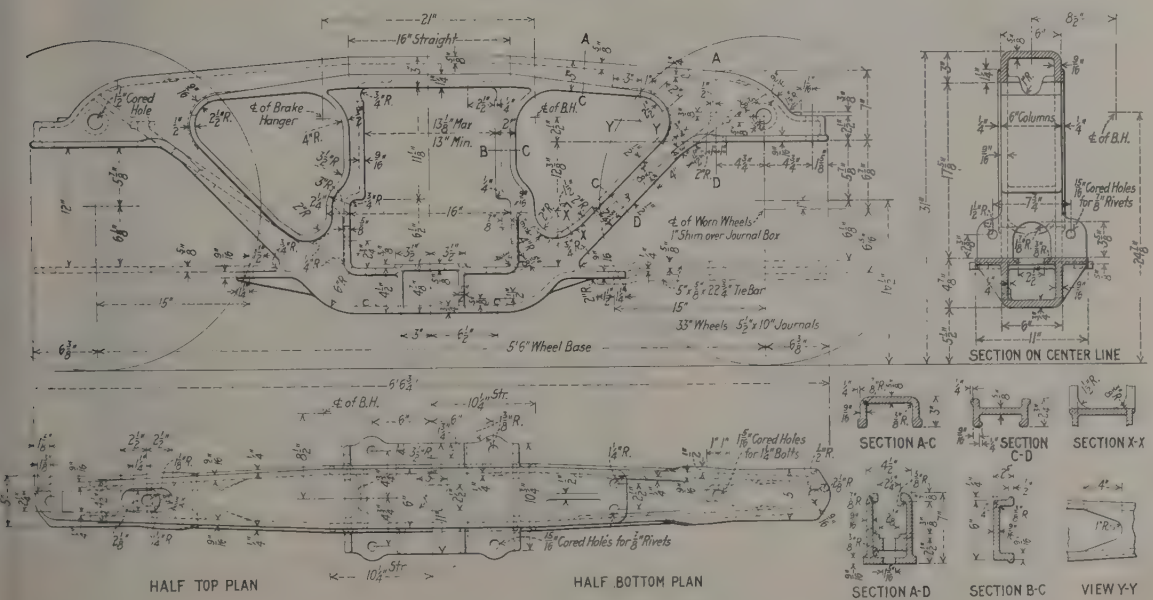


Fig. 1412—Buckeye Cast Steel Side Frame for Freight Car Trucks with 5½ in. by 10 in. Axles.

The Buckeye Steel Castings Company.

(See also Page 632.)

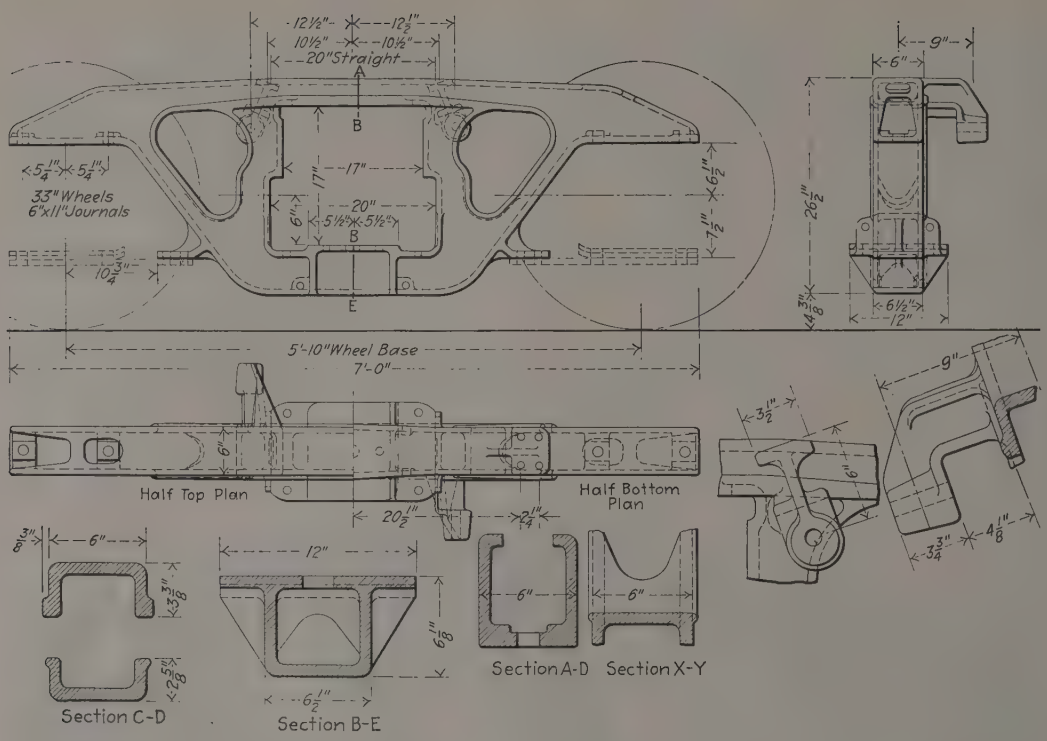


Fig. 1413—Cast Steel Truck Side Frame for 70-Ton Capacity. Buckeye Steel Castings Company.

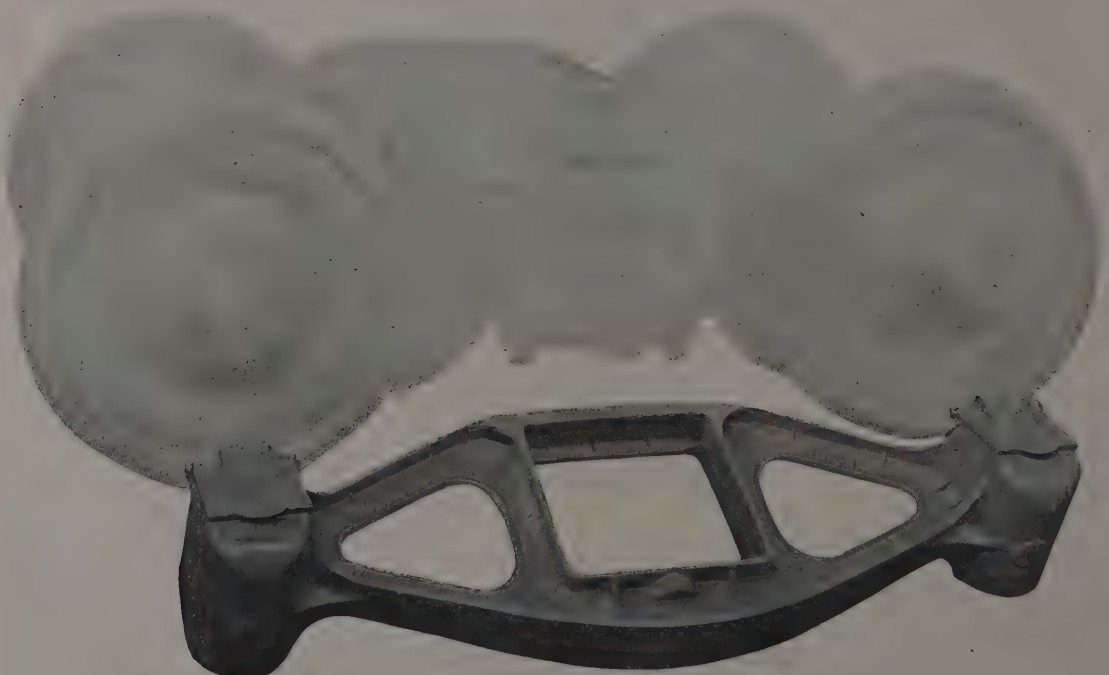


Fig. 1414—Bettendorf One-Piece Cast Steel Truck Side Frame Ready for Application to Truck. The Bettendorf Company.

(*See also Page 627.*)

Bettendorf One-Piece Side Frames

The outstanding feature of the Bettendorf Side Frame is its single-unit type of construction. It is a well-designed, simple, one-piece steel casting which embodies all the essential attachments such as separate journal boxes, column bolts, columns, arch bars, journal box bolts, etc., ordinarily found in the old arch bar type of side frame.

The elimination of detachable parts and the incorporation of all the functions of a side frame in a single steel casting, has made it possible to produce a structure of light weight and great strength, with a simplicity of detail which has made possible marked economy in maintenance and operating expenses. No part of a freight or passenger car is more exposed to excessive disintegrating vibration than the truck side frames. In the presence of these intense vibratory stresses, the connections in many other types of trucks have serious limitations and are at all times a potential cause of disaster. Such stresses are exceedingly detrimental in their action upon the members of a structure which is not of unit construction—due to the crystallizing effect of rapidly repeated strains magnified and concentrated by loosened connections. Frequently this is the cause of the complete failure of one or more of the various parts of such a structure.

The Bettendorf single-piece steel side frame has no bolted connections whatever, consequently the stresses can be determined without taking into consideration the uncertain effect introduced by a fastening which may become loose or insecure. Thus, since stresses can be readily calculated at any point in a Bettendorf Side Frame, it becomes a comparatively simple matter to adjust the weight and distribution of metal so that excessive strain is avoided and the crystallizing action of vibratory stresses completely neutralized.

The Bettendorf Side Frame is produced in two forms, the new design or U-section—Fig. 1415—and the regular design or T-section—Fig. 1416. As compared with the United States Railroad Administration side frame, the Bettendorf U-section design will save approximately 600 lb. per car, while the regular or T-section will effect a saving of about 1,000 lb. per car. The bolster opening is designed to accommodate any bolster of standard dimensions, either of the rigid or lateral motion type. In the spring seat of the frame, a hole is provided which is engaged by a round boss or projection from the spring plank when the frames are assembled in a truck. Flexibility of connection is thus secured and rigidity is overcome to the extent that the truck adjusts itself to track irregularities, thereby reducing flange wear on the wheels and end wear on the brasses.

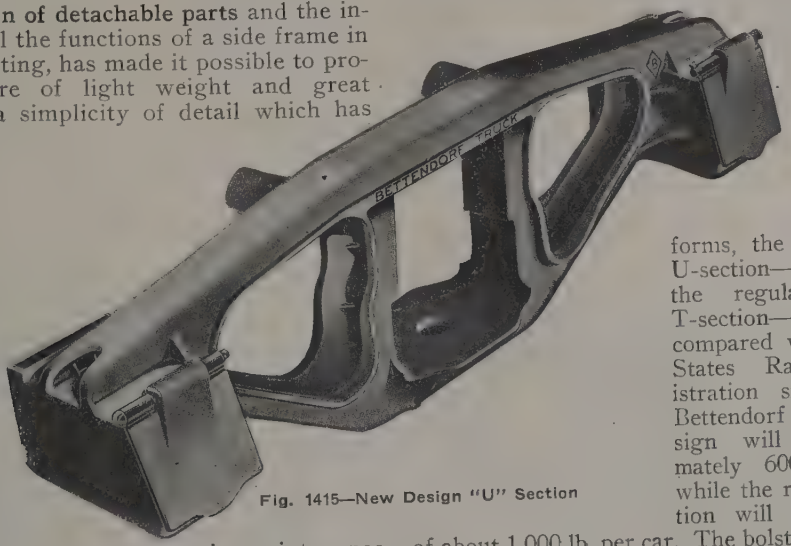


Fig. 1415—New Design "U" Section

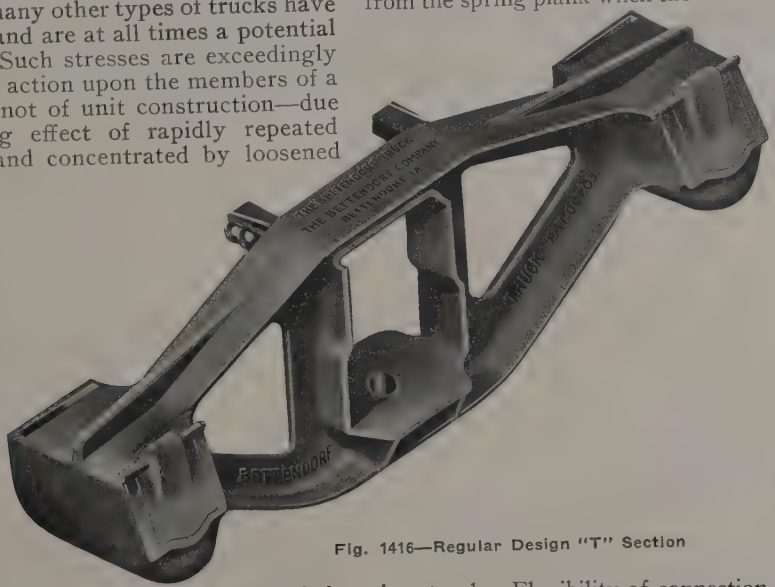


Fig. 1416—Regular Design "T" Section

For other products and branch offices, see classified and alphabetical indexes.

THE BETTENDORF COMPANY, BETTENDORF, IOWA.

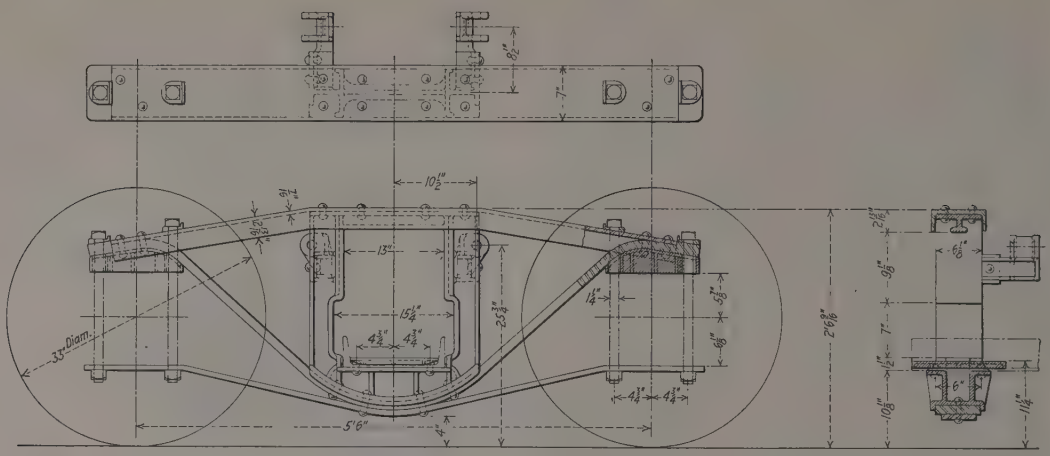


Fig. 1417—Application of Pilcher Trussed Side Frame. Republic Railway Equipment Company.

Fig. 1418—Pilcher Trussed Side Frame. Republic Railway Equipment Company.

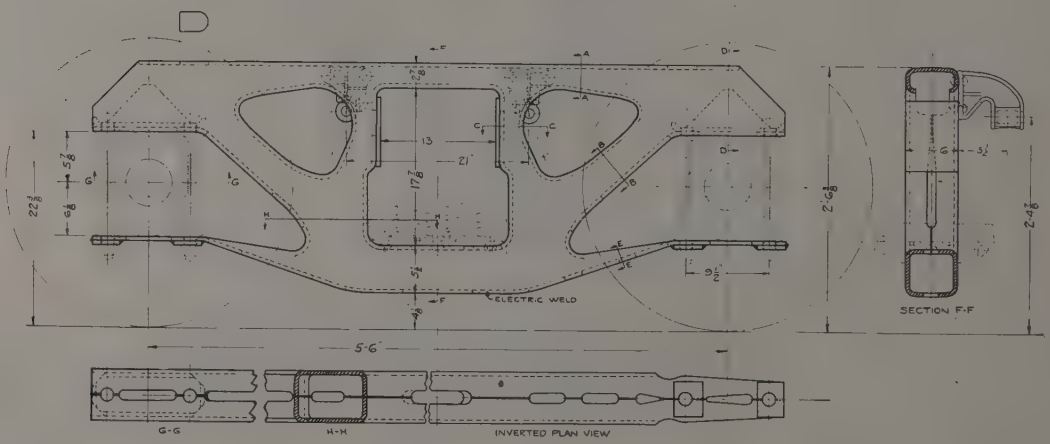


Fig. 1419—Symington Wrought Steel Side Frame for 55-Ton Capacity Truck with 5½ in. by 10 in. Axles. The T. H. Symington Company.

(See also Page 629.)

Symington Wrought Steel Side Frames

The Symington wrought steel truck side frame is designed to meet the specifications now under development by the special truck committee of the American Railway Association and is within the limiting dimensions of A. R. A. present recommended practice. It is formed from a single plate of open hearth steel by successive operations of blanking, flanging and folding. The blank for the entire frame is produced in one piece and at one operation by means of blanking or shearing dies under a hydraulic press. The blank is then placed between a pair of heavy flanging dies and marginal flanges are formed along its edges and around all of the principal openings.

The flanged blank is then folded along two bend lines parallel to and on either side of its longitudinal center line, the marginal flanges of the two sides of the folded frame facing inwardly. At certain points these flanges are brought into contact to form box sections where required to meet local conditions of stress. At these contacting points the flanges are then welded together and the bolster wear plates and journal box reinforcing pads welded in position. The brake hanger brackets are then riveted to the frame and the journal box bolt holes drilled to exact locations.

The frame is designed to suit the A. R. A. standard arch bar type journal box and the recommended A. R. A. truck bolster can be used with it. The spring plank may be of any standard type such as a structural or pressed channel. The spring plank seat is a malleable iron casting which fits over the lower central member of the frame, being held in position through contact between the frame member and suitable lugs projecting downward from the casting. For a rigid or square truck this seat casting is riveted to the end of the spring plank. Omitting the rivets produces a flexible truck, the usual flexible connection being provided in the standard seat casting and the spring plank made to suit.

The essential feature of the Symington frame is the forming of the bottom box tie bars integral with the main body of the frame. This construction avoids the use of tie bar rivets and provides a rigid anchorage for the lower end of the journal box bolts, thus relieving the truck frame of all racking strains due to brake applications, and forming a continuous horizontal girder which resists the transverse forces from bolster end thrust. This eliminates torsional or twisting moments in the ends of the truck frame near the journal boxes.

The method of manufacture makes it possible to use the most efficient and economical sections for the various frame members and these sections are generally of box or modified channel form. The strength of the side frame does not depend in the slightest degree upon the welds between

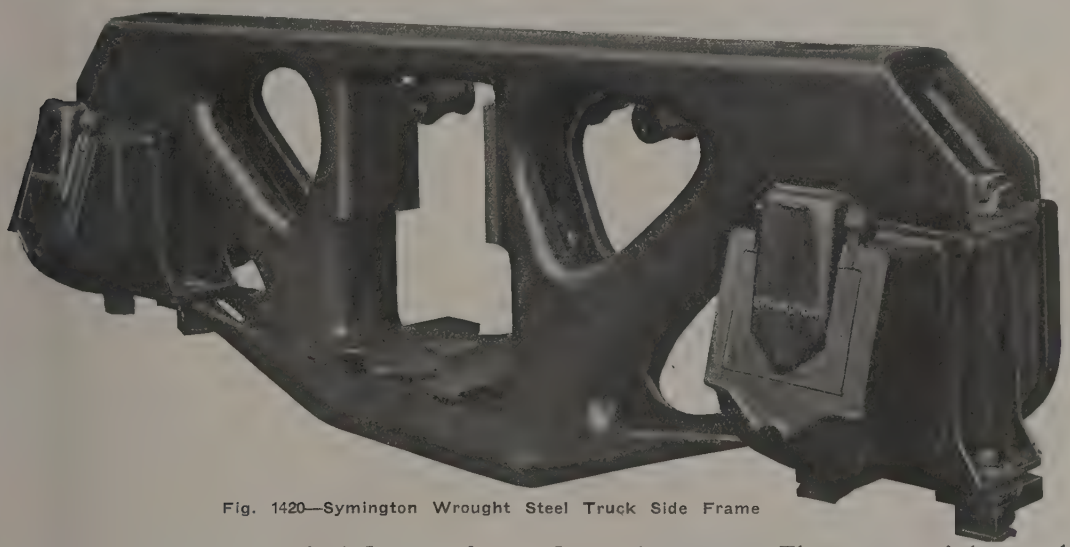


Fig. 1420—Symington Wrought Steel Truck Side Frame

flanges in contact. The purpose of these welded connections is merely to maintain alignment of the individual sections and to insure both sides of the frame acting together in service. No welding is done across a line of stress, all weld lines being parallel thereto, and in the principal members the welding is limited to the center line of the frame where the stress from transverse loading is minimum.

Exhaustive tests show the Symington wrought steel truck side frame to have a strength or resisting capacity under static loading sufficient to meet all the requirements of service and provide a high factor of safety, while impact tests show that it has great resistance under dynamic loading. The Symington frames for 55-ton and 70-ton cars weigh considerably less than the corresponding sizes of U. S. R. A. cast steel frames and of the A. R. A. arch bar frames.

In addition to the characteristics of maximum strength and relatively light weight, the Symington frame can be easily restored to its original strength if distorted as in a wreck, and the bolster wear plates may be renewed, when necessary.

For other products and branch offices, see classified and alphabetical indexes.

THE T. H. SYMINGTON CO., ROCHESTER, N. Y.

Fig. 1421.—Andrews Channel Section Cast Steel Truck Side Frame for Freight Equipment.

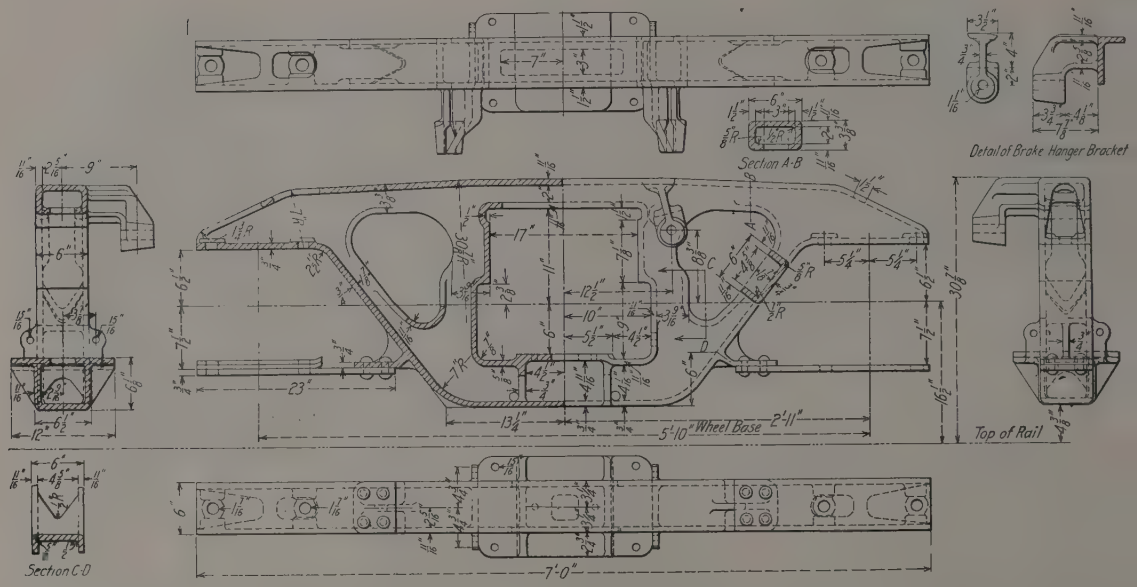


Fig. 1422—Side Frame for Trucks of Pennsylvania Railroad 70-Ton Capacity Freight Cars.

Fig. 1423—Vulcan Channel Section Cast Steel Truck Side Frame.

American Steel Foundries.

(*See also Page* 631.)

Truck Side Frames and Bolsters

The American Steel Foundries manufactures two general types of Cast Steel Truck Side Frames, one type having separate journal boxes such as the Andrews and Vulcan designs and the other type, the Integral Box Frame, having journal boxes cast integral with the frame. The Andrews Frame works in conjunction with the same journal box and journal box bolts as the arch bar

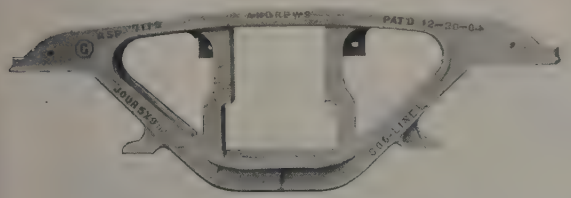


Fig. 1424—Andrews Cast Steel Truck Side Frame

truck. The Vulcan is the same as the Andrews in the body of the frame proper but provides pedestal jaws at the ends to fit around the upper part of the journal boxes.

Both the Andrews and Vulcan frames are one piece castings; the Andrews Frame eliminating some 60 to 80 parts per car and the Vulcan some 80 to 100 parts per car, as compared with the arch bar truck. The Vulcan Truck is somewhat simpler than the Andrews, in that it eliminates the use of journal box bolts and nuts and tie bars. It is also considerably easier to remove the wheels from the Vulcan Truck, in that it is only necessary to remove one small journal box tie bar, jack up the ends of the truck and roll out the wheels.

Some of the advantages of the Andrews and Vulcan Trucks are briefly as follows: greater strength, lighter weight, fewer parts, low cost of

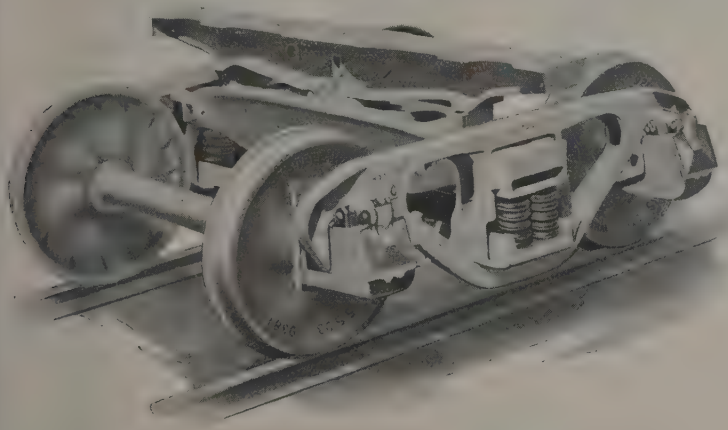


Fig. 1425—Vulcan Truck

maintenance, low cost of inspection, easy removal of wheels, more thorough inspection of wheels, brake riggings, etc., and adaptability to all kinds of service.

The Integral Box Frame has the journal boxes cast integral and, therefore, in a single piece casting it eliminates all the parts required with the arch bar frame.

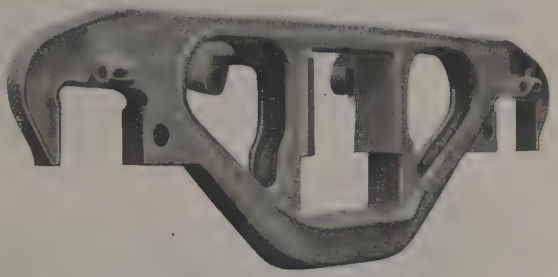


Fig. 1426—Vulcan Truck Side Frame

The cast steel box shape truck bolster is cast in a single piece thus eliminating all loose parts and thereby greatly reducing maintenance expense. The

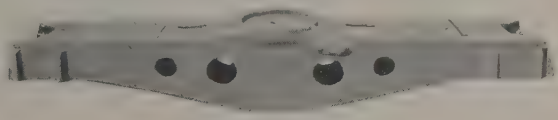


Fig. 1427—Cast Steel Bolster

metal is so distributed in the design of this bolster as to provide ample strength for the service it is to perform.

The one-piece cast steel bolster has gradually supplanted practically all types of built-up bolster

Fig. 1428—Simplex Bolster

particularly those depending upon a large number of rivets for their strength. The numerous parts of the riveted built-up bolster represent a greater up-keep and maintenance cost. The box shape bolster is the most dependable in that it affords great transverse strength in addition to vertical strength.

Cast Steel is more easily adaptable to unusual shapes and designs, making it particularly desirable for body bolsters where an unusual construction of car is involved and for truck bolsters where restricted clearances limit the amount of space available.

Cast Steel Side Frames in conjunction with Cast Steel Bolsters give a simple, strong and very satisfactory type of truck construction.

The American Steel Foundries also manufactures Simplex Body and Truck Bolsters.

The Simplex bolster is a trussed construction and, although of a built-up type, it is not dependent upon rivets for strength, due to its lapped end construction.

For other products and branch offices, see classified and alphabetical indexes.

AMERICAN STEEL FOUNDRIES, CHICAGO, ILL.

Buckeye Cast Steel Bolsters and Truck Frames

The Buckeye cast steel bolster is designed to meet the exacting requirements of modern railway service. It is made in one piece and the metal is distributed so as to give maximum and uniform strength.

The design of this bolster embodies features which make it practically indestructible in service.

Fig. 1429—Buckeye Cast Steel Heavy Duty Truck Bolster

The side flanges on the top and bottom members make it very strong transversely, while the center plate is well supported by a heavy center post. The integral type of casting eliminates the possibility of any parts jarring loose as occurs with built-up designs, while the absence of small parts is responsible not only for extremely low maintenance charges, but also renders possible, easy and thorough inspection at low cost.

The sections of metal are uniform throughout. Provision is made for full box section at the side bearings, thus assuring a large factor of safety for the destructive action of the body pounding on the bolster side bearing. These castings are produced under highly standardized conditions of manufacture resulting in high grade material and workmanship.

The Buckeye cast steel truck frames are designed for use on heavy freight equipment. The various members constituting each frame have channel sections which give greater strength transversely with the same vertical strength as T-sections of the same weight. The sections are uniform throughout. Journal box tie bars and supports for the brake hangers are cast integral with the frame.

Three designs of these channel section frames are manufactured, the difference between the respective types being in the method employed for holding the journal boxes. One design provides for the bolted type of the standard journal box, one has the journal boxes cast integral, and the third uses a special pedestal type box.

All A. R. A. requirements are met by Buckeye cast steel truck frames, both as to limiting dimension, weight and strength. The frame illustrated was tested by the M. C. B. Association (M. C. B. Proceedings, 1914, Exhibit P. Test 43) and the results show that for similar capacity, it has an ultimate strength twice that of arch bar construction.

Low costs for inspection and repairs are direct results of the one-piece construction; with Buckeye cast steel frames there are no parts to wear or jar loose.

Fig. 1430—Buckeye Cast Steel Truck Side Frame with Channel Sections

These features—great strength, few parts, simplified truck construction—of Buckeye cast steel truck frames, should be carefully considered by railroad officials when planning ways and means for reducing the cost of maintaining freight equipment without impairing the service rendered.

For other products and branch offices, see classified and alphabetical indexes.

BUCKEYE STEEL CASTINGS COMPANY, COLUMBUS, OHIO

Fig. 1431—Cast Steel Bolster for Trucks with 5½ in. by 10 in. Axles for U. S. R. A. Freight Cars.

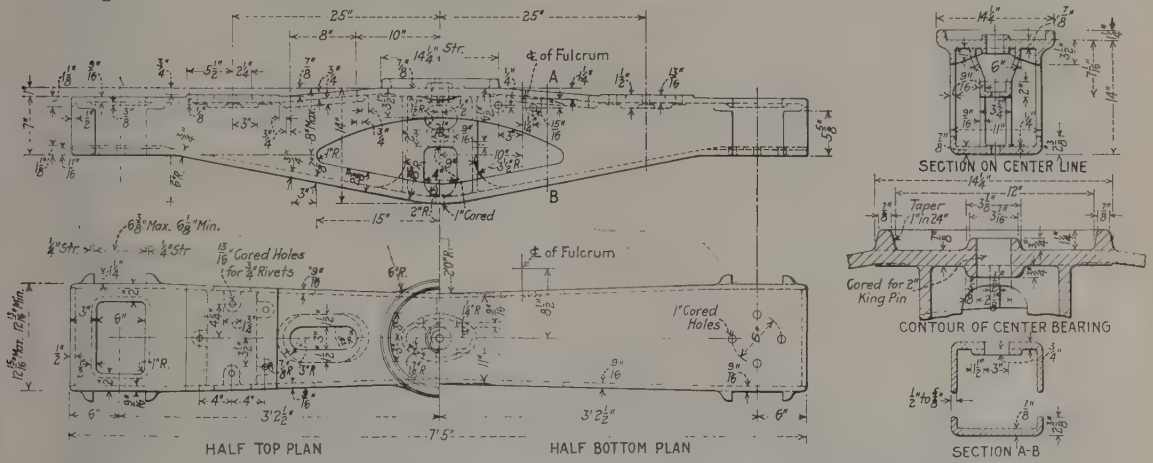


Fig. 1432—Buckeye Cast Steel Bolster for Trucks with 5½ in. by 10 in. Axles.

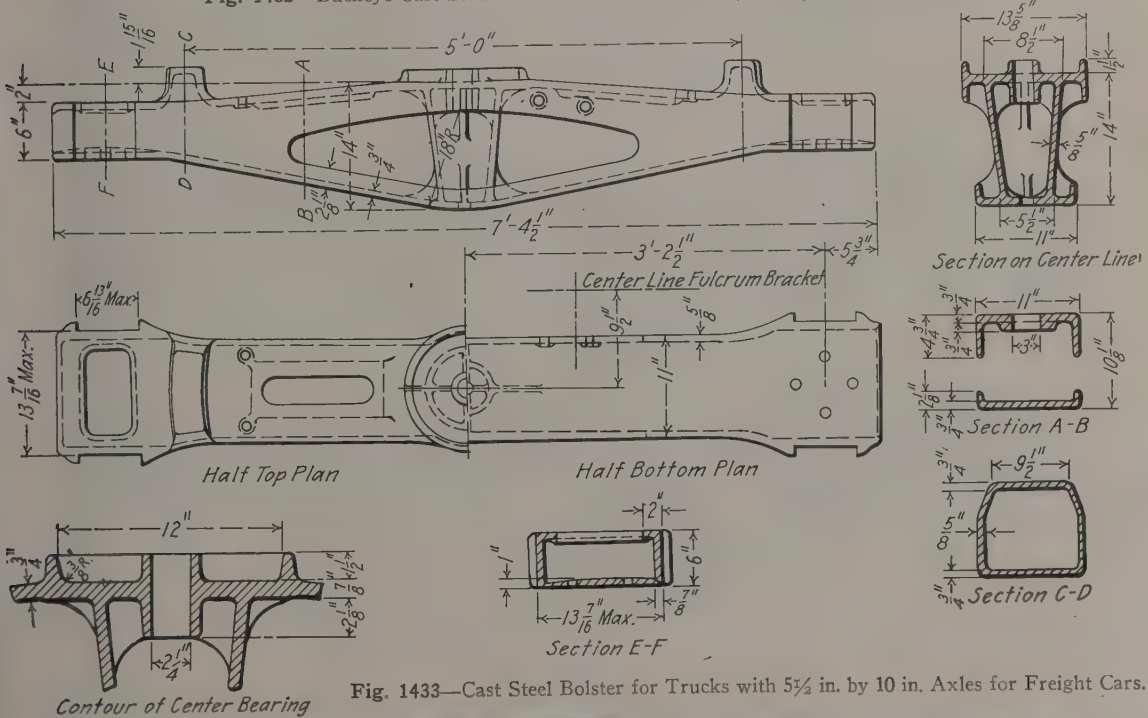


Fig. 1433—Cast Steel Bolster for Trucks with 5½ in. by 10 in. Axles for Freight Cars.

Fig. 1434—Buckeye Cast Steel Bolster for Freight Car Trucks.
Buckeye Steel Castings Company.
(*See also Page 632.*)

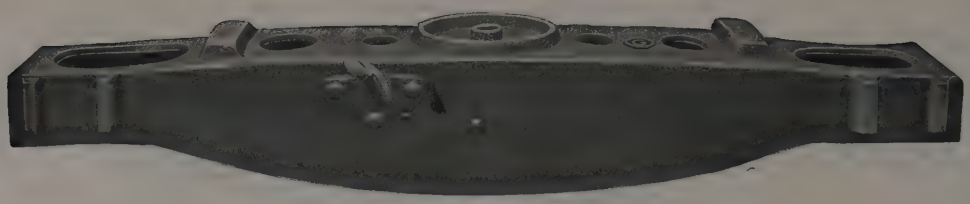


Fig. 1435—Box Shape Cast Steel Truck Bolster for Freight Cars.

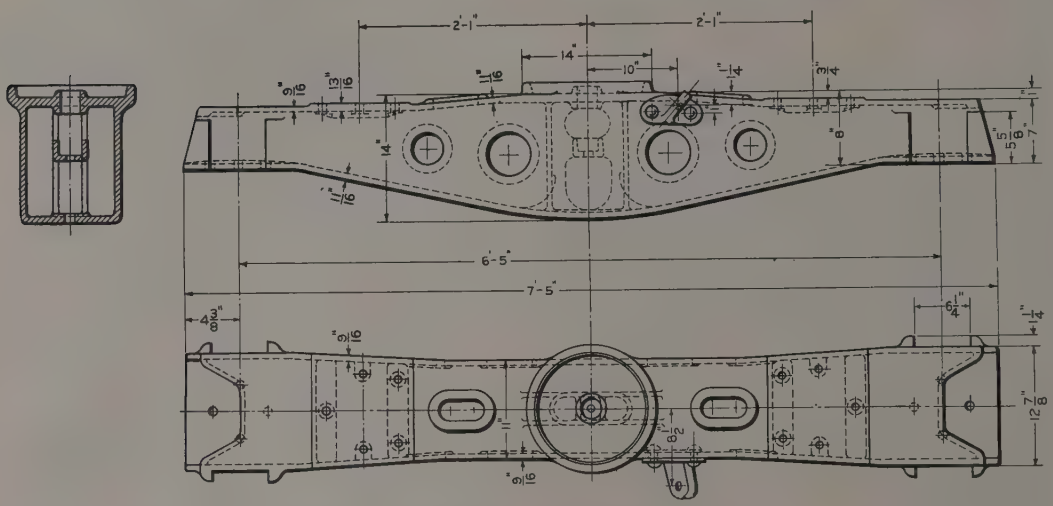


Fig. 1436—Box Shape Cast Steel Truck Bolster.

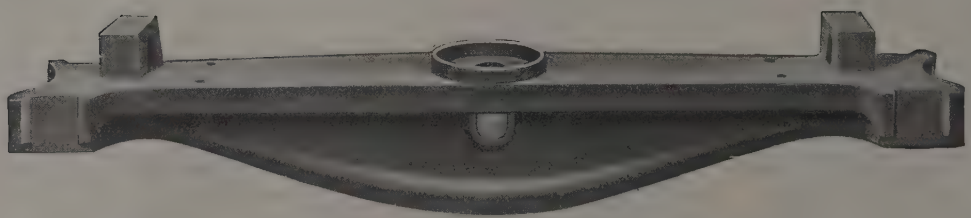


Fig. 1437—T-Shape Cast Steel Truck Bolster for 30 to 50-Ton Capacity Freight Cars.

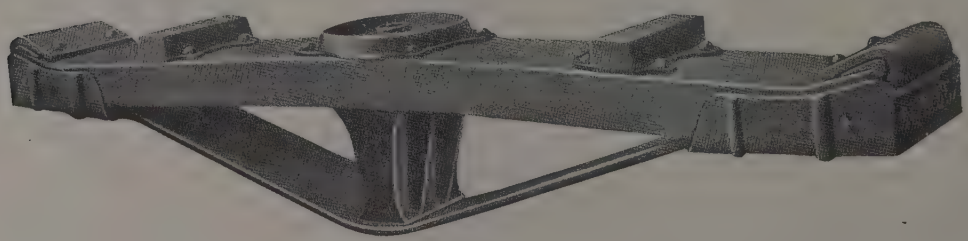


Fig. 1438—"Simplex" Truck Bolster with Plain Side Bearings.
American Steel Foundries.
(*See also Page* 631.)

Fig. 1439—Gould Improved Z-Type Cast Steel Truck Bolster for Freight Cars. **Gould Coupler Company.**
(*See also Page* 955.)

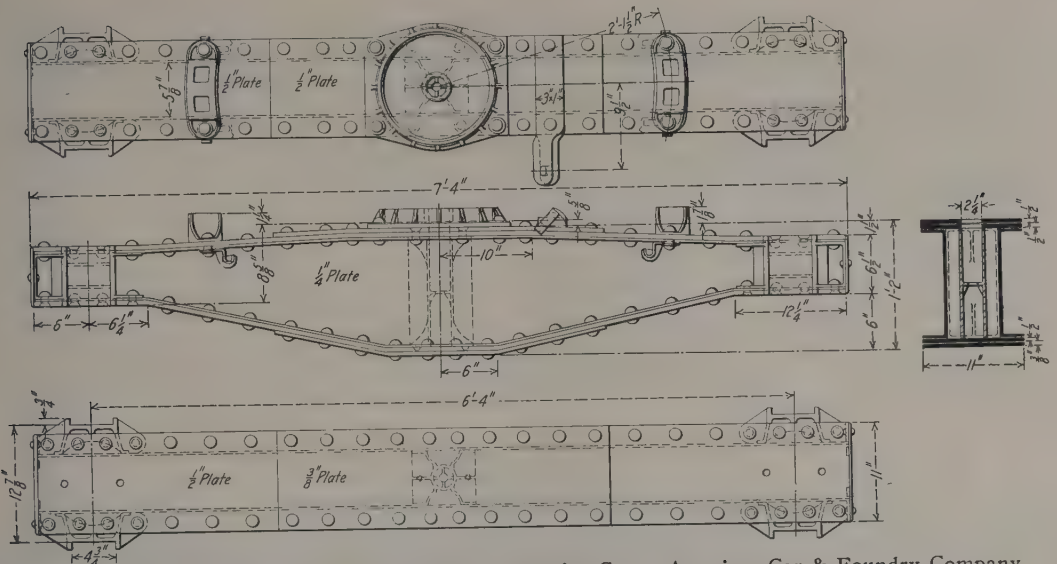


Fig. 1440—Standard Truck Bolster for 40-Ton Capacity Cars. American Car & Foundry Company.

Fig. 1441—Box Section Cast Steel Truck Bolster. The Bettendorf Company.

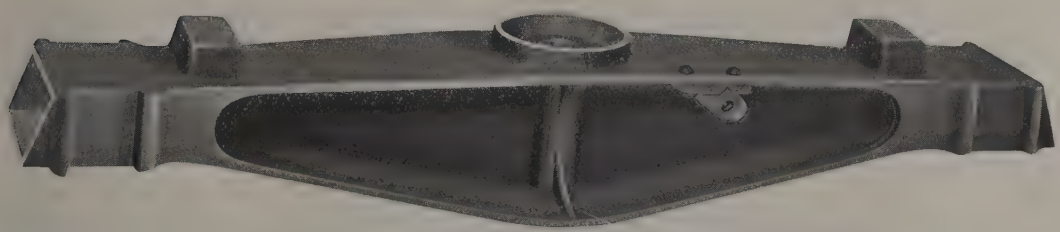


Fig. 1442—I-Section Cast Steel Truck Bolster. The Bettendorf Company.

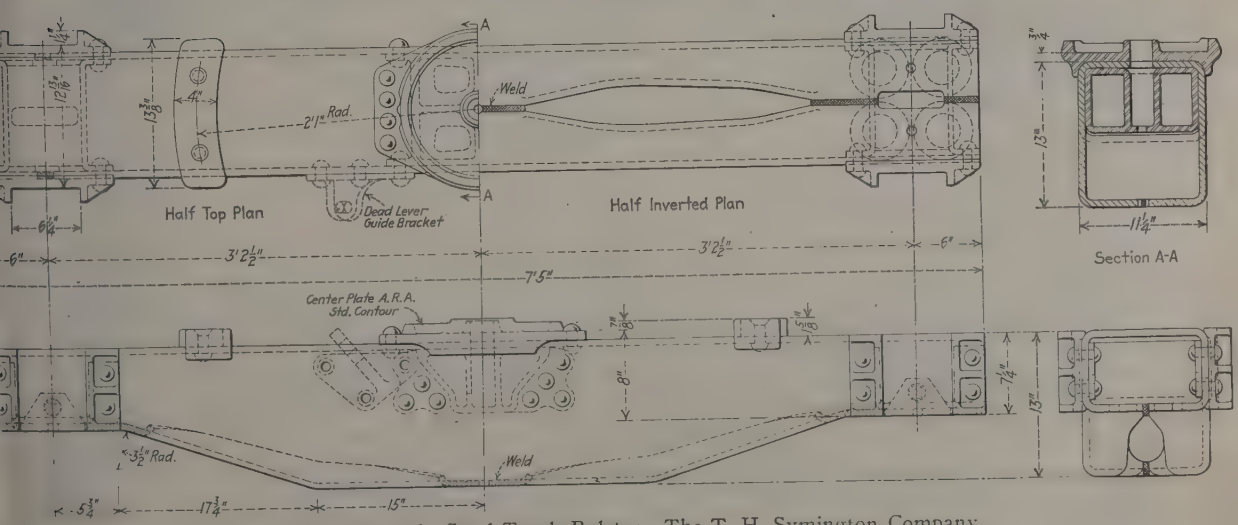


Fig. 1443—Wrought Steel Truck Bolster. The T. H. Symington Company.

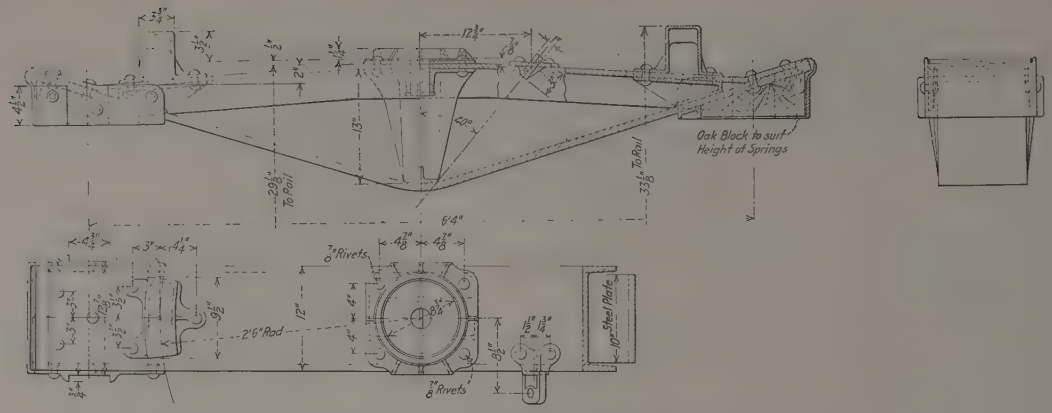


Fig. 1444—Huntoon Truck Bolster for 40-Ton Capacity Freight Cars.

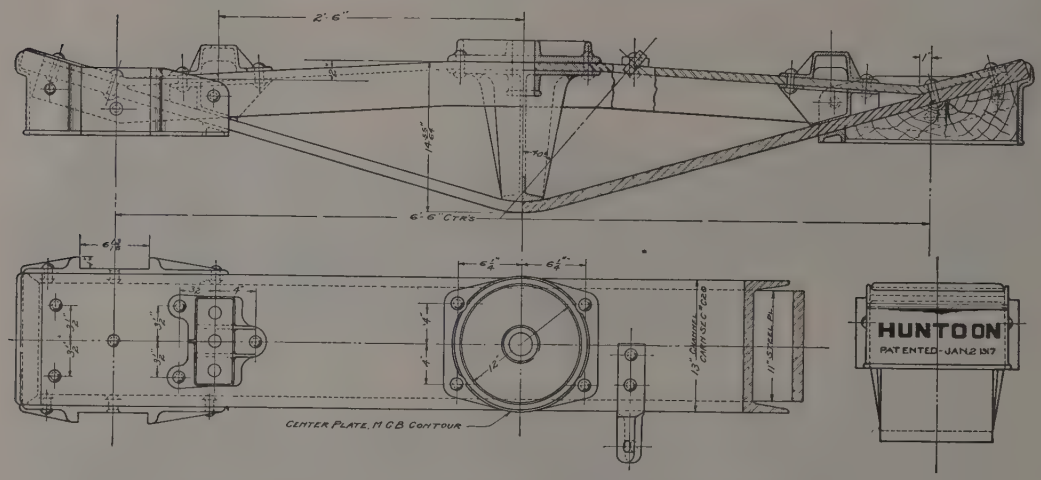


Fig. 1445—Huntoon Truck Bolster for 75-Ton Capacity Freight Cars.

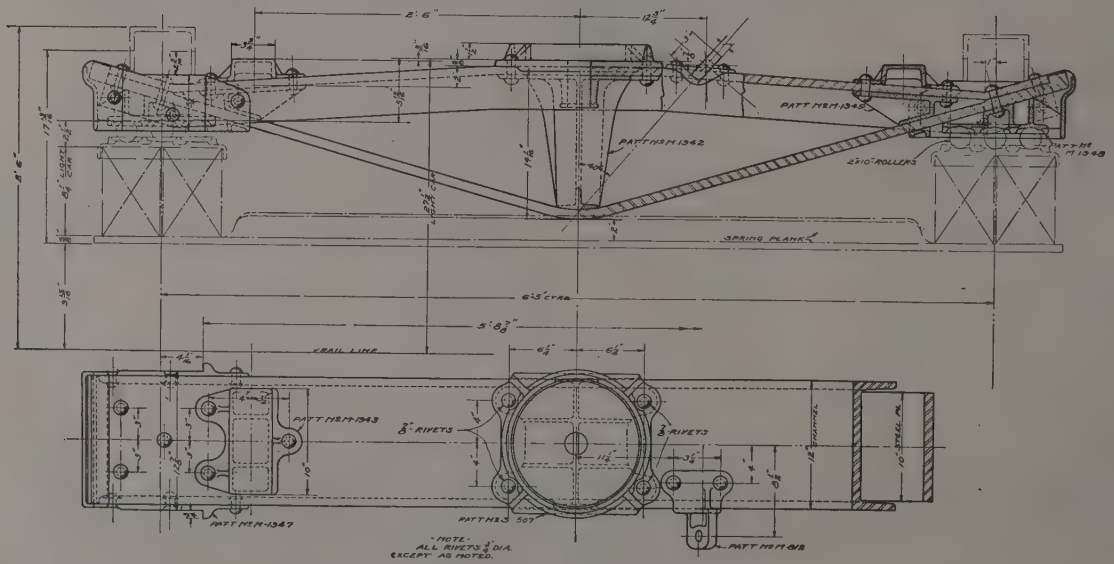


Fig. 1446—Huntoon Truck Bolster for 50-Ton Capacity Freight Cars.

Republic Railway Equipment Company.

(*See also Page 637.*)

Huntoon Truck Bolsters

Practical tests and service under various and exacting conditions have thoroughly demonstrated durability and efficiency of the Huntoon Truck Bolster. This bolster is of the built-up type, embodying the same principle of design and construction that is used so successfully in the Huntoon Brake Beam.

The method of interlocking the tension and compression members of truss in the Huntoon Bolster gives it great strength and rigidity. Both members are of open hearth steel, the compression member being a channel and the tension member a flat bar upset at the ends to maintain the full cross sectional area at the rivet holes.

Before shipment, all bolsters are subjected to a test load greatly in excess of the service load, to properly seat all parts, and to disclose any defects in workmanship or material. All tension and compression members are carefully

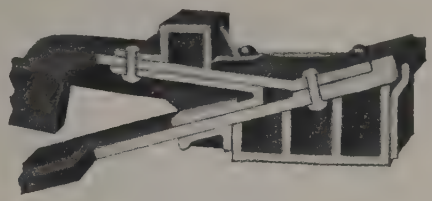


Fig. 1449—Section Showing Malleable Spring Seat

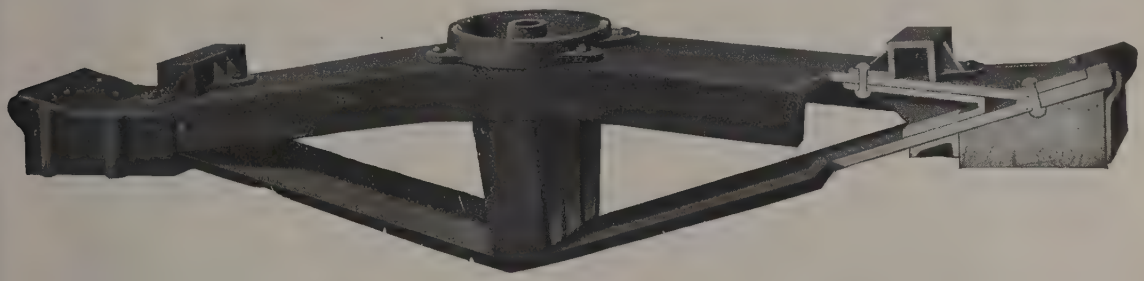


Fig. 1447—Huntoon Truck Bolster Showing Section of Wood Spring Seat

The king post is made of a high grade of malleable iron and is designed with a heavy cross section.

The ends of the tension member as shown in Figs. 1447 and 1449—has shoulders which interlock with and bear directly against the web and flanges of the compression member, thus preventing any shearing strain on the rivets binding these members together at the ends. This construction absolutely prevents any creeping of the tension member. The end joint between the compression and tension members is machined which insures minimum deflection under load.

The tension, shearing and bearing values at the upset ends exceeds the tensile strength of the tension bar at the center in contrast to ordinary types of built-up bolsters which are weakened on account of the rivet apertures at the ends.

gaged in order to provide a uniform length and thus make possible the interchange of parts—a very desirable repair feature.

Bolsters are furnished in 30, 40, 50 and 70 ton capacities to meet any service requirements. Center plates are made of malleable iron, cast steel, or drop forgings as required. Side bearings are either plain or anti-friction types and the spring seats are arranged for wood, malleable iron, or for a lateral motion device as required by the purchaser.

Fig. 1448—Huntoon Truck Bolster with Anti-Friction Side Bearings

Huntoon Truck Bolsters are now in use on many railroads and are giving excellent service and satisfaction; they are safe, efficient, and durable and being made of material of known strength and quality they can be depended upon to meet all service shocks without the possibility of failure.

Fig. 1450—Commonwealth Cast Steel Bolster for Six-Wheel Passenger Train Car Truck. Commonwealth Steel Company.
(See also Page 619.)

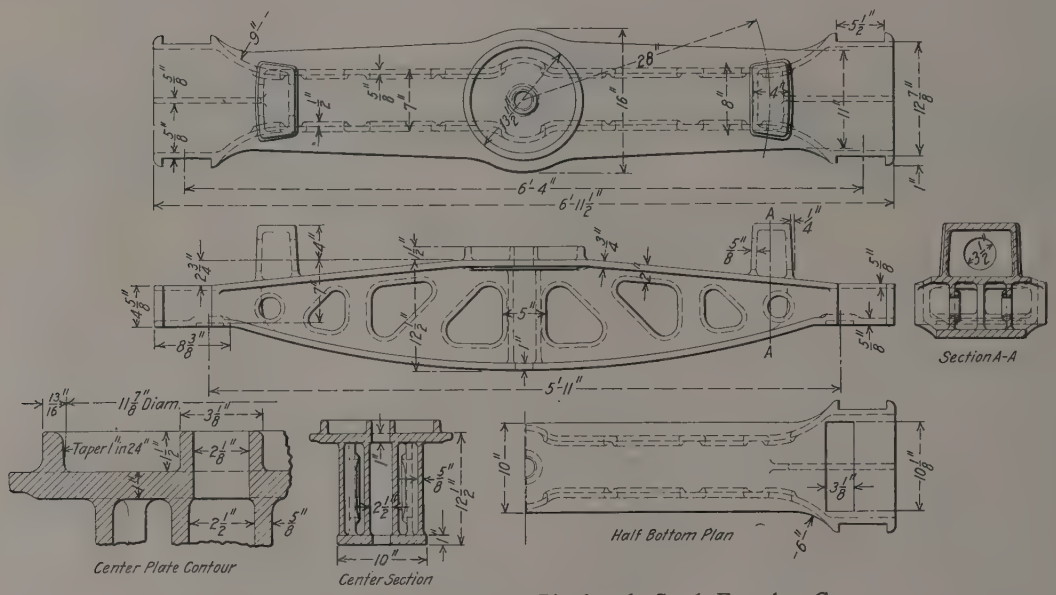


Fig. 1451—Cast Steel Truck Bolster. Pittsburgh Steel Foundry Company.

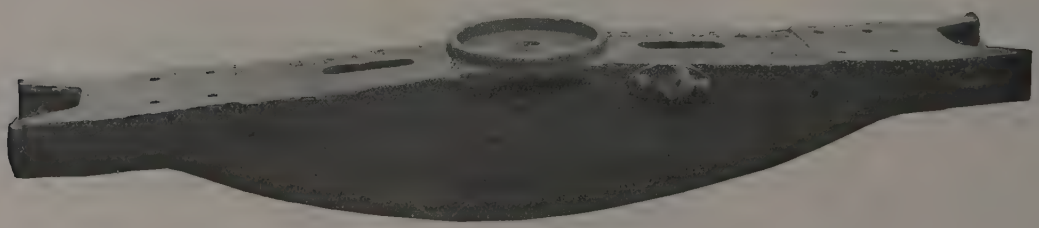


Fig. 1452—Cast Steel Box Section Truck Bolster. Scullin Steel Company.

Fig. 1453—Huntoon Truck Bolster for 30, 40, 50 and 70-Ton Capacity Freight Cars. Plain Side Bearings. Republic Railway Equipment Company.
(See also Page 637.)

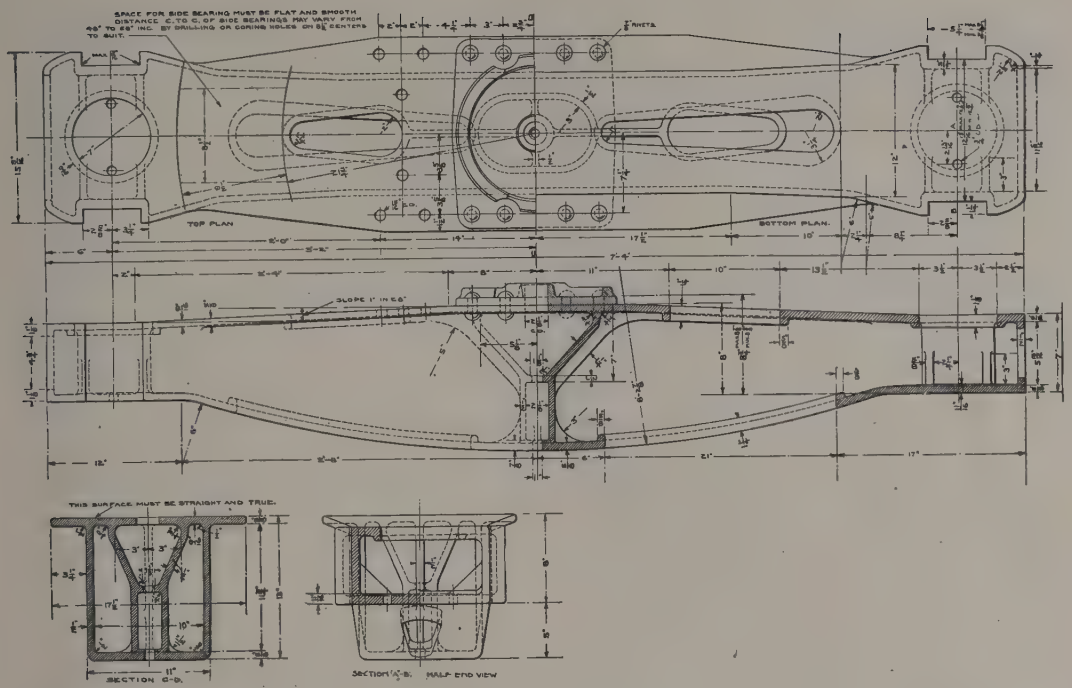

SPACE FOR SIDE BEARING MUST BE FLAT AND SMOOTH.
DISTANCE C. TO C. OF SIDE BEARINGS MAY VARY FROM
46" TO 56" INC. BY DRILLING OR CORING HOLES ON 2" CENTERS
TO SUIT.
TOP PLAN
BOTTOM PLAN.
SLOPE 1" IN 20"
THIS SURFACE MUST BE STRAIGHT AND TRUE.
SECTION C-D.
SECTION A-B.
HALF END VIEW

Fig. 1454—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 80,000 lb. Capacity Car, With Separate Center Plate.

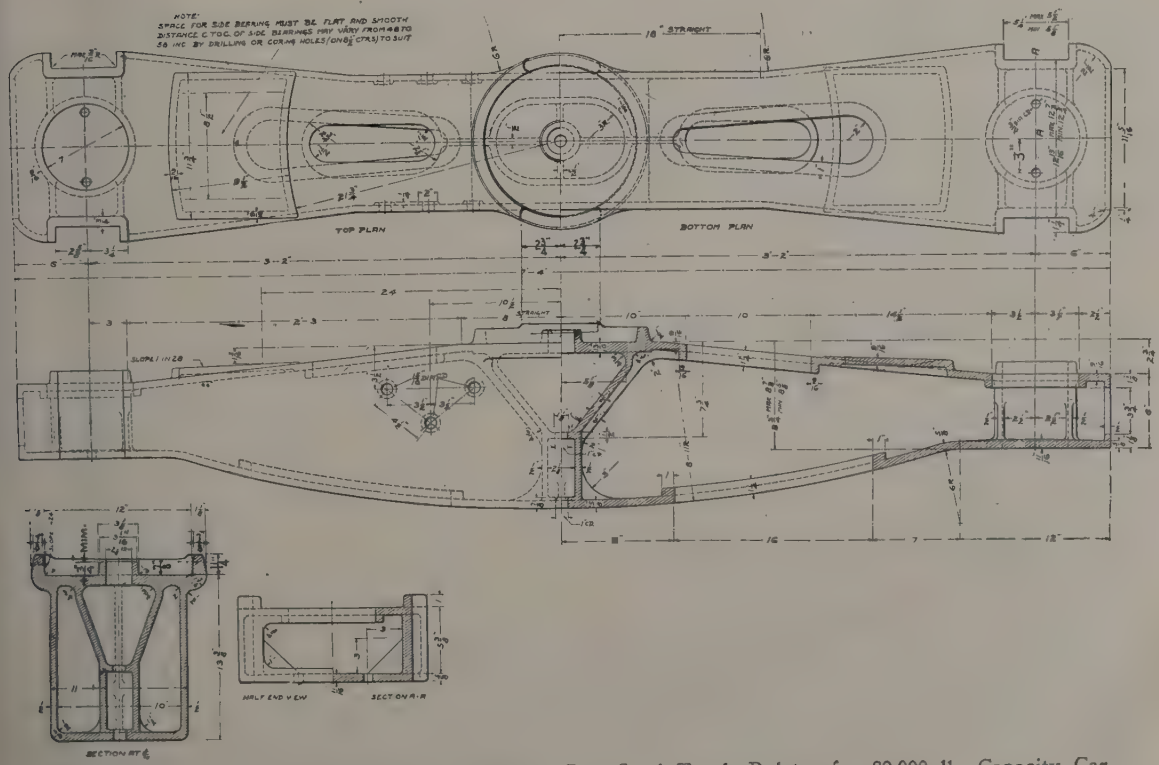

NOTE:
SPACE FOR SIDE BEARING MUST BE FLAT AND SMOOTH
DISTANCE C TO C. OF SIDE BEARINGS MAY VARY FROM 46 TO
56 INC. BY DRILLING OR CORING HOLES ON 2" CTRS TO SUIT
18" STRAIGHT
TOP PLAN
BOTTOM PLAN
SLOPE 1 IN 20
HALF END VIEW
SECTION A-A
SECTION AT C

Fig. 1455—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 80,000 lb. Capacity Car, With Center Plate Cast Integral.

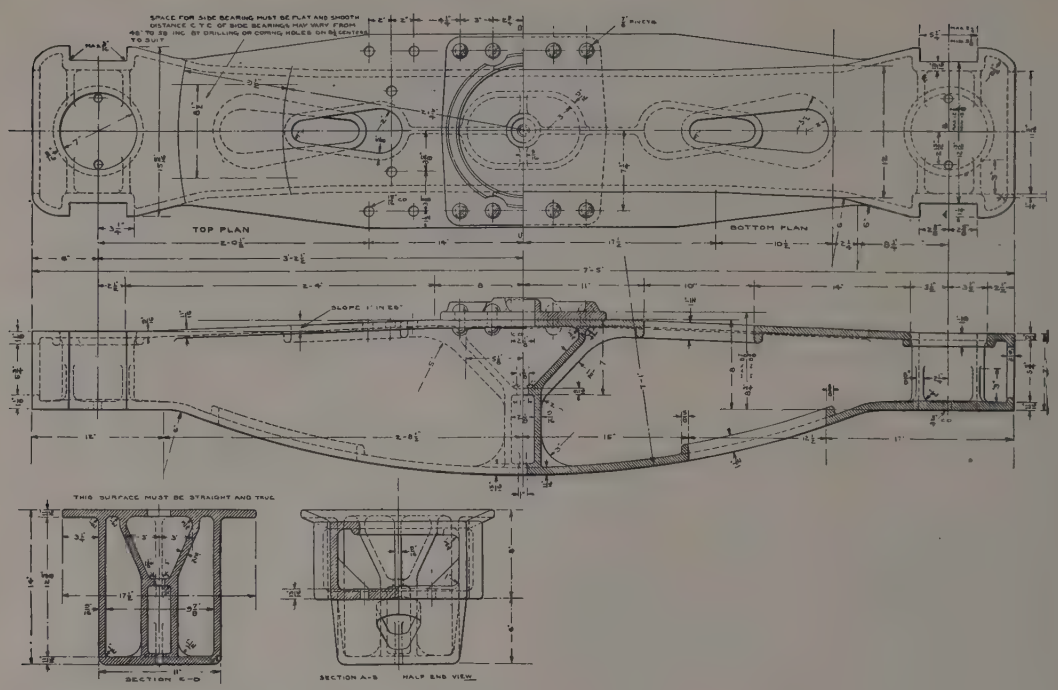


Fig. 1456—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 100,000 lb. Capacity Car, With Separate Center Plate.

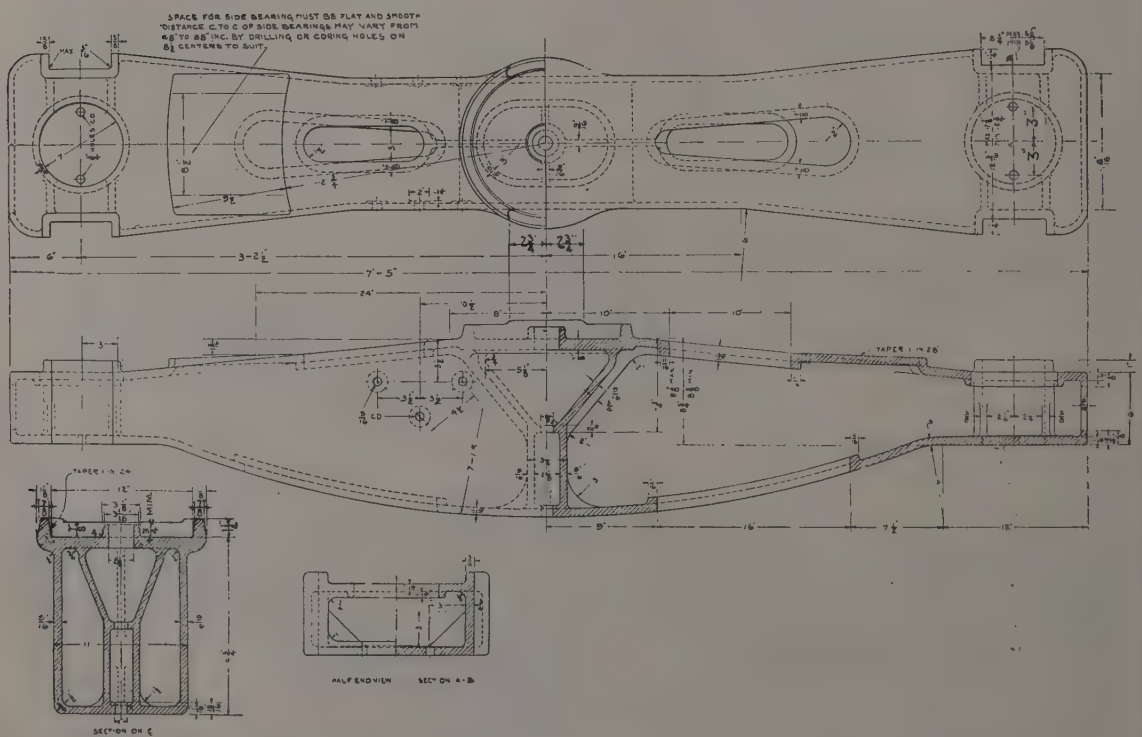


Fig. 1457—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 100,000 lb. Capacity Car, With Center Plate Cast Integral.

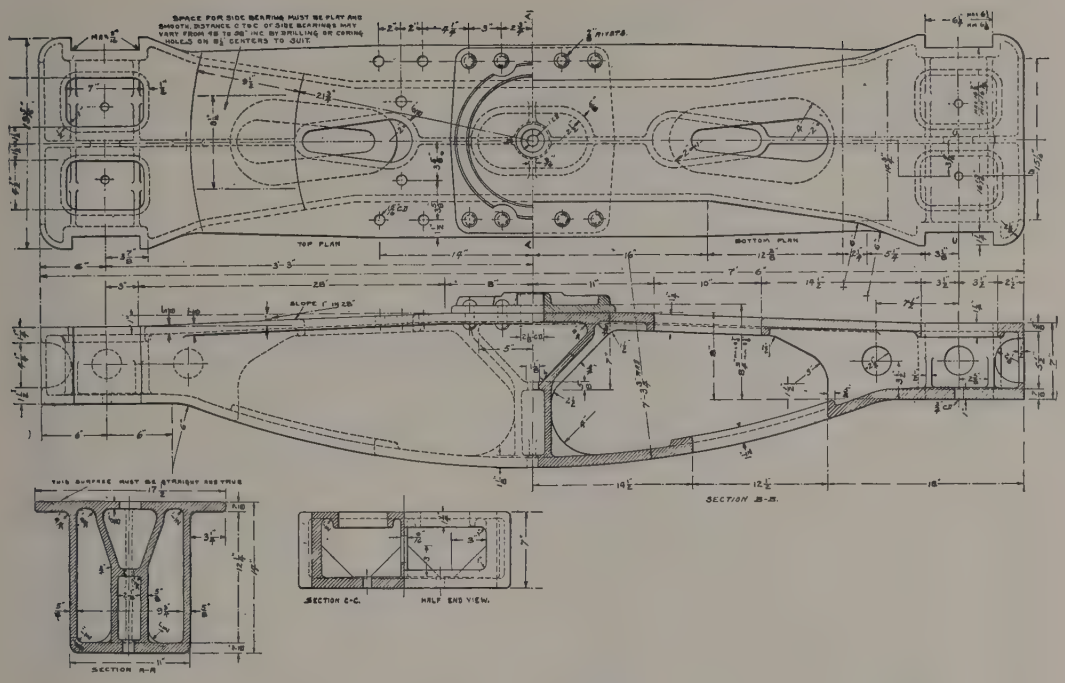


Fig. 1458—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 140,000 lb. Capacity Car, With Separate Center Plate.

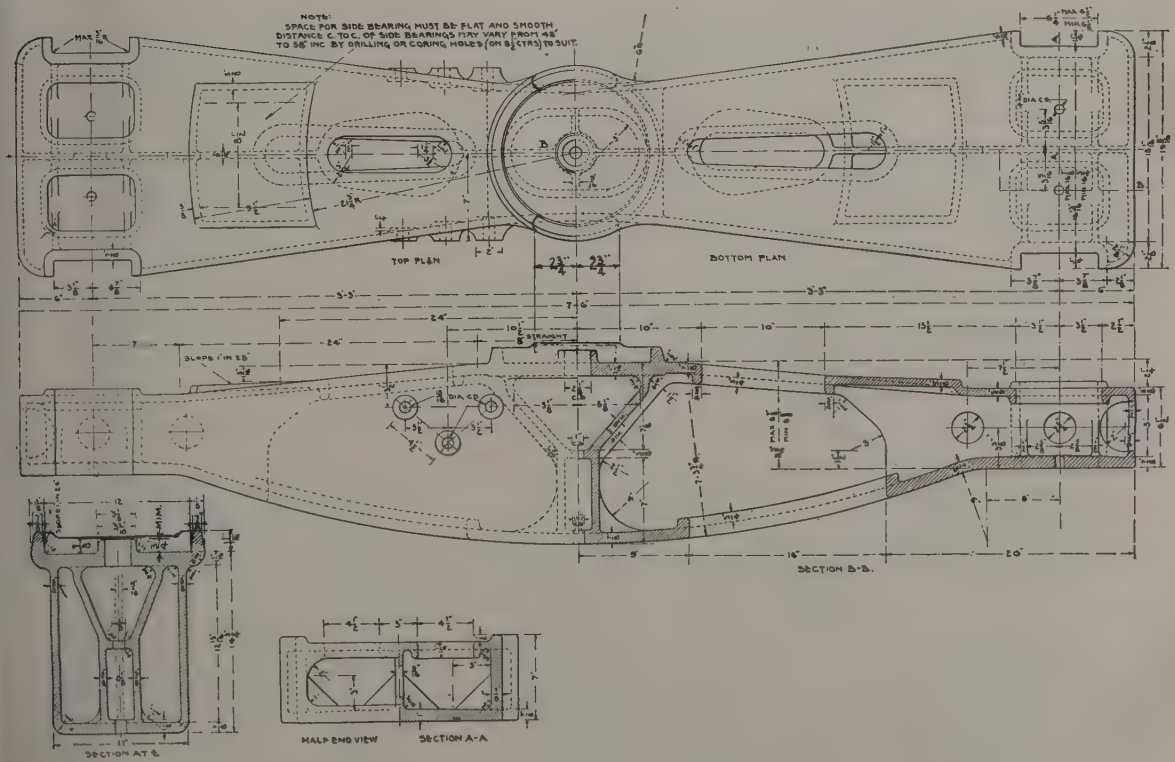
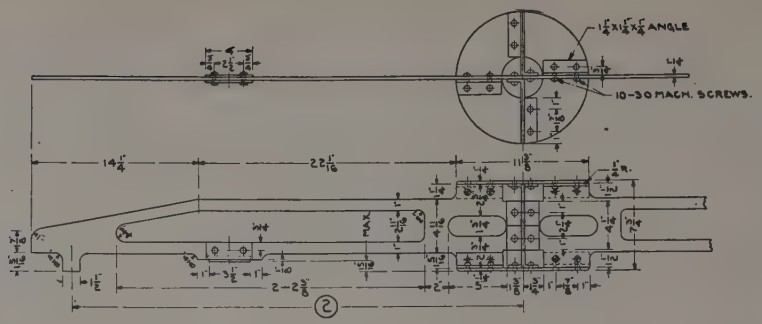
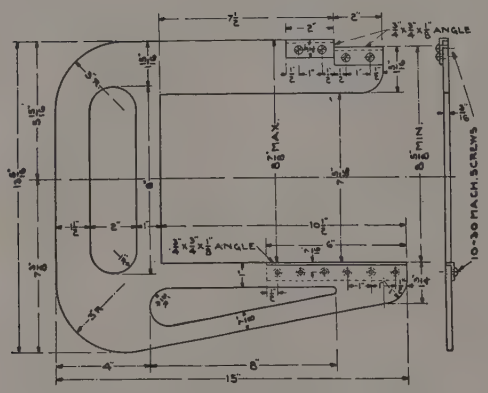


Fig. 1459—A. R. A. Recommended Practice for Cast Steel Truck Bolster for 140,000 lb. Capacity Car, With Center Plate Cast Integral.

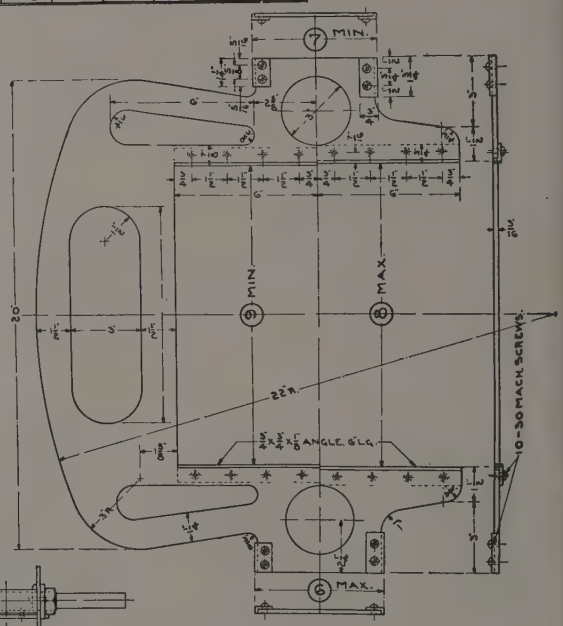


CENTER PLATE AND STRAIGHT EDGE GAUGE.

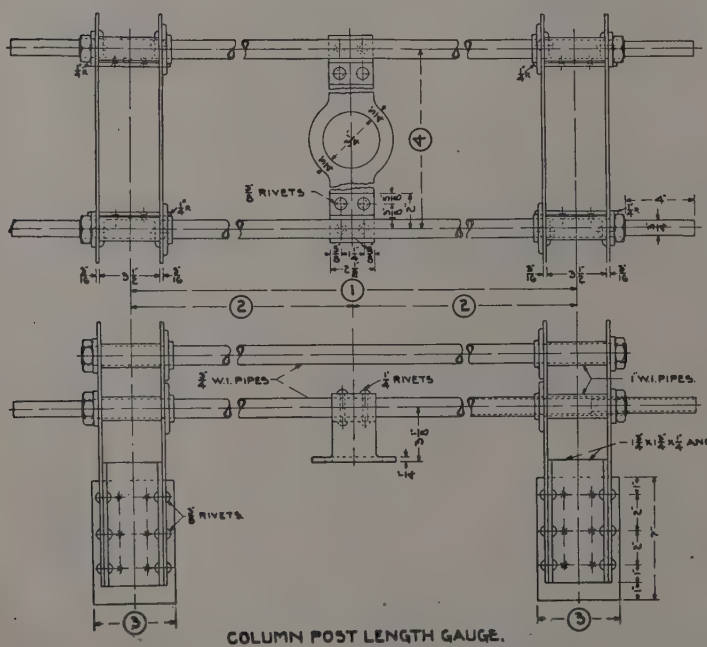
BOLSTER.	VALUES FOR DIMENSIONS SHOWN BY CIRCLED NUMERALS.								
	1	2	3	4	5	6	7	8	9
80000 LBS	6'-4"	3'-2"	5 5/8"	14 7/8"	12 7/8"	MAX. 5 5/8"	MIN. 5 5/8"	MAX. 12 5/8"	MIN. 12 3/4"
100000 "	6'-5"	3'-2½"	5 5/8"	14 7/8"	12 7/8"	5½"	5 5/8"	12 7/8"	12 3/4"
140000 "	6'-6"	3'-3"	6 5/8"	18 7/8"	16 7/8"	6½"	6 5/8"	16 7/8"	16 3/4"



SPRING SEAT TO SIDE BEARING GAUGE.



COLUMN POST WIDTH GAUGE.



COLUMN POST LENGTH GAUGE.

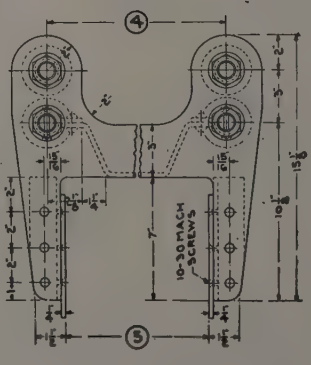


Fig. 1460—A. R. A. Recommended Practice for Gages for Truck Bolsters for 80,000, 100,000 and 140,000 lb. Capacity Freight Cars.

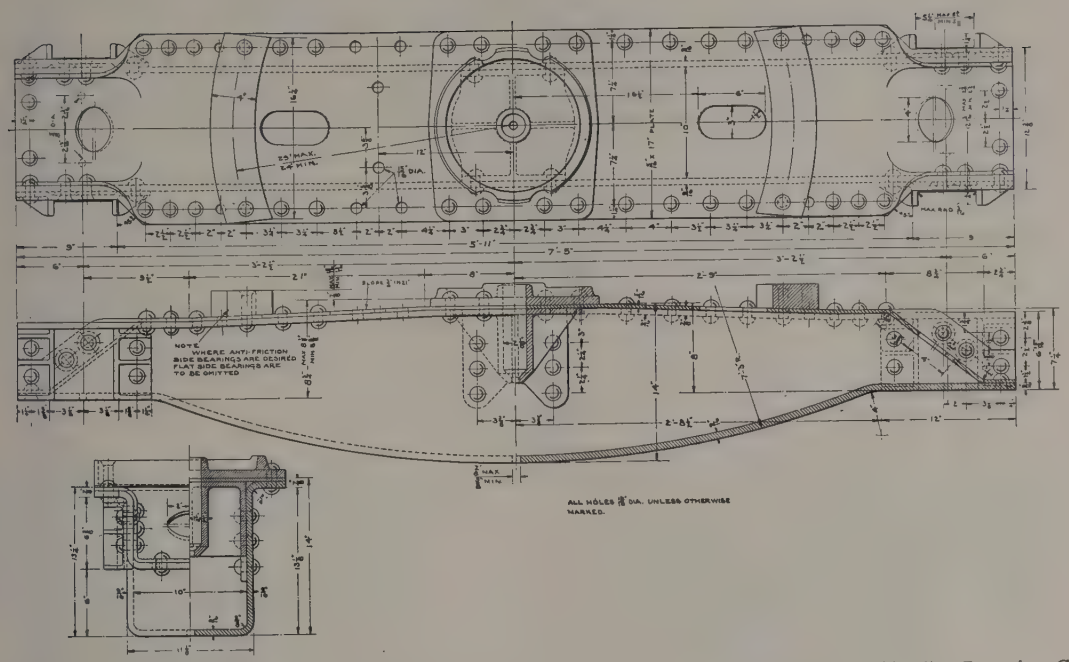

NOTE
WHERE ANTI-FRICTION SIDE BEARINGS ARE DESIRED FLAT SIDE BEARINGS ARE TO BE OMITTED
ALL HOLES 1" DIA. UNLESS OTHERWISE MARKED.

Fig. 1461—A. R. A. Recommended Practice for Pressed Steel Truck Bolster for 100,000 lb. Capacity Car.

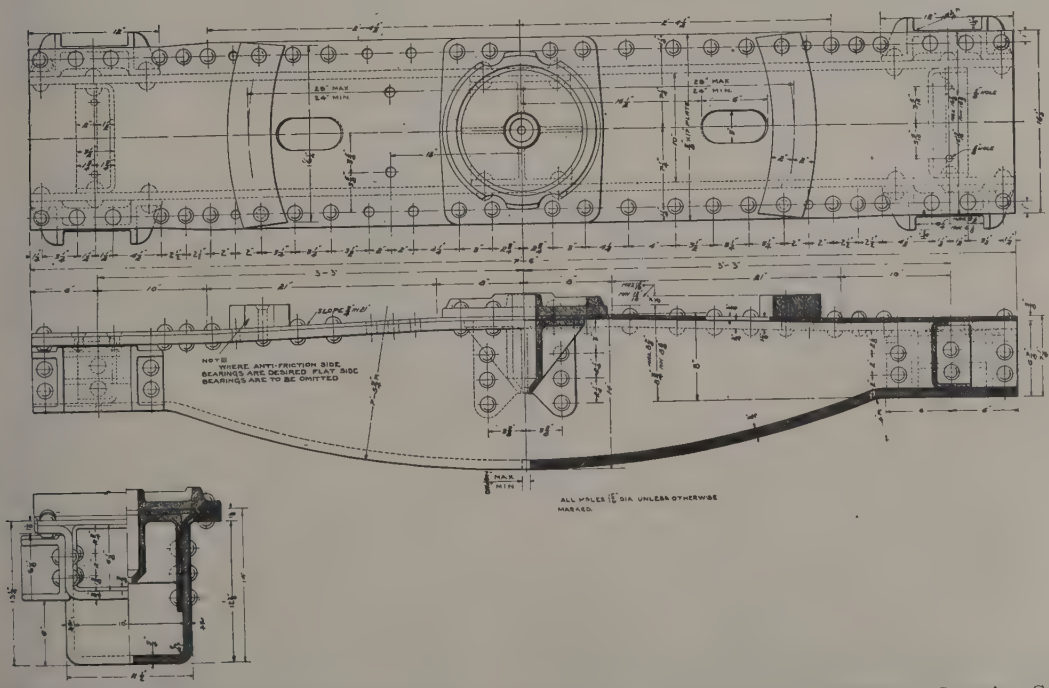

NOTE
WHERE ANTI-FRICTION SIDE BEARINGS ARE DESIRED FLAT SIDE BEARINGS ARE TO BE OMITTED
ALL HOLES 1" DIA UNLESS OTHERWISE MARKED.

Fig. 1462—A. R. A. Recommended Practice for Pressed Steel Truck Bolster for 140,000 lb. Capacity Car.

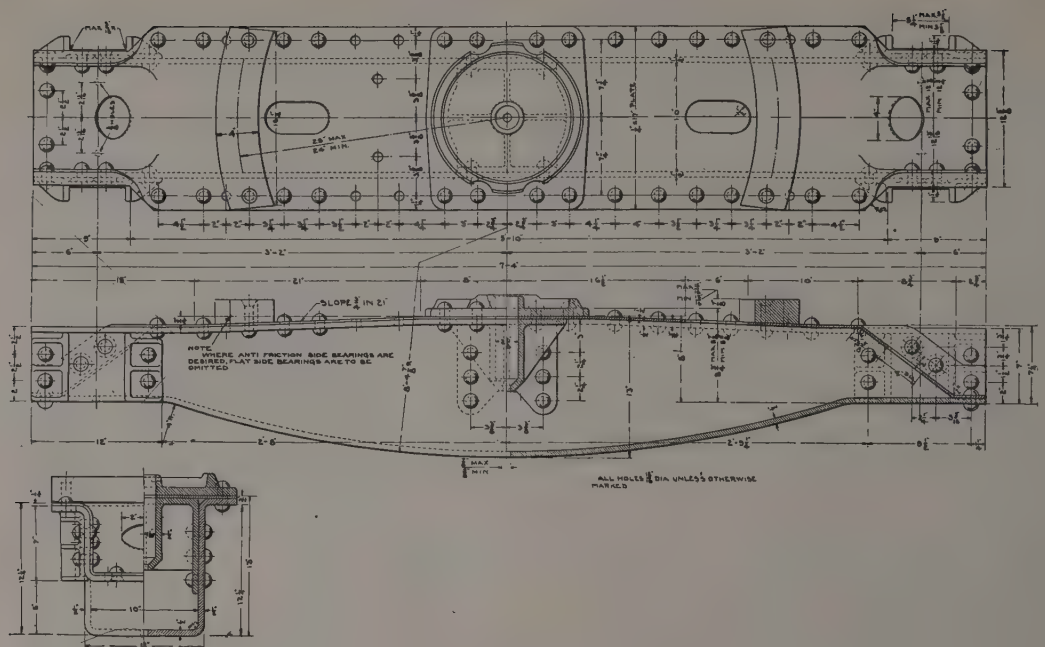

NOTE
WHERE ANTI FRICTION SIDE BEARINGS ARE DESIRED, PLAT SIDE BEARINGS ARE TO BE OMITTED
SLOPE 1 IN 21
ALL HOLES 1 DIA. UNLESS OTHERWISE MARKED

FIG. 1463—A. R. A. RECOMMENDED PRACTICE FOR PRESSED STEEL TRUCK BOLSTER FOR 80,000 LB. CAPACITY CAR.

Specifications and Tests for Pressed Steel Truck Bolsters for 80,000, 100,000 and 140,000 lb. Capacity Cars.

Recommended Practice—ADOPTED, 1915.

The steel for pressed steel truck bolsters shall conform to the requirements of the specifications and tests for structural steel for freight cars.

Limiting Weights.

Bolsters, including center plate and side bearings, shall conform to the weights given in the table shown below. In case the bolsters have met all requirements except that of overweight, they may be accepted at the maximum allowable weight here specified.

Car Capacity, Lbs.	Weight, Lbs. Minimum	Normal	Maximum
80,000	775	795	815
100,000	840	865	890
140,000	1,110	1,140	1,170

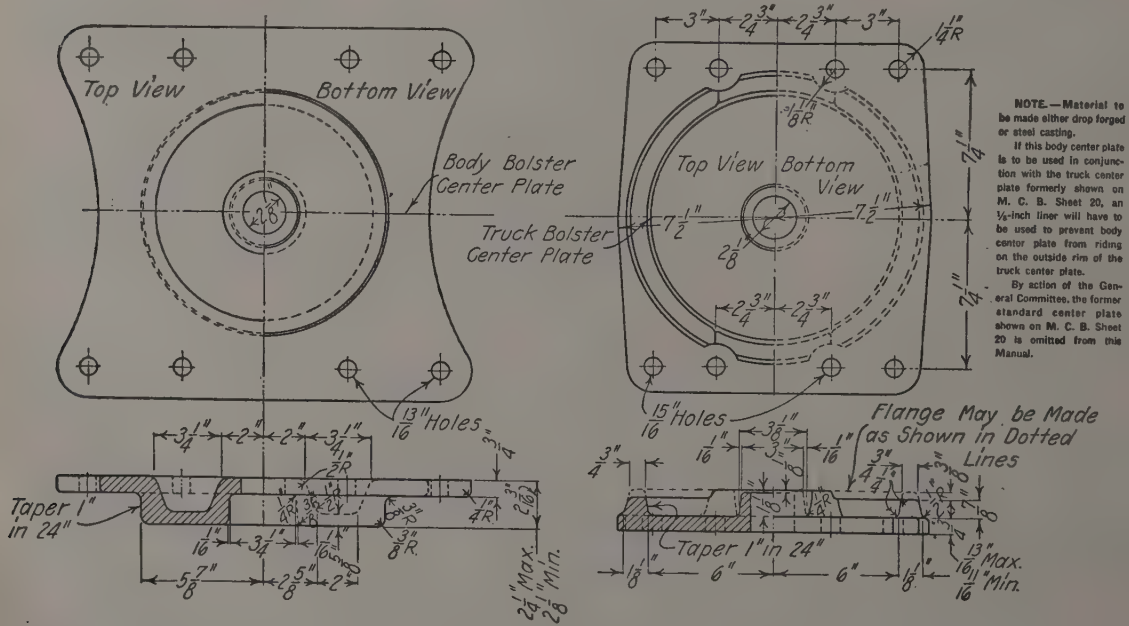

Top View
Bottom View
Body Bolster Center Plate
Truck Bolster Center Plate
13/16" Holes
Taper 1" in 24"
Top View
Bottom View
15/16" Holes
Flange May be Made as Shown in Dotted Lines
Taper 1" in 24"
NOTE.—Material to be made either drop forged or steel casting.
If this body center plate is to be used in conjunction with the truck center plate formerly shown on M. C. B. Sheet 20, an 1/8-inch liner will have to be used to prevent body center plate from riding on the outside rim of the truck center plate.
By action of the General Committee, the former standard center plate shown on M. C. B. Sheet 20 is omitted from this Manual.

FIG. 1464—A. R. A. STANDARD CENTER PLATE. ADOPTED 1920.

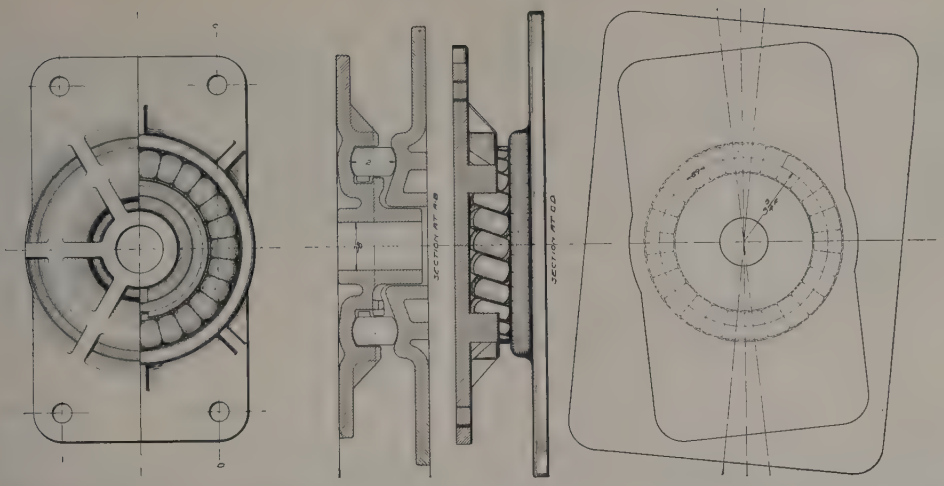


Fig. 1465—General Arrangement of 12 in. Roller Center Plate. Edwin S. Woods & Company.
(*See also Page* 656.)

Fig. 1466—Baltimore Ball-Bearing Center Bearing. T. H. Symington Company.

Fig. 1467—Ball-Bearing Center Bearing, Equalizer Type. T. H. Symington Company.

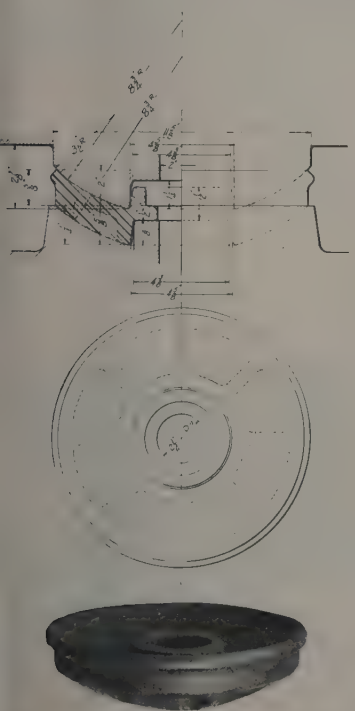


Fig. 1468—Miner Center Plate Shim as Applied to Passenger Cars. W. H. Miner.

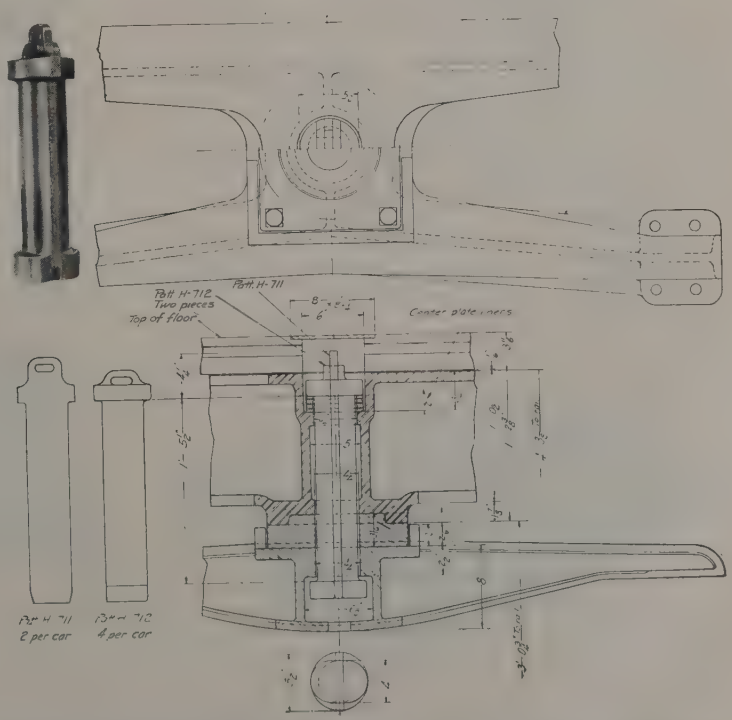
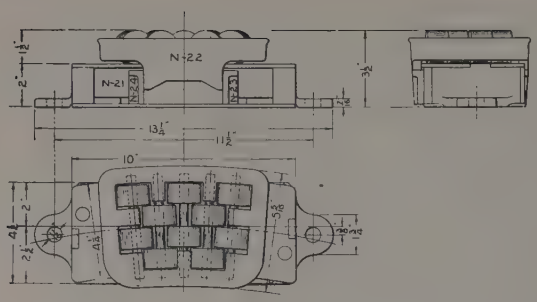


Fig. 1469—Safety Bolster Locking Center Pin for Passenger Equipment. W. H. Miner.



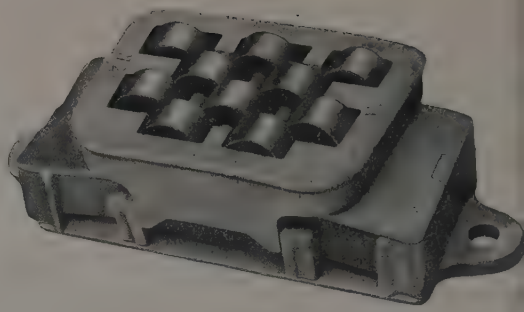


Fig. 1470—Creco Roller Side Bearing No. 4-A for Four-Wheel Passenger Train Car Trucks.

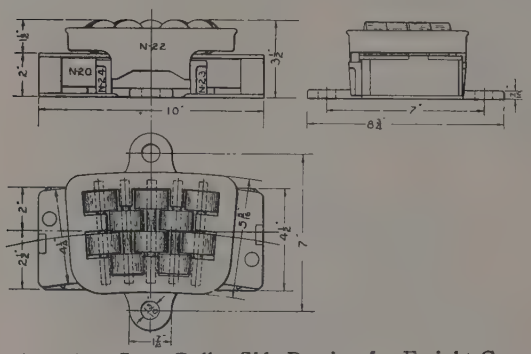


Fig. 1471—Creco Roller Side Bearing for Freight Cars.

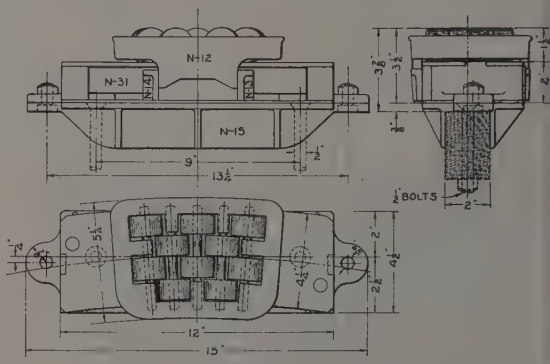


Fig. 1472—Creco Roller Side Bearing No. 7-A for Six-Wheel Passenger Train Car Trucks.

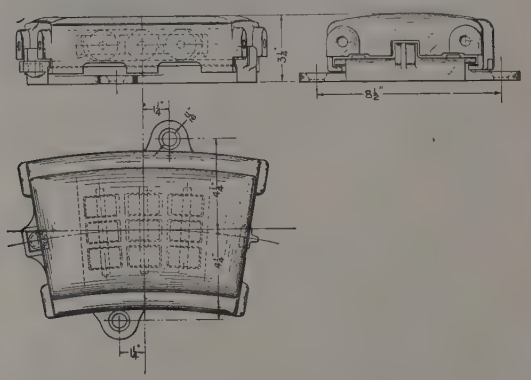


Fig. 1473— Creco Covered Roller Side Bearing for Freight Car Trucks.

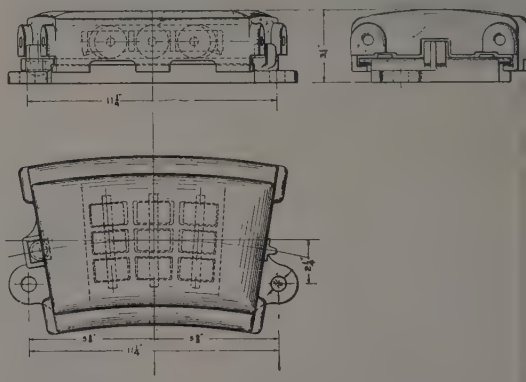


Fig. 1474—Creco Covered Roller Side Bearing for Four-Wheel Passenger Train Car Trucks.

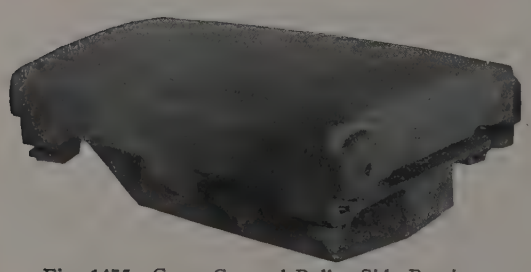


Fig. 1475—Creco Covered Roller Side Bearing.

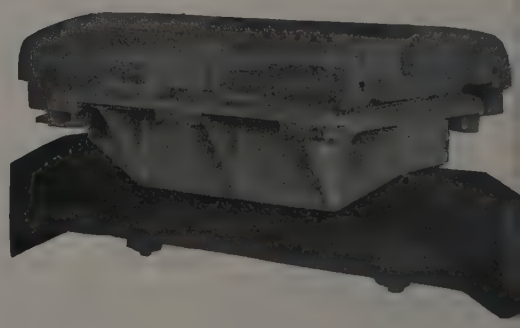


Fig. 1476—Creco Covered Roller Side Bearing Applied to Bearing Bridge of Six-Wheel Truck.

Chicago Railway Equipment Company.

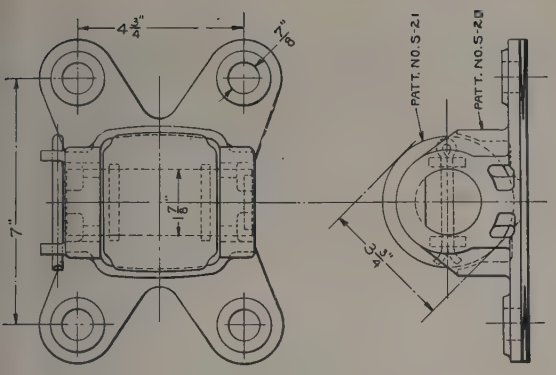

PATT. NO. S-21
PATT. NO. S-20
NOTE.
OPPOSITE WEARING SURFACE MUST BE EITHER A HARDENED STEEL PLATE OR CHILLED CAST IRON.
TAPER IN 5 1/4"

Fig. 1477—Economy Single Roller Side Bearing.

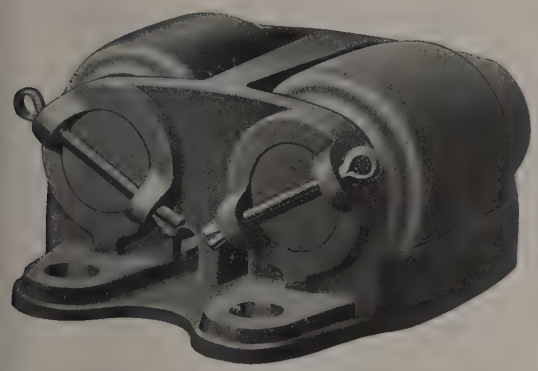


Fig. 1479—Economy Roller Side Bearing.

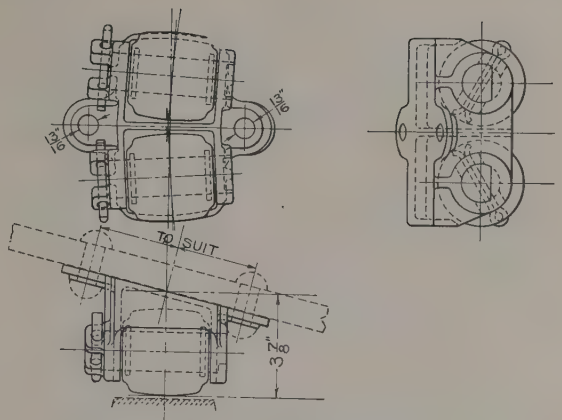


Fig. 1478—Economy Inverted Style Roller Side Bearing for Freight Service.

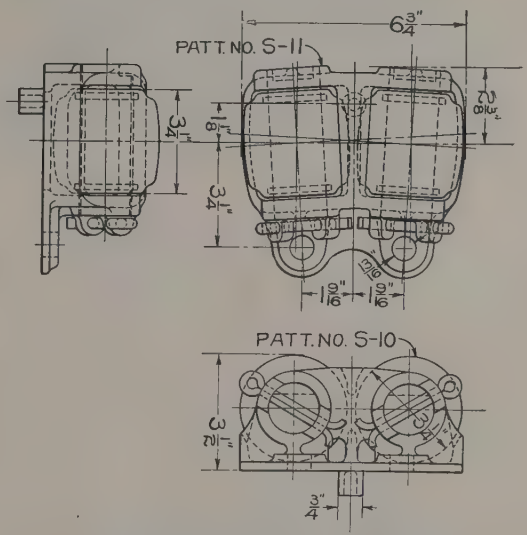


Fig. 1480—Economy Double Roller Side Bearing for Freight Service.

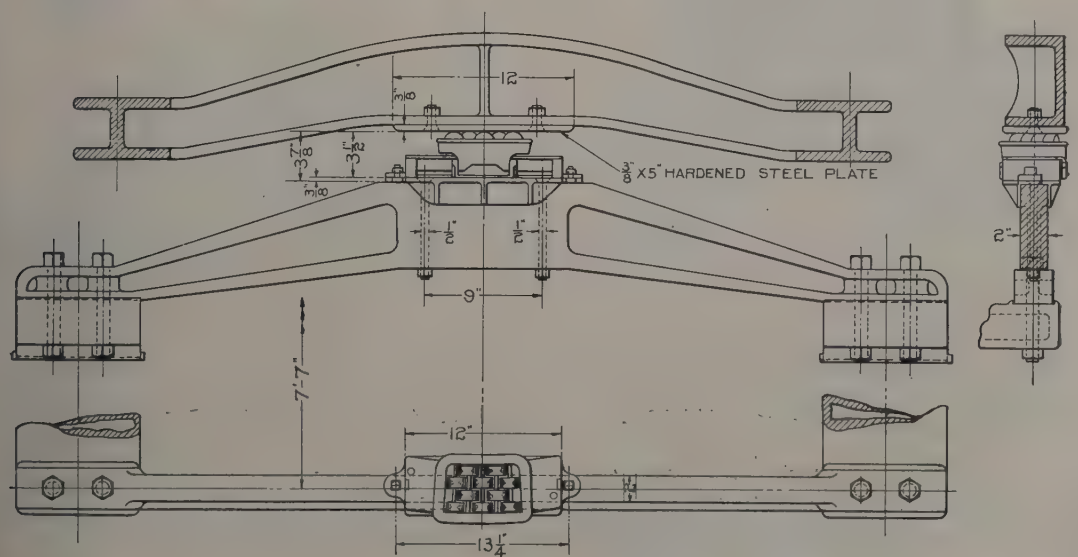
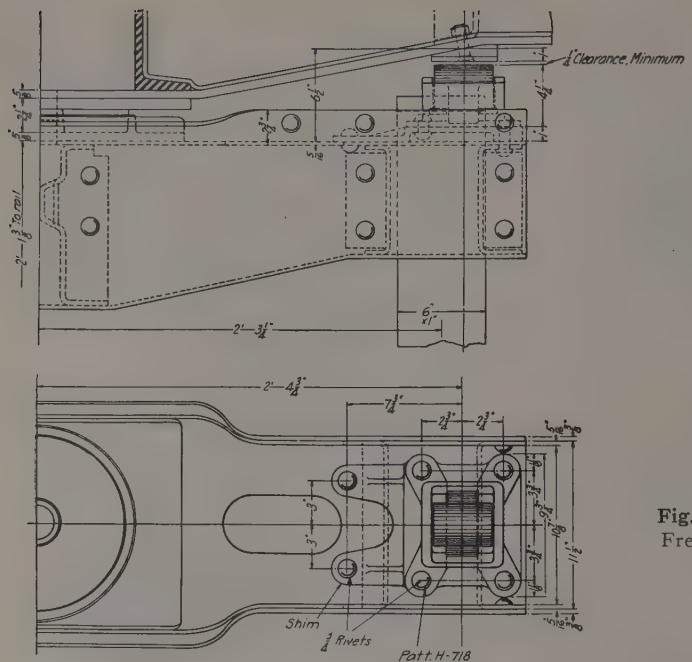


Fig. 1481—Creco Roller Side Bearing Applied to Bearing Bridge of Six-Wheel Truck.

Chicago Railway Equipment Company.



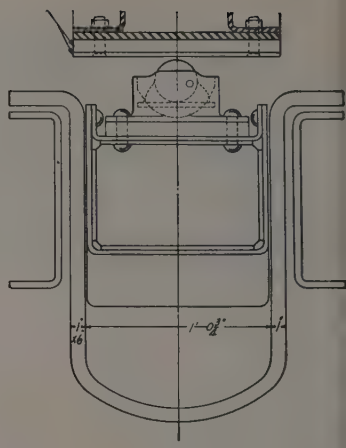
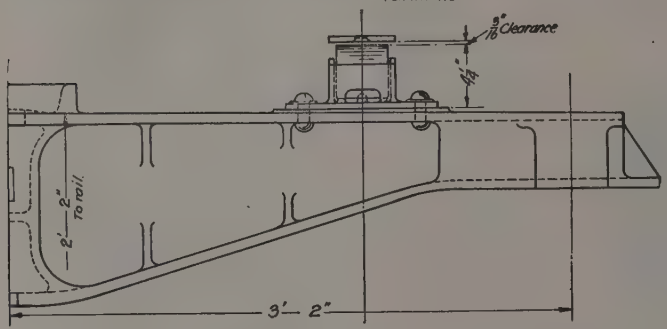
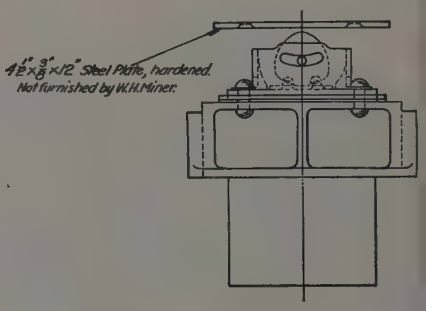


Fig. 1482—Miner Balanced Side Bearing for Freight Equipment as Applied to Gondola Cars





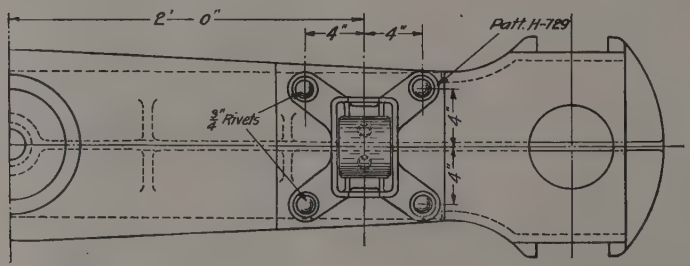


Fig. 1483—Miner Rocker Side Bearings Applied to Refrigerator Cars.

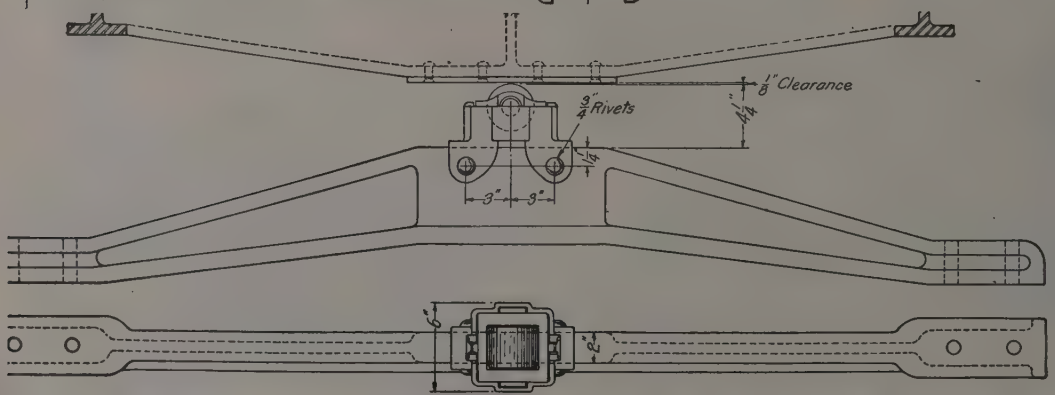


Fig. 1484—Miner Roller Side Bearing Applied to Passenger Train Equipment with Six-Wheel Trucks.

W. H. Miner.

(*See also Page 649.*)

Miner Side Bearings for Car Equipment

Miner Side Bearings are carefully designed to effectually meet every requirement of freight and passenger car service. These important items of car construction have been thoroughly developed through many years of active experience in this field.

As cars have grown heavier in design to accommodate increased severity of operating conditions, the underframes have necessarily been made extremely rigid to accommodate heavy loads and rough handling.

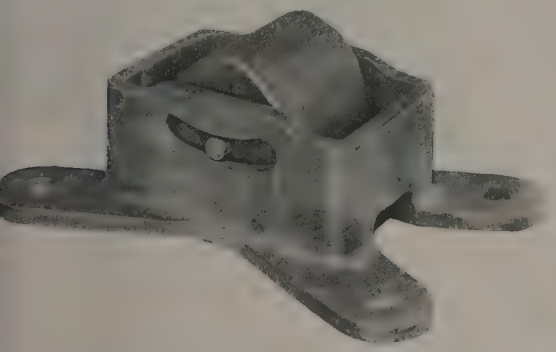


Fig. 1485—Miner Rolling Rocker Side Bearing

The importance of equipping the modern rigid underframe car with efficient anti-friction side bearings is now generally recognized. It has been thoroughly demonstrated that excessive wheel flange and rail wear, also derailments, may be prevented by the use of well designed bearings.

Miner Side Bearings provide a most effective medium for reducing friction incident to track curvature to a minimum. Since these bearings are truly anti-friction and permit free movement of trucks around the curves, the train resistance is materially decreased. Therefore, substantial economy in the use of tractive effort is made possible.

Fig. 1486—Miner Roller Side Bearing for 4-Wheel Trucks

Miner bearings are so well constructed that enormous loads can be accommodated without causing any friction which would ten to bind the wheel flanges against the rails. The materials used in each design are selected with careful reference to their ability to successfully resist abrasion. These devices, being self-contained, are shipped to the car builder as complete units ready for instant application to the car.

The Miner Rolling Rocker Bearing for freight equipment embodies strength, simplicity and durability. It is designed to suit various bolster rivet layouts. The rolling rocker is self-centering and will resist severest shocks and loads without failure or appreciable wear. The base casting is of rugged construction and contains a tempered spring steel wear plate, securely riveted in position. These bearings have been applied to many thousands of cars of various types.

The Miner Balanced Side Bearing for freight equipment is also of simple and strong construction and successfully meets the most severe requirements. It is extensively used on many types of cars and is supplied to suit any particular bolster condition.

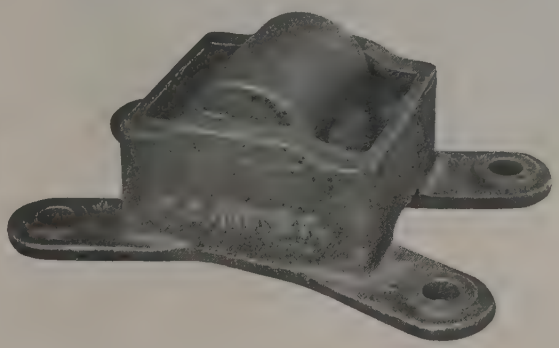


Fig. 1487—Miner Balanced Side Bearing

The Miner Roller Side Bearings for passenger equipment have been particularly designed to withstand exacting service and are being used on many thousands of passenger cars. They are absolutely noiseless in operation and adapted to meet every service requirement. The adjustable feature of these bearings, which is automatic, compensates for possible errors in the camber of the body and truck bolsters, thereby insuring proper contact between the body and truck side bearings throughout the entire length of the roller.

Fig. 1488—Miner Roller Side Bearing for 6-Wheel Trucks

For other products and branch offices, see classified and alphabetical indexes.

Fig. 1489—Susemihl Side Bearing for Four-Wheel Passenger Train Car Trucks. American Steel Foundries.

Fig. 1490—Susemihl Side Bearing for Freight Trucks. American Steel Foundries.

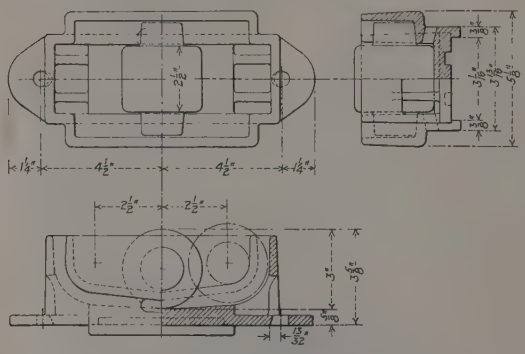


Fig. 1491—Laughlin Open Type Truck Side Bearing for Passenger Service.

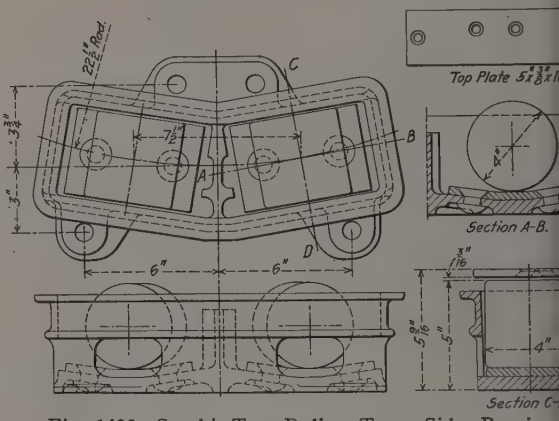


Fig. 1492—Stucki Two-Roller Type Side Bearing. A. Stucki Company.

(See also Page 651.)

Fig. 1493—Perry Roller Side Bearing for 50-Ton Capacity Freight Cars. Burry Railway Supply Company.

Fig. 1494—Perry Roller Side Bearing for 70 and 100-T Capacity Freight Cars. Burry Railway Supp Company.

Stucki Side Bearings

Stucki Bearings were designed to meet the demand for a substantial, well built and practically frictionless side bearing to be used under all types of cars in freight service. The old-fashioned side bearing, usually consisting of two flat rubbing surfaces, produced, of course, a great deal of friction, which acted to destroy the free swivelling movement of

Fig. 1495—Stucki Side Bearing

a car truck when entering upon curves or tangents and to cause the flange of the guiding wheel to be forced against the rail with an intense grinding pressure. This condition resulted in serious flange wear, rapid abrasion of the rail head and a large increase in the amount of power required to move traffic, which means added expense from every point of view.

A 50-ton car if equipped with old style side bearings will develop sufficient side bearing friction to force the leading wheel flange against the rail of a curve with a pressure of about 15,300 lb. Since friction between two rubbing surfaces is directly proportional to the amount of normal pressure, it follows that as cars and their loading become heavier, the side bearing friction also increases, flange and rail wear become excessive with frequent derailments and the constant possibility of disastrous consequences. The result of

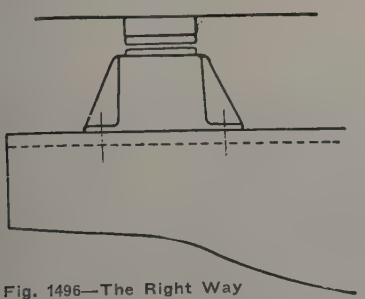


Fig. 1496—The Right Way

these conditions has been that practically all railroads have installed side bearings designed to eliminate friction and to facilitate the swivelling motion of car trucks.

Continual service extending over a period of eleven years, the Stucki Side Bearing has conclusively demonstrated its value. During the entire eleven years it has never been necessary to make any change in design and according to present reports this side bearing will last as long as the car and even then, the roller can be used again on other equipment.

Simplicity has been attained, inasmuch as the device consists of only four parts. One solid roller is used, made amply large and strong enough to carry the whole load. This roller is centered by gravity which obviates the necessity of using springs, axles, levers, keys, etc. It has a frictionless travel of 7 inches which is quite sufficient to meet all conditions of service.

Experience has shown that side bearings should be attached to the truck bolster. A distinct and essential feature inherent in the truck side bearing is its distribution of the load. Weak truck bolsters equipped with it only show one-half the stresses in their top members compared with those obtained when body side bearings are used, owing to the fact that the former distributes

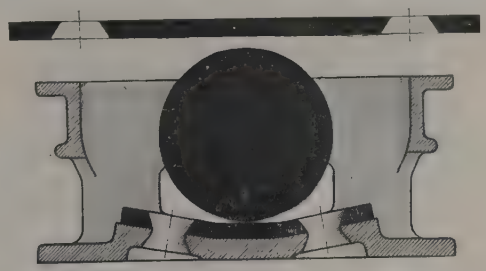


Fig. 1497—Stucki Side Bearing Sectional View

the load over a considerable area on the roof of the truck bolster and concentrates it against the body bolsters, which, as a rule, are made strong and rigid for other reasons. Fig. 1496 shows such an application.

This arrangement eliminates the necessity for the integral humps sometimes cast in the truck bolster to accommodate the application of the body side bearings. Such a hump has in some cases been found to be very injurious, as the compression member is thereby discontinued and bolsters of that type often show compression stresses

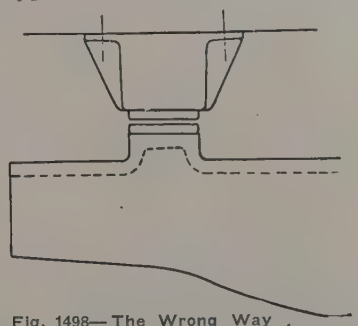


Fig. 1498—The Wrong Way

much greater than in the other type. Fig. 1498 shows an application of this sort.

With the Stucki Side Bearing, no fine fit or machine work is necessary and inequalities of ordinary workmanship do not affect the proper working of the bearing, which fact contributes greatly to the success obtained.

No lubrication is required nor desired. The reduction of train resistance in actual tests conducted a few years ago was found to be 10.4 per cent.

A. STUCKI COMPANY, PITTSBURGH, PA.

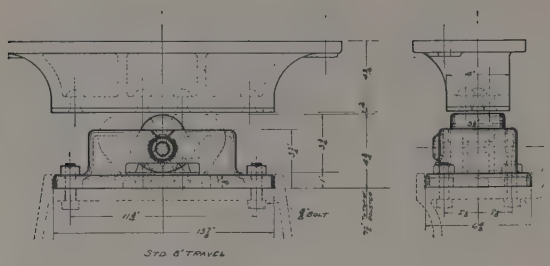


Fig. 1499—Application of Wine Self-Centering Roller Side Bearing. The Wine Railway Appliance Company.

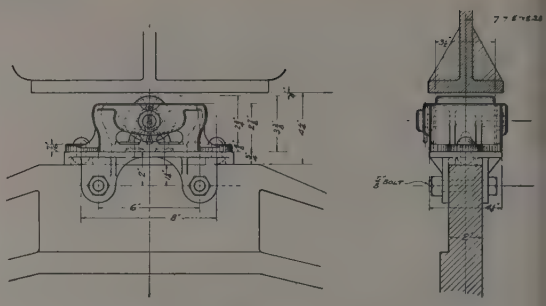


Fig. 1500—Application of Wine Self-Centering Roller Side Bearing. The Wine Railway Appliance Company.

Fig. 1501—Self-Centering Roller Side Bearing. The Wine Railway Appliance Company.

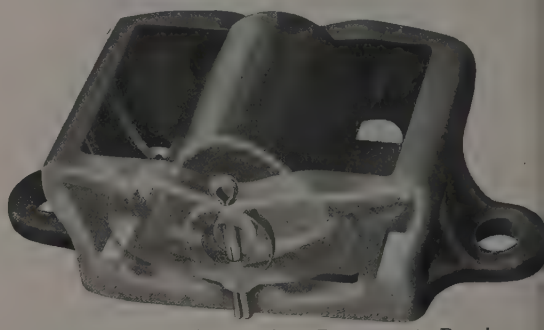
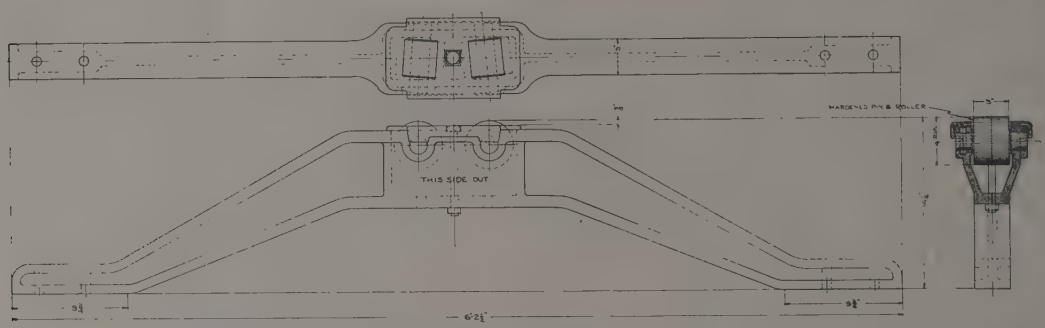


Fig. 1502—Self-Centering Roller Side-Bearing. The Wine Railway Appliance Company.

(*See also Page* 653.)



Fgi. 1503—Application of Barber Two-Roller Side Bearing to Six-Wheel Passenger Truck. Standard Car Truck Company.

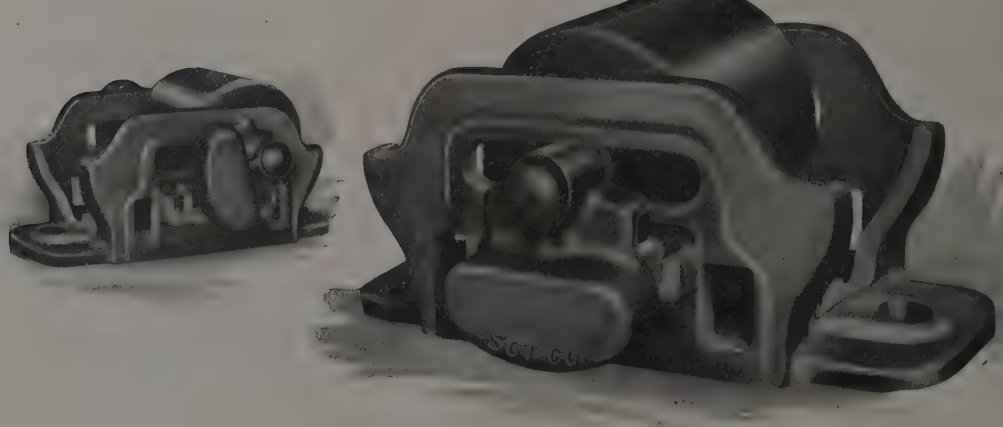


Fig. 1504—Barber No. 10 Roller Side Bearing. Standard Car Truck Company.

Wine Roller Side-Bearings

The use of anti-friction side bearings on both passenger and freight equipment has become a recognized necessity. The Wine Railway Appliance Company have specialized on the manufacture of a self-Centering Roller, Side-Bearing with unlimited travel to meet this need. The successful performance of this bearing on many thousands of cars has demonstrated that it reduces wheel flange wear, increases the engine tonnage capacity by reducing friction, and helps considerably in preventing derailments.

The Wine Roller Bearing as shown in Fig. 1505 is self-centering and requires less than one-sixteen of an inch clearance to allow the roller to return to the center. The rollers are secured to the housing by center pins and locked by spring cotter pins. As the weight on the roller is transferred to the steel plate in the bottom of the housing the working conditions are improved by constant usage, the roller and plate becoming polished and smooth thus facilitating the movement. The housing of the bearing has cored holes, so that accumulated dirt and small stones powdered by the crushing force of the steel roller and steel plate, can escape through the openings. The housing is slightly varied for different bolsters as shown in Fig. 1506 and Fig. 1507, but the roller construction is the same for every type.

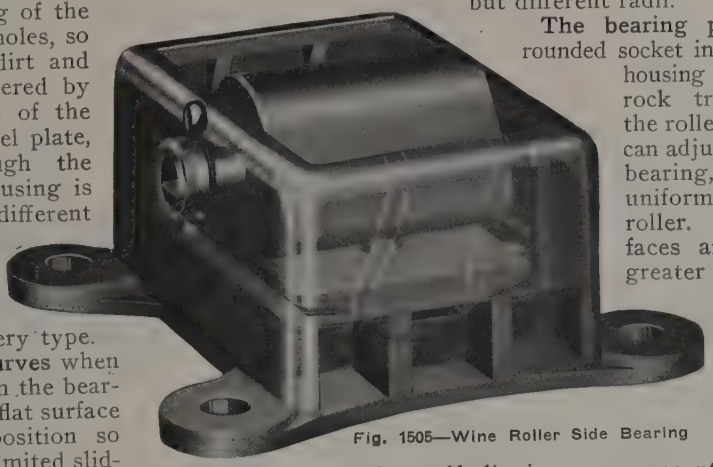


Fig. 1505—Wine Roller Side Bearing

On very sharp curves when the rolling travel on the bearing is complete the flat surface is brought into position so that practically unlimited sliding travel is then provided. However, the bearing is designed so that the flat surface is brought into position only when the car is moving on industrial sidings or other tracks of 38 deg. curve or greater. The flat sides are tangent to the top rolling surface and in the two extreme positions are parallel to the wearing plate in the bottom of the housing. Regardless of the movement the top of the roller is always at the same height in every position, as the top and bottom rolling surfaces are arcs of circles having a common center but different radii.

Fig. 1506—Wine Side Bearing in Freight Service

Fig. 1507—Wine Bearing in Passenger Service

The bearing plate fits into a rounded socket in the bottom of the housing and is designed to rock transversely under the roller so that the roller can adjust itself to the body bearing, thus insuring a uniform bearing on the roller. All bearing surfaces are equal to or greater than the bearing on the roller and operate in direct compression.

The Wine Roller Bearing has no springs and its few parts, positive self-aligning arrangement and simple construction gives most satisfactory results. All of its members are made of very high grade material; the housings are made of high grade malleable iron; the bearing plates of high carbon rolled steel; and the rollers of high carbon cast steel.

The Table of Side Bearing Movements under varying conditions of curvature and truck centers—shown below—has been calculated for a distance of 60 in. between centers of side bearings by the "Wine" engineers for the convenience of car designers.

TABLE OF SIDE BEARING MOVEMENT

Truck Ctrs.	750′ R No. 9 Frog 7½°	600′ R No. 8 Frog 9½°	460′ R No. 7 Frog 12½°	340′ R No. 6 Frog 17°	235′ R No. 5 Frog 24½°	150′ R No. 4 Frog 39°	100′ R 57°+
25	1.0	1.25	1.63	2.2	3.2	5.0	7.5
28	1.12	1.4	1.82	2.5	3.5	5.6	8.4
30	1.2	1.5	2.0	2.7	3.8	6.0	9.0
32	1.3	1.6	2.1	2.9	4.1	6.4	9.6
36	1.4	1.8	2.34	3.2	4.6	7.2	10.8
38	1.5	1.9	2.5	3.35	4.8	7.6	11.4
40	1.6	2.0	2.6	3.5	5.1	8.0	12.0
45	1.8	2.25	2.7	3.9	5.7	9.0	13.5
50	2.0	2.5	3.26	4.4	6.4	10.0	15.0
53	2.12	2.65	3.45	4.7	6.7	10.6	15.9
56	2.24	2.8	3.65	4.9	7.14	11.2	16.8
58	2.3	2.9	3.8	5.1	7.4	11.6	17.4

For other products and branch offices, see classified and alphabetical indexes.

THE WINE RAILWAY APPLIANCE COMPANY, TOLEDO, OHIO

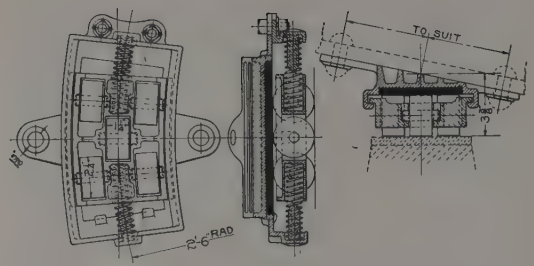


Fig. 1508—Drexel Five-Roller Side Bearing for Freight Service. Chicago Railway Equipment Company.

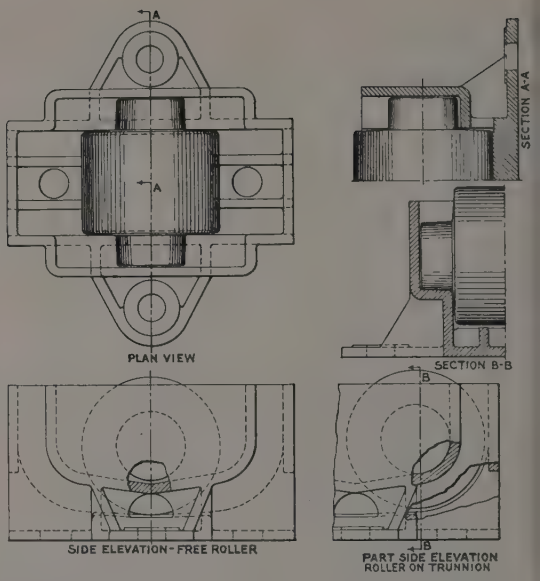


Fig. 1509—Laughlin Truck Type Side Bearing.

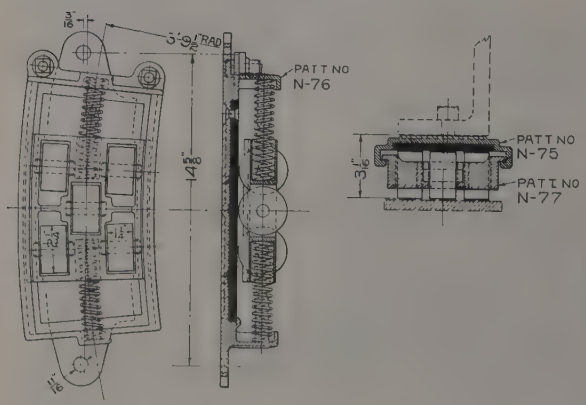


Fig. 1510—Drexel Five-Roller Side Bearing for Passenger Service. Chicago Railway Equipment Company.

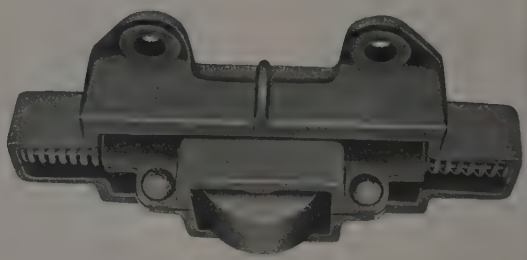


Fig. 1511—Drexel Roller Side Bearing. Chicago Railway Equipment Company.

Fig. 1512—Rocker Carrier, Side Plate, and Rocker for Cardwell Rocker Side Bearing. Universal Draft Gear Attachment Company.

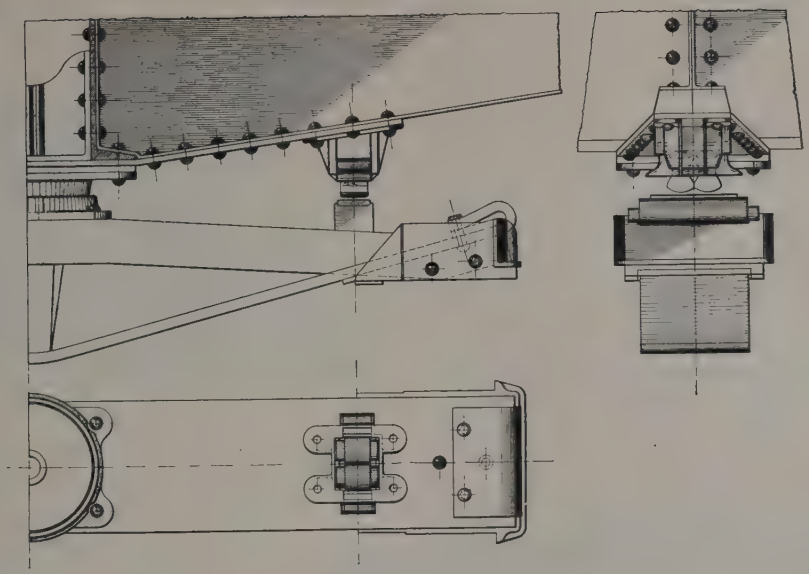


Fig. 1513—Tip Roller Side Bearing Applied to 50-Ton Capacity Freight Car. Edwin S. Woods & Company.

14— Single Roller Side Bearing for reight Cars. Edwin S. Woods & ompany.

Fig. 1515—Barber No. 5 Roller Side Bearing. Standard Car Truck Company.

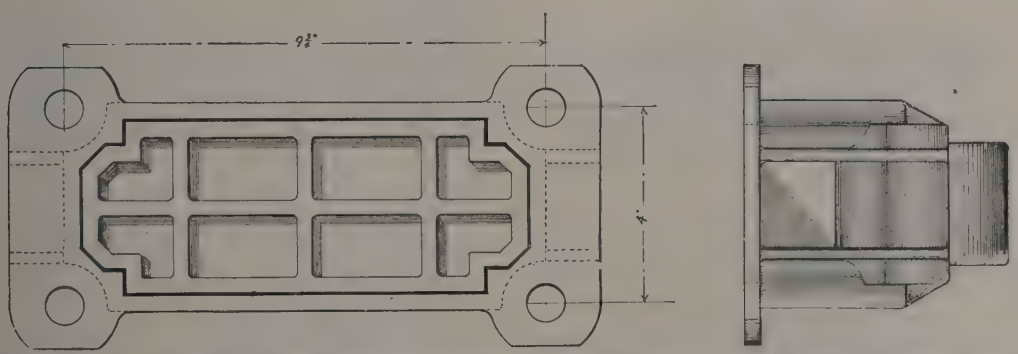


Fig. 1516—"Counter Balance" Roller Side Bearing for Application to Truck Bolster. Edwin S. Woods & Company.

(See also Page 656.)

Roller Side Bearings and Center Plates

The various forms of anti-friction side bearings and center plates manufactured by E. S. Woods and Company are particularly designed for service under modern heavy freight and passenger equipment. Their function is to practically eliminate friction between the rubbing surfaces of side and center bearings. The existence of such friction, at these points, is seriously detrimental to the facility of truck movement during curvature, and is therefore a direct cause of excessive flange wear, increased train resistance, derailments and other undesirable consequences. The importance with which railroads regard the use of anti-friction bearings is evidenced by the fact that practically all roads of any consequence are using some type of anti-friction bearings.

The Tip Roller Side Bearing—Fig. 1517—is intended for application to the body bolster. The rollers are made from cast steel or hard iron and work between oil tempered spring steel plates. The design resulted from a careful study of the elements involved in meeting general as well as difficult service conditions and while this device has a wide field of usefulness in ordinary freight service, it will also withstand without failure, the intense crushing stress encountered under the heaviest class of equipment. By combining a number of intermeshing rollers, the required carrying capacity and also sufficient travel to accommodate the necessary movement, are secured.

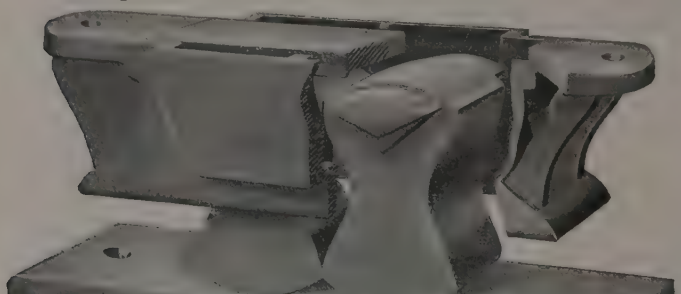


Fig. 1517—"Tip Roller" Side Bearing for Application to Body Bolster

Fig. 1519—Counterbalance Side Bearing

The Counterbalance Side Bearing—Fig. 1519—is designed for application to the truck bolster. This bearing has ample strength and carrying capacity to meet the most severe service under rolling stock of the heaviest class. It consists of a steel or special hard iron roller carried in a suitable housing and arranged to roll on its own periphery without the use of axle or trunnion. This design permits of all loads being carried directly through the solid body of the roller and by means of a simple counterbalance this roller is made to center itself automatically, thereby insuring sufficient travel in both directions under all service conditions.

The Ball Center Plate—Fig. 1520—depends upon the use of flat-sided balls for its remarkable sustaining power. This is the important basic principle of the E. S. Woods' center plate inasmuch as the use of flat-sided balls not only increases the carrying capacity to a large extent, but also entirely eliminates the detrimental end thrust of the ordinary conical roller bearing. It is estimated that a center plate having 40 flat-sided rollers has a sustaining power nearly three times that of the same sized plate provided with rollers of full circular cross section. The large amount of bearing area is well indicated in the illustration.

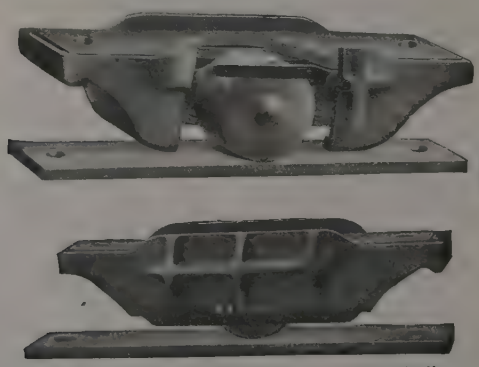


Fig. 1518—Passenger Car Side Bearing Showing Roller and Springs

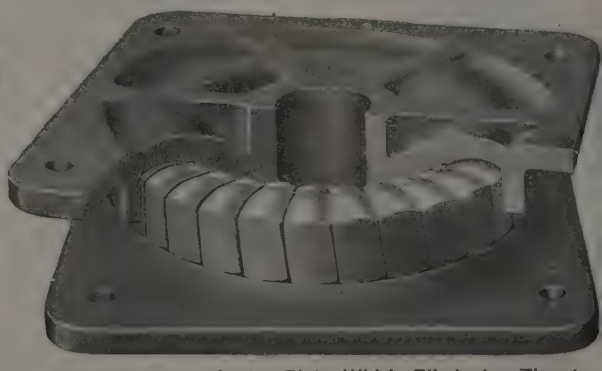


Fig. 1520—Ball Center Plate Which Eliminates Thrust of Conical Rollers

Journal Boxes

In 1920 a standard practice to designate axles, journal boxes and contained parts was adopted by letter ballot as follows:

3¾ x 7 in. axle, journal box and contained parts, to be designated by the letter A.

4¼ x 8 in. axle, journal box and contained parts, to be designated by the letter B.

5 x 9 in. axle, journal box and contained parts, to be designated by the letter C.

5½ x 10 in. axle, journal box and contained parts, to be designated by the letter D.

6 x 11 in. axle, journal box and contained parts, to be designated by the letter E.

6½ x 12 in. axle, journal box and contained parts, to be designated by the letter F.

In the same manner the classifications 2A, 2B, 2C, etc., were adopted for two axle trucks and 3A, 3B, 3C, etc., for three axle trucks, the letters designating the axle used and the figures designating the number of axles in each truck.

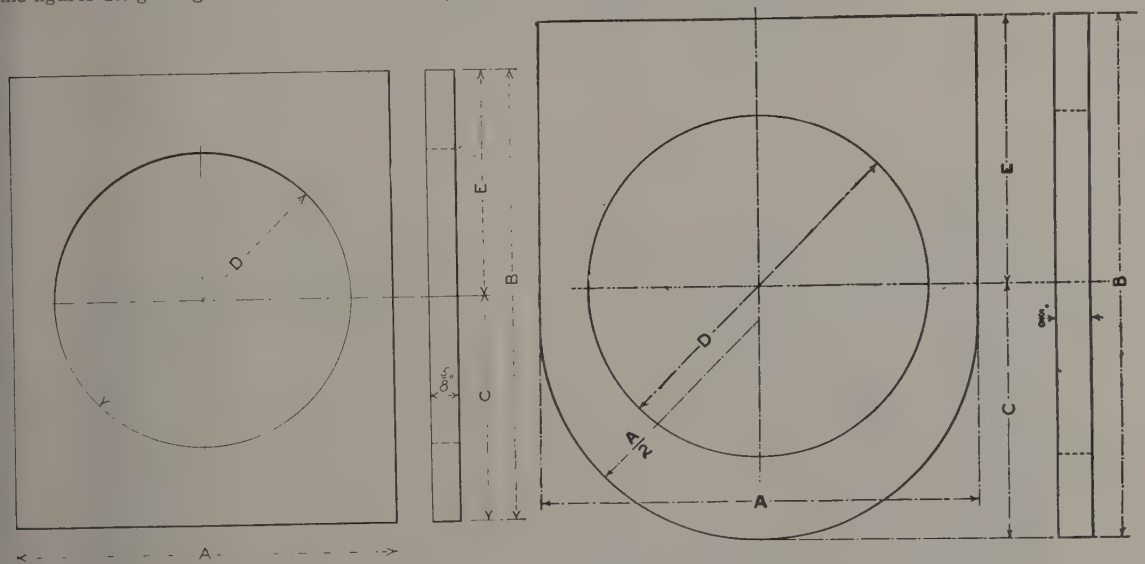
below the center line and material may be cast iron, malleable iron, pressed steel or cast steel, provided all the essential dimensions are adhered to.

When journal box is made of material other than cast iron, reduction in thickness of metal and coring to lighten weight is permissible provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts are adhered to.

If the method of manufacture does not permit of placing the letters "A.R.A." on the side of the journal box, they may be placed on the top between the hinge lug and seat of truck sides.

When used with side frames of such design that the bottom tie bar is omitted, or is not an essential strength number for carrying the load, the bottom box lugs may be omitted.

When used in connection with other side frames, the bottom box lugs must be equivalent, both in location and strength, to those shown.



Classification of Guard	Size of Journal	A	B	C	D	E
A	3¾"x 7"	6"	7½"	3¾"	4 3/16"	3½"
B	4¼"x 8"	7¼"	8½"	4⅜"	5 5/16"	4⅜"

CLASSIFICATION OF GUARD	SIZE OF JOURNAL	A	B	C	D	E
C	5 X 9	8	9½	4⅝	6 3/16	4⅞
D	5½ X 10	8⅞	10	4⅞	6 11/16	5⅛
E	6 X 11	10⅛	10¾	5⅛	7 5/16	5⅜
F	6½ X 12	11	11⅝	5⅜	7 13/16	6¼

Fig. 1521—Dust guards for journal boxes A, B, C, D, E, and F.

Journal Boxes A and B

Standard

Journal Box A for trucks having axles with 3¾x7 in. journals was adopted 1893; modified 1917.

Journal Box B for trucks having axles 4¼x8 in. journals was adopted 1893; modified 1917.

Specifications for Journal Boxes A and B:

Section of box may be made either circular or square

The lid face of bar should be reasonably straight and smooth. For journal boxes used on passenger train equipment, a machine fit is recommended.

Journal Boxes, C, D, E and F

Arrow heads, without figures, indicating radii, represent ¼-in. radius.

Dimensions for tolerances underscored are plus or minus

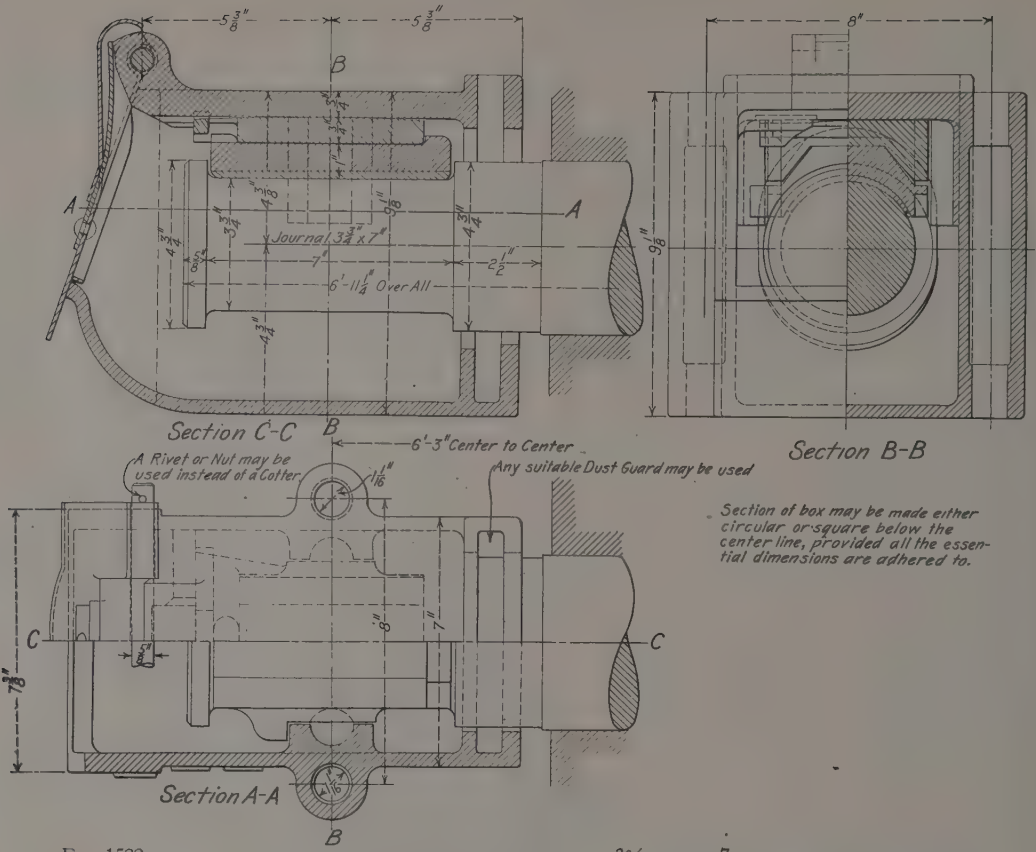

Section C-C
Section B-B
Section A-A
Journal 3¾" x 7"
6'-11¼" Over All
6'-3" Center to Center
A Rivet or Nut may be used instead of a Cotter
Any suitable Dust Guard may be used
Section of box may be made either circular or square below the center line, provided all the essential dimensions are adhered to.

FIG. 1522—A. R. A. STANDARD BOX AND CONTAINED PARTS FOR 3¾ IN. BY 7 IN. FREIGHT CAR JOURNAL.

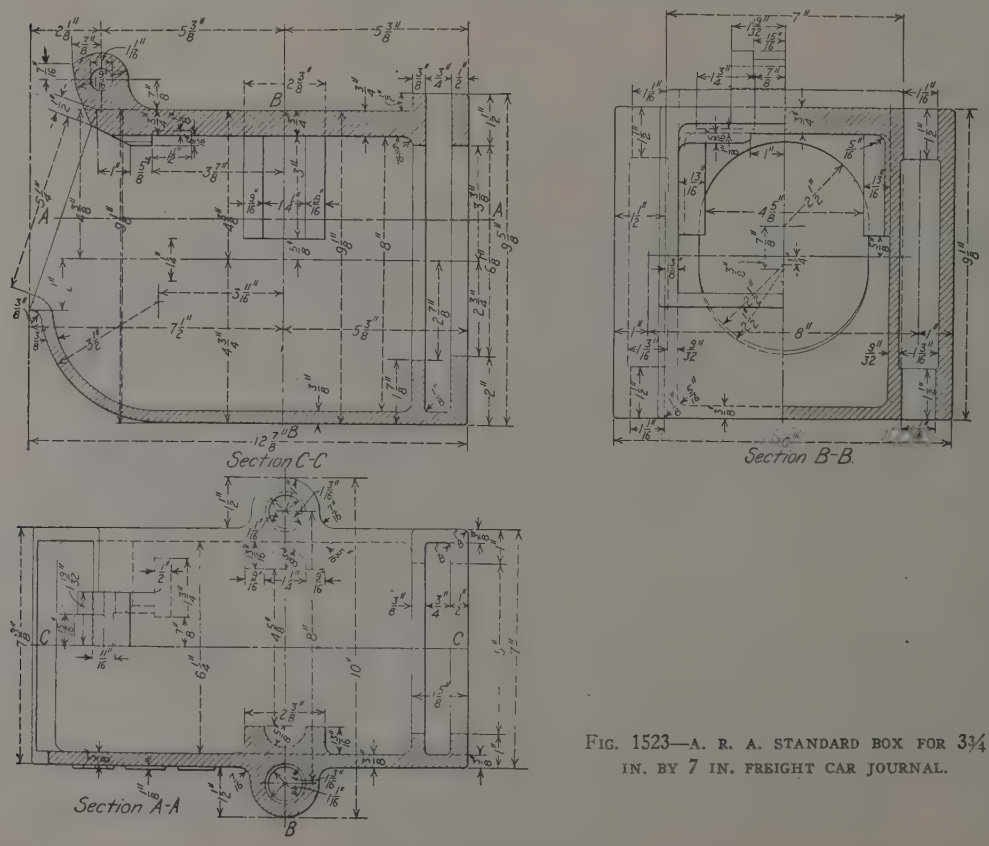


FIG. 1523—A. R. A. STANDARD BOX FOR 3¾ IN. BY 7 IN. FREIGHT CAR JOURNAL.

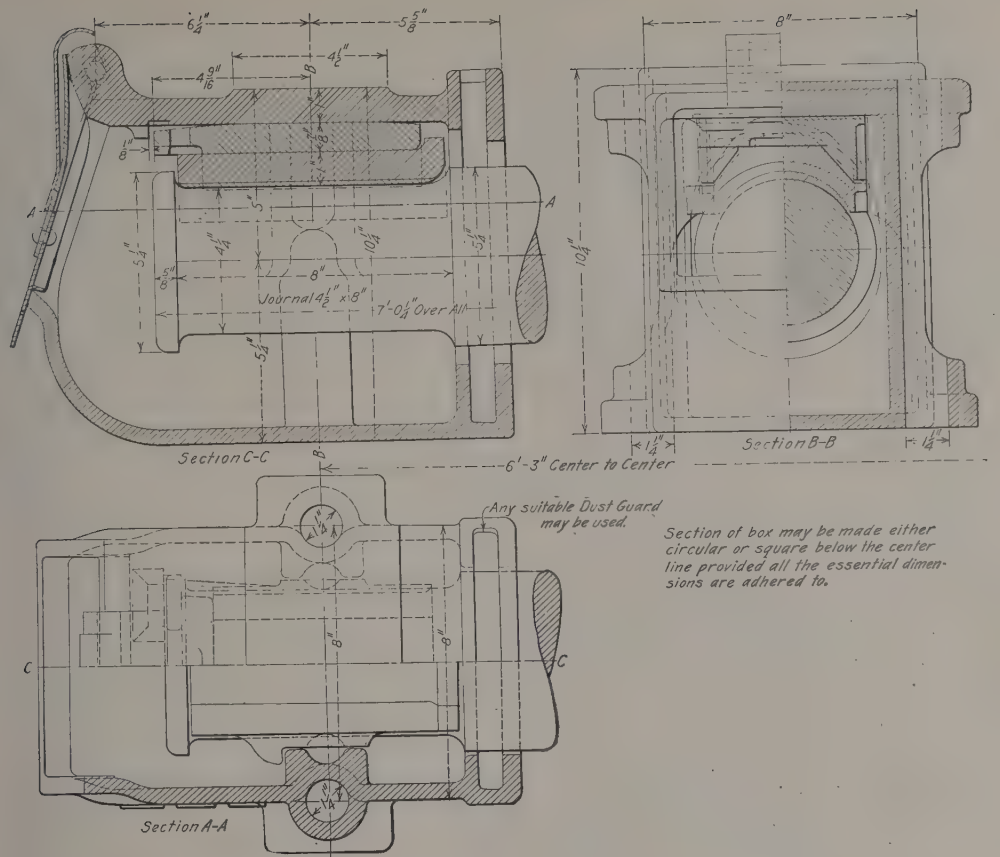

Section C-C
Section B-B
Section A-A
Journal 4½" x 8"
7'-0¼" Over All
6'-3" Center to Center
Any suitable Dust Guard may be used.
Section of box may be made either circular or square below the center line provided all the essential dimensions are adhered to.

FIG. 1524—A.R.A. STANDARD BOX AND CONTAINED PARTS FOR 4½ IN. BY 8 IN. FREIGHT CAR JOURNAL.

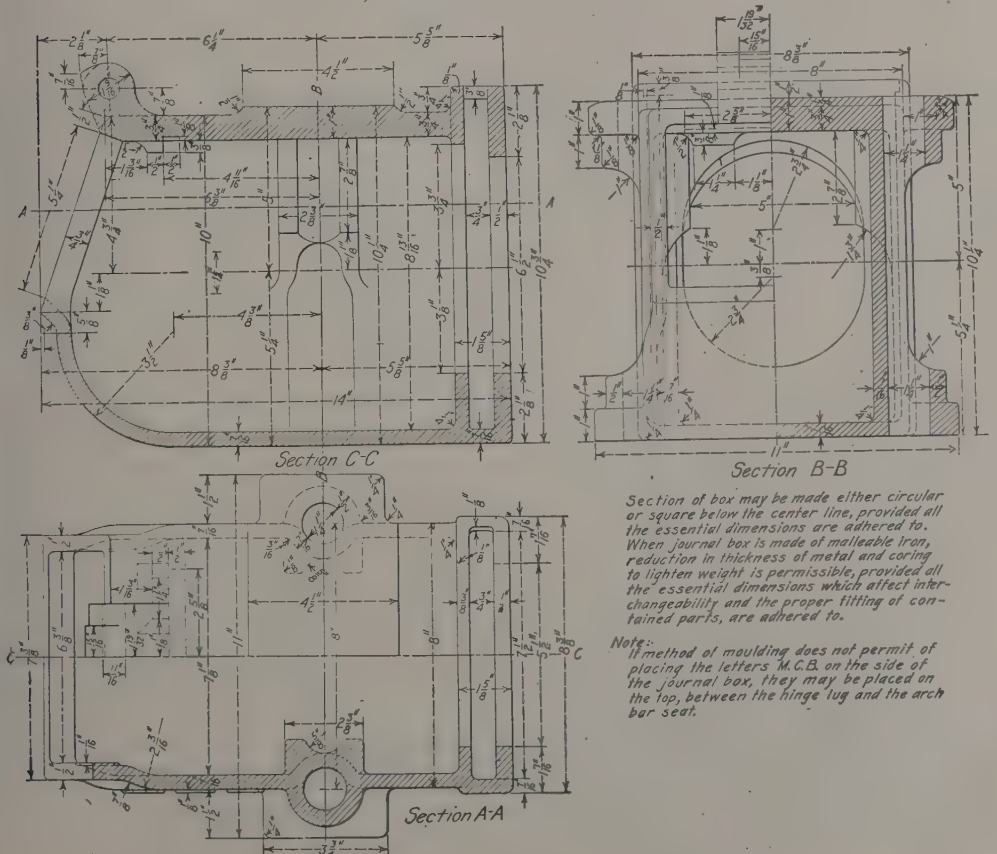
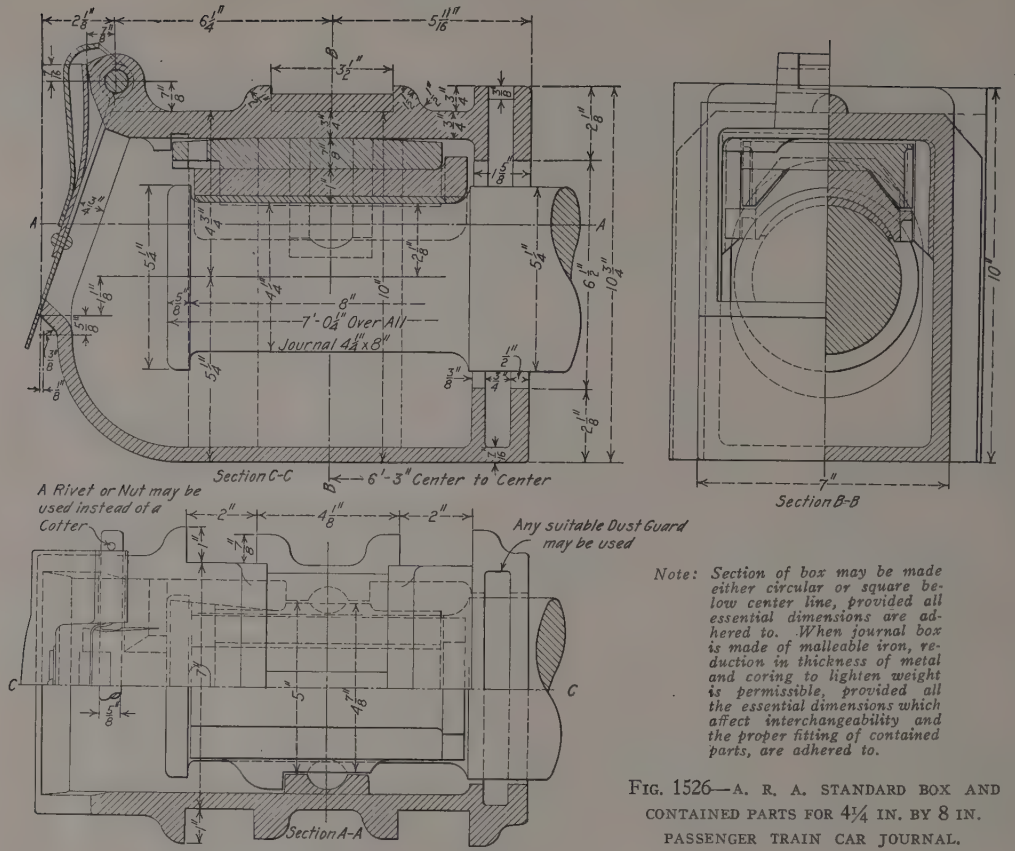
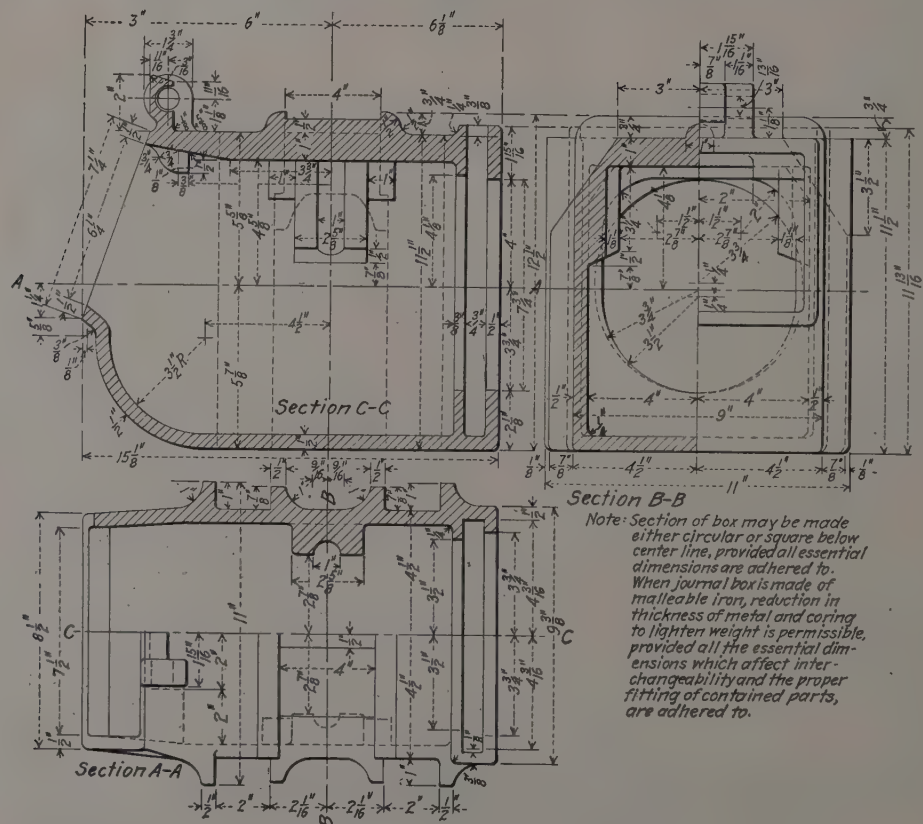

Section C-C
Section B-B
Section A-A
Section of box may be made either circular or square below the center line, provided all the essential dimensions are adhered to. When journal box is made of malleable iron, reduction in thickness of metal and coring to lighten weight is permissible, provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts, are adhered to.
Note:—If method of moulding does not permit of placing the letters M.C.B. on the side of the journal box, they may be placed on the top, between the hinge lug and the arch bar seat.

FIG. 1525—A.R.A. STANDARD BOX FOR 4¼ IN. BY 8 IN. FREIGHT CAR JOURNAL.


Section C-C
6'-3" Center to Center
Section B-B
7'-0¼" Over All
Journal 4¼"x8"
A Rivet or Nut may be used instead of a Cotter
Any suitable Dust Guard may be used
Section A-A

Note: Section of box may be made either circular or square below center line, provided all essential dimensions are adhered to. When journal box is made of malleable iron, reduction in thickness of metal and coring to lighten weight is permissible, provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts, are adhered to.

FIG. 1526—A. R. A. STANDARD BOX AND CONTAINED PARTS FOR 4¼ IN. BY 8 IN. PASSENGER TRAIN CAR JOURNAL.



Note: Section of box may be made either circular or square below center line, provided all essential dimensions are adhered to. When journal box is made of malleable iron, reduction in thickness of metal and coring to lighten weight is permissible, provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts, are adhered to.

FIG. 1527—A. R. A. STANDARD BOX FOR 5 IN. BY 9 IN. PASSENGER TRAIN CAR JOURNAL.

1/16 in.; lesser tolerances are given with the dimensions. Other dimensions of lesser importance may vary, plus or minus, ⅜ in.

Metal thickness given in table under "T" is minimum.

Section of any box may be made either circular or square, below center line.

The metal may be cast iron, malleable iron, pressed steel or cast steel, provided all of the essential dimensions which affect interchangeability and the proper fitting of contained parts, are adhered to.

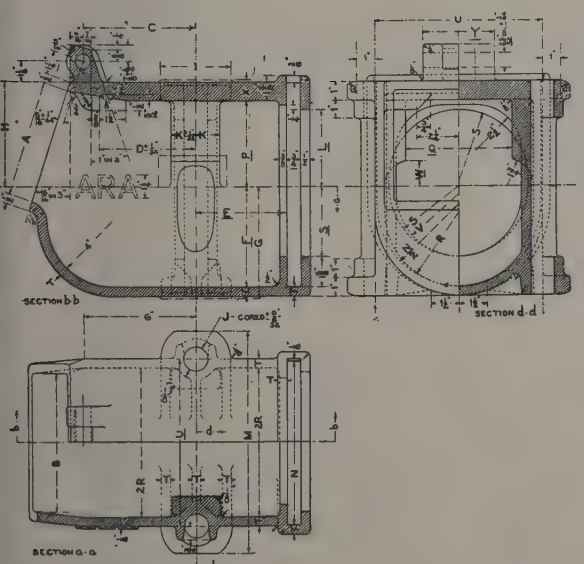
When used with side frames of such design that the bottom tie bar is omitted, or is not an essential strength member for carrying the load, the bottom box lugs may be omitted.

When used in connection with other side frames, the bottom box lugs must be equivalent, both in location and strength, to those shown.

If the method of manufacture does not permit the placing of letters "ARA" on the side of the journal box, they may be placed on the top, between the hinge lugs and the seat of truck sides.

Classification of Box.	Size of Journal.	A	B	C	D	E	F	G	H	I	J	K	L	M
C	5 by 9	6¼	7¾	6 1/16	5 1/16	4⅞	5⅜	5⅛	5⅝	4¾	1¼	1 1/16	4⅛	12
D	5½ by 10	6¼	7¾	6 1/16	5¼	5⅜	5⅜	6⅛	5⅞	5¾	1⅜	1 1/16	4⅝	12½
E	6 by 11	7¼	8¾	7 1/16	6¼	5⅞	5⅞	6½	6⅜	6¼	1½	1⅜	4¾	14¼
F	6½ by 12	8⅜	9¼	7 1/16	6⅜	6⅜	6⅜	6⅝	7	7¼	1⅝	1¾	5⅛	14¾

Classification of Box.	N	O	P	Q	R	S	T	C.I. T	MC. S.C. T	U	V	W	X	Y
C	8⅛	1½	4⅝	5⅜	4	3¾	½	¼	¼	9	3⅝	1⅜	1	3⅞
D	9¾	2	4⅞	6¼	4	4	½	¼	¼	9½	3 1/16	1½	1	3⅞
E	11½	2½	5⅜	7¼	4⅝	4⅝	⅝	1/16	1/16	10½	4	1½	1⅜	4⅜
F	11⅞	2½	6	7⅜	5⅛	4⅝	...	⅜	⅜	11	4¼	1½	1⅜	4⅜



C Box adopted, 1898; *revised,* 1921.
D Box adopted, 1900; *revised,* 1921.
E Box adopted, 1914; *revised,* 1921.
F Box adopted, 1920; *revised,* 1921.

FIG. 1528—STANDARD JOURNAL BOXES C, D, E AND F.

The lid face of box should be reasonably straight and smooth. For journal boxes used on passenger train equipment, a machine fit is recommended.

Standard Journal Bearings

A—Bearing, adopted, 1893; modified, 1920
B—Bearing, adopted, 1893; modified, 1920.
C—Bearing, adopted, 1898; modified, 1920.
D—Bearing, adopted, 1900; modified, 1920.
E—Bearing, adopted, 1914; modified, 1920.
F—Bearing, adopted, 1920.

Note: Journal bearings must bear markings as called for in A. R. A. Specifications for Lined Journal Bearings.

CLASSIFICATION OF WEDGE	SIZE OF JOURNAL	DIMENSION — INCHES A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
A	5 3/4 x 7	5 3/8	6 9/16	4 1/2	2 1/16	3 3/4	2 1/4	1	3/4	1 1/8	5	1 1/4	3 7/8	2 11/16	3 5/8	1 3/16	1	23/32
B	4 1/2 x 8	6 3/8	7 3/8	4 5/8	2 11/16	4 1/2	2 9/16	1/16	7/8	1 15/16	5	1 1/4	4 3/8	3 3/8	4 1/16	1 3/16	1/16	25/32
C	5 x 9	7 3/8	8 3/8	5 5/8	3 1/16	5 1/4	3 3/8	1/16	1	2 1/16	6 3/8	1 7/16	5 1/16	3 11/16	4 3/8	1 3/8	1/16	29/32
D	5 1/2 x 10	8 3/8	9 13/16	6 1/2	3 3/8	5 3/8	3 3/8	1/8	1	2 1/16	6 3/8	1 7/16	5 1/8	4 1/8	5 1/2	1 1/16	1/16	29/32
E	6 x 11	9 3/8	10 13/16	7 1/8	3 5/8	6 3/8	3 3/4	1/8	1 1/8	2 1/8	7 1/2	1 5/8	6 1/4	4 11/16	6 1/8	1 1/16	1/16	29/32
F	6 1/2 x 12	10 3/8	11 13/16	7 3/8	4 1/16	7 3/8	4 1/4	1 1/8	1 3/8	2 3/8	8 1/4	1 5/8	6 3/8	5 1/8	6 5/8	1 1/16	1/16	7/8

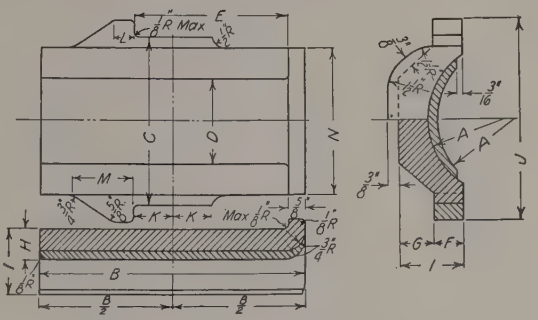


FIG. 1529—STANDARD JOURNAL BEARINGS.

Standard Journal Bearing Wedges

Wedge A, adopted, 1893; modified, 1920.
Wedge B, adopted, 1893; modified, 1920.
Wedge C, adopted, 1898; modified, 1920.
Wedge D, adopted, 1900; modified, 1920.
Wedge E, adopted, 1914; modified, 1920.
Wedge F, adopted, 1920.

Note: Wedge shall be of malleable iron, forged or cast steel.

CLASSIFICATION OF WEDGE	SIZE OF JOURNAL	DIMENSION — INCHES A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	5 3/4 x 7	1 29/32	6 3/4	4 1/4	2	4	7/8	1/8	1	2	5 1/2	1/4	2	1 5/8	3 3/4
B	4 1/2 x 8	2 5/8	7 3/4	4 3/4	2 5/8	4 1/2	31/32	1 3/16	1	2 1/8	3 1/8	1/4	2	1 3/4	4 3/4
C	5 x 9	2 17/32	8 3/4	5 3/8	3 1/8	5 1/16	1 1/32	1/16	1 1/8	2 1/4	6 3/8	1 7/16	1 1/16	2 1/16	4 3/8
D	5 1/2 x 10	2 15/32	9 1/4	6 1/4	3 3/8	5 1/16	1 1/16	1 1/8	1 1/8	2 3/8	7 1/8	1 1/16	1 3/8	2 1/4	5 1/8
E	6 x 11	3 1/32	10 1/4	7 1/8	3 1/2	6 1/4	1 1/4	1 1/2	1 1/4	2 3/4	8 3/8	1 3/4	1 13/16	2 7/16	6 1/4
F	6 1/2 x 12	3 3/8	11 3/4	7 3/8	4	7 1/8	1 1/8	1 3/8	1 1/8	3	9 1/8	1 3/8	1 7/8	2 3/8	6 1/4

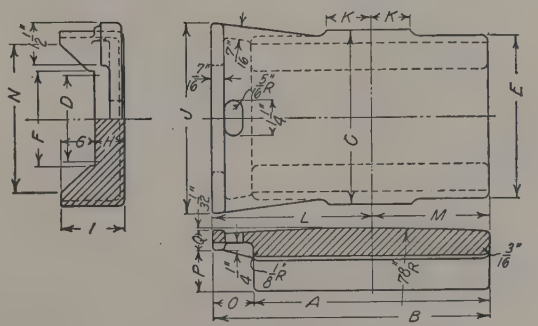


FIG. 1530—STANDARD JOURNAL BEARING WEDGES.

Journal Box Lids

Standard—ADOPTED, 1920.

1. *Scope.*—This specification covers all lids for use on A. R. A. standard journal boxes.

2. *Material.*—Lids may be made of malleable iron or pressed steel. Material to be not less than 3/32 in. thick.

3. *Functions.*—(a) Lid must protect the journal by

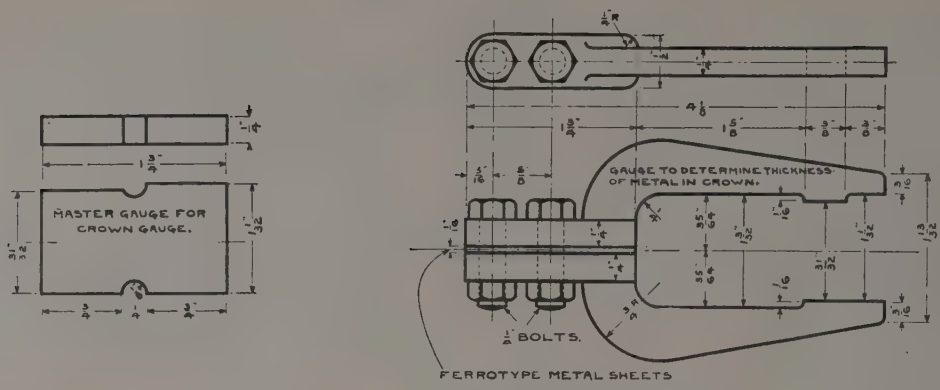
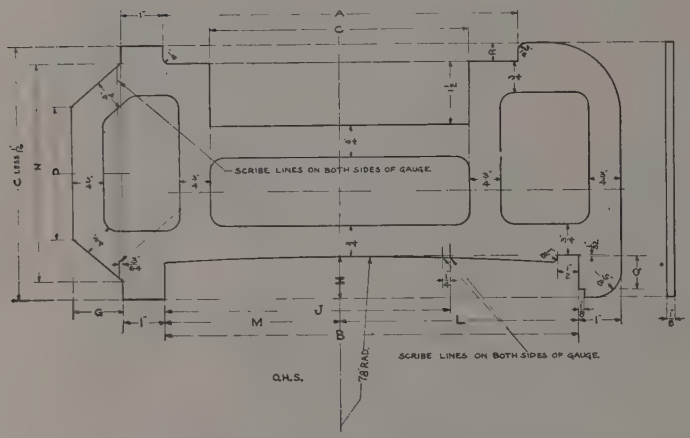
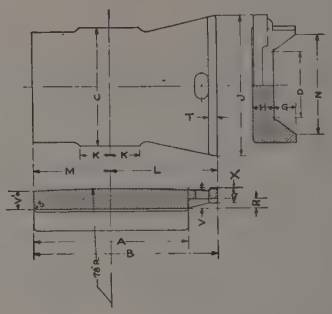


FIG. 1531—CROWN GAGE FOR 6 IN. BY 11 IN. JOURNAL BEARINGS—AND MASTER GAGE.



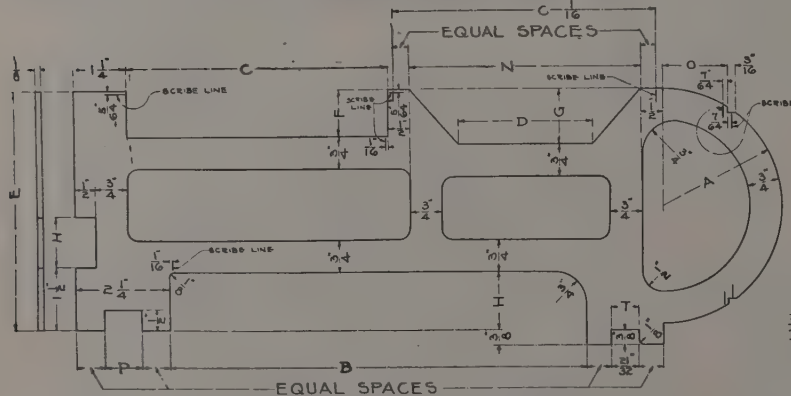


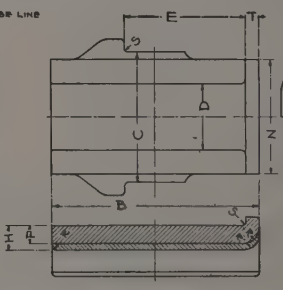
A.R.A. CLASSIFICATION	SIZE OF JOURNAL	DIMENSIONS IN INCHES A	B	C	D	G	H	J	L	M	N	Q	R
A	3¾" X 7"	5 7/16	6 13/32	4 17/32	2 1/16	1	25/32	5 1/8	3 7/8	2 23/32	3 5/8	2 23/32	3/16
B	4¼" X 8"	6 7/16	7 25/32	4 29/32	2 11/32	1 1/16	29/32	5 1/8	4 1/16	3 23/32	4 1/16	2 27/32	3/16
C	5" X 9"	7 7/16	8 25/32	5 21/32	3 3/16	1 1/16	1 1/32	6 7/8	5 1/16	3 23/32	4 3/8	2 23/32	7/16
D	5½" X 10"	8 7/16	9 27/32	6 5/32	3 3/16	1 3/16	1 1/32	6 7/8	5 5/8	4 7/32	5 7/32	2 23/32	7/16
E	6" X 11"	9 7/16	10 27/32	7 5/32	3 9/16	1 3/8	1 5/32	7 7/8	6 1/8	4 23/32	6 1/8	2 25/32	1/2
F	6½" X 12"	10 7/16	11 27/32	7 21/32	4 1/16	1 1/2	1 13/32	8 3/8	6 5/8	5 7/32	6 7/16	7/8	21/32

	DIMENSIONS A	B	C	D	G	H	J	K	L	M	N	Q	R	S	T	V	V'
MAY BE GREATER BY	1/16	1/32	1/32	1/32	0	1/32	1/8	1/8	1/32	1/32	1/32	0	1/16	1/16	1/16	1/32	1/32
MAY BE LESS BY	1/16	1/32	1/32	0	3/64	1/16	1/8	1/8	1/16	1/16	0	1/16	1/16	1/16	1/16	3/32	3/32

V AND V' MUST NOT DIFFER MORE THAN 1/16 ON ANY WEDGE.

FIG. 1532—JOURNAL WEDGE GAGES FOR A TO F, INCLUSI





A.R.A. CLASSIFICATION	SIZE OF JOURNAL	DIMENSIONS—INCHES A	B	C	D	E	F	G	H	N	O	P
A	3¾" × 7"	1 57/64	2 25/32	4 17/32	2 1/32	2 31/32	2 29/32	1 1/8	1 1/16	3 25/32	57/64	3/4
B	4¼" × 8"	2 9/64	7 25/32	4 29/32	2 11/32	4 15/32	7/8	1 9/32	1 1/16	4 13/32	1 1/64	3/4
C	5" × 9"	2 33/64	8 25/32	5 21/32	3 5/32	5 5/32	1 1/16	1 7/32	1 3/16	4 29/32	1 25/64	7/8
D	5½" × 10"	2 29/32	9 25/32	6 5/32	3 5/32	5 21/32	1 3/8	1 5/16	1 3/16	5 13/32	1 33/64	7/8
E	6" × 11"	3 1/64	10 25/32	7 5/32	3 13/32	6 13/32	1 9/32	1 1/2	1 5/16	6 9/32	1 33/64	1
F	6½" × 12"	3 17/64	11 25/32	7 21/32	4 5/32	7 3/32	1 15/32	1 9/16	1 7/16	6 17/32	1 41/64	1 1/8

DIMENSION "P" ASSURES 1/8 LINING

	DIMENSIONS A	B	C	D	E	F	G	H	P	R
MAY BE GREATER BY	1/64	1/32	1/32	1/32	1/16	1/32	3/64	1/16	1/16	1/16
MAY BE LESS BY	1/64	1/32	1/32	1/32	1/32	3/64	0	1/32	0	0

FIG. 1533—JOURNAL BEARING GAGES FOR A TO F INCLUSIVE.

preventing the entrance into the journal box of dust, sand, fine coal, or other foreign matter.

(b) Lid should prevent oil from working out of the end of the journal box.

4. *Construction.*—(a) Lid to be attached to the journal box by a suitable fastening so arranged that it can be easily opened and closed, but it must retain itself in a fully open position without danger of closing.

(b) When closed, the tension between the lid and fastening must be sufficient to prevent vibration of lid or any parts thereof.

(c) Lids of the hinged type to have the hinge located at the top of the journal box, so arranged that the lid will open outward and upward to an angle of 90 deg. with the lid face of the journal box. Lids of other types should provide an equivalent opening.

(d) A tight contact between the lid and the face of the journal box must be maintained in order to meet the requirements as stated under item No. 3. For journal boxes used on passenger train equipment a machined fit is recommended.

(e) A ledge, flange, or other suitable arrangement, should be provided on the inside of the lid, particularly along the lower part, so that oil thrown against the inside face will drain back into the box.

(f) Springs should be of the coiled type when possible.

(g) The eyes of the lid must be integrally closed.

Lined Journal Bearings

Recommended Practice—ADOPTED, 1915; REVISED, 1920.

1. *Scope.*—These specifications cover journal bearings for use on locomotive tenders, passenger train cars and freight train cars.

2. *Manufacture.*—Before lining, the brass backs shall be bored and thoroughly tinned in accordance with the best standard practice. The thickness of linings which is desired shall be specified in the order. If it is not specified, linings one-quarter inch thick shall be furnished. After lining, the ends of the bearings shall be made smooth by scraping, filing or machining. They must not be ground or rubbed with abrasive materials.

I. CHEMICAL PROPERTIES AND TESTS.

3. *Composition of Back.*—	PER CENT. A	B
Lead	16 to 24	24 to 30
Tin	5 to 7	4 (Min.)
Total of other impurities, maximum	4	3
Copper	67 to 77	63 to 72

Within the ranges permitted, the tin and lead should vary, if at all, in opposite directions, the tin being increased for the lower percentages of lead.

The owner of the equipment on which the bearings are to be used shall specify which class of metal is desired. If he does not do so, metal of Class A shall be furnished.

4. *Composition of Lining.*—	C	D
Tin	3 to 5	0.5 to 1.5
Antimony	8 to 10	.....
Antimony plus tin	12 to 14	3 to 5
Arsenic, maximum	0.2	.....
Total of other impurities, maxi'm	0.5	0.5
Lead	85 to 88	94 to 96

Metal of Class C is for linings of a nominal thickness over ⅛ in. Metal of Class D is for linings of ⅛ in. or less in nominal thickness. This classification is independent of the composition of the back. Either composition of the back may be used with the composition of lining metal specified for the thickness of journal lining which is ordered.

5. *Analysis.*—The sample for chemical analysis of the shell shall consist of a thorough mixture of equal quantities of fine drillings taken at three points on the bearing, surface metal being discarded. The sample for analysis of the lining shall be taken by scraping the lining, after removing surface metal.

II. PHYSICAL PROPERTIES AND TESTS.

6. *Tests.*—The finished casting representing a lot for acceptance shall be broken, either longitudinally or transversely, or both, in order to ascertain the uniformity of the grain of the metal. When this fracture shows separation or imperfect mixing of component parts or dross or dirt spots, the lot shall be rejected.

7. *Number of Tests.*—Bearings shall be divided into lots of 300 or less, and one bearing shall be taken for test and chemical analysis from each lot.

III. PERMISSIBLE VARIATIONS.

8. *Gaging.*—All bearings shall conform to the latest standards of the Mechanical Section of the American Railroad Association, with respect to form and dimensions and variations therefrom.

IV. FINISH.

9. *Finish.*—All bearing surfaces shall be smooth and free from tool marks. The castings shall be sound and free from blow-holes, dross, and mechanical defects.

V. MARKING.

10. *Marking.*—Each lot of 300 or less shall bear a serial number, commencing with 1 at the beginning of the year

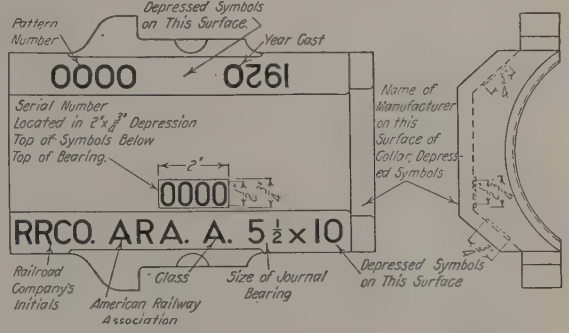


FIG. 1534—MARKING JOURNAL BEARINGS.

and continuing consecutively until the end of the year, at each manufacturer's plant. The bearings shall be cast with marks as shown in Fig. 1534.

VI. INSPECTION AND REJECTION.

11. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the analysis of the material at his own laboratory or elsewhere. Such tests shall show the material to conform to Sections 3, 4, 5 and 6.

12. *Rejection.*—Material which, subsequent to above tests at the mills or elsewhere and its acceptance, shows any de-

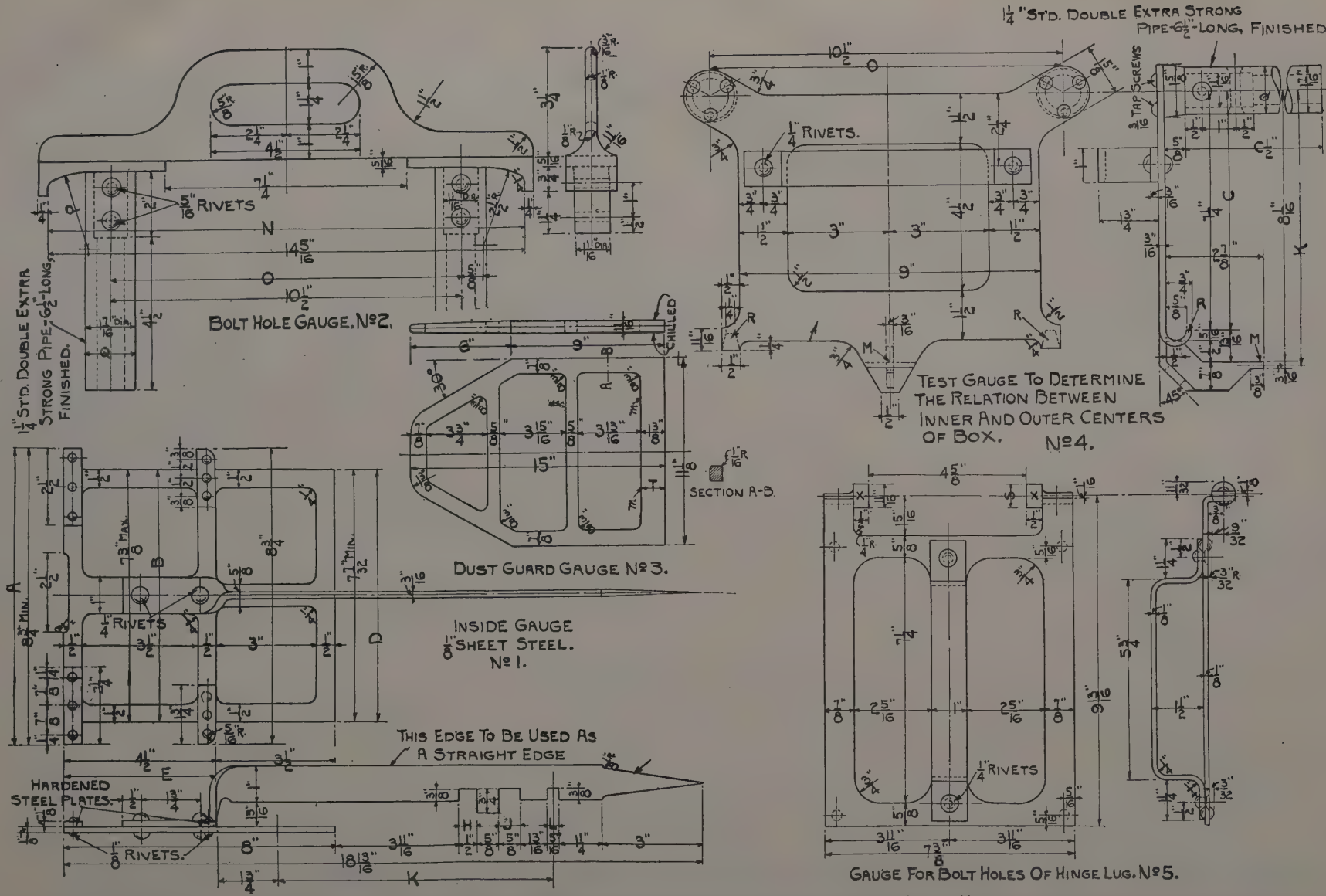

1¼" STD. DOUBLE EXTRA STRONG PIPE-6½" LONG, FINISHED.
BOLT HOLE GAUGE. No2.
1¼" STD. DOUBLE EXTRA STRONG PIPE-6½" LONG, FINISHED.
5/16" RIVETS
TEST GAUGE TO DETERMINE THE RELATION BETWEEN INNER AND OUTER CENTERS OF BOX. No4.
¼" RIVETS.
3/16 TAP SCREWS
CHILLED
DUST GUARD GAUGE No3.
SECTION A-B
INSIDE GAUGE 1/8" SHEET STEEL. No1.
¼" RIVETS
THIS EDGE TO BE USED AS A STRAIGHT EDGE
HARDENED STEEL PLATES.
⅛" RIVETS.
GAUGE FOR BOLT HOLES OF HINGE LUG. No5.
¼" RIVETS

FIG. 1535—A.R.A. RECOMMENDED PRACTICE FOR JOURNAL BOX GAGES FOR JOURNAL 6 IN. x 11 IN.

fects shall be rejected and shall be replaced at the expense of the manufacturer.

13. *Rehearing.*—Samples tested in accordance with Section 11-(b), which represent rejected material, shall be preserved for 14 days from date of test report.

Journal Box Gages

GAGE NO. 1—INSIDE GAGE.—Dimension "A" gives minimum dust guard opening and minimum width for front of box. Dimensions "B" and "D" give maximum and minimum width between inside lugs or bearing stops. Dimension "E" gives exact distance between outer edge of lug or bearing stop and wedge stop and allowable variation in this distance is provided for by the slots "H" and "J," which fit over the walls at back of box or dust guard opening, these slots being ⅛ inch wider than walls, allowing 1-16 inch play each way, maximum allowance.

GAGE NO. 2—JOURNAL BOX BOLT HOLE GAGE.—Dimension "O" is the exact distance between centers of journal box bolt holes, and dimension "Q" is size of the plugs, being 1-16 inch smaller than holes in box, thus allowing for a variation of ⅛ inch. Boxes are not to be accepted if plugs will not enter bolt holes. Boxes not to be accepted if wider than dimension "N," or do not have radius "P" to conform to truck frame.

GAGE NO. 3—DUST GUARD GAGE.—The dust guard opening or slot must allow this gage to enter all the way. The dimension "T" is made of such width that the line "M-N" will not be above the bottom of dust guard opening.

Gage No. 4—Outside Alignment Gage

This gage determines the relation between inner and outer center lines of box and is used in conjunction with Gage No. 1. The application being as follows: The Plugs "Q" of Gage No. 4 are placed in bolt holes and points "M" and "R" extending over back end of box. Gage No. 1 is placed on the inside of box, through the dust guard opening. A normal box will show the point "M" of Gage No. 4 centrally located in slot "L" of Gage No. 1. The distance "K" of both gages coincides. The dimension of slot "L" allows for longitudinal variation of ⅛ in., also points "R" allow for ⅛ in. variation in width at back of box. These points must go over all boxes accepted. The maximum amount, out of alignment, between inside and outside centers of box, is ⅛ in.; that is, the point "M" of Gage No. 4 must not extend on either side of slot "L" of Gage No. 1 by more than this amount. These gages are shown in Fig. 1431.

Gage No. 5—Bolt Hole Hinge Lug Gage

This gage is placed on the surface of lid opening and the location of holes in hinge lug must be such as to allow the plug points "X" to enter holes, the necessary variation to be allowed being provided for in the diameters "S" of same.

Standard Method of Packing Journal Boxes

Recommended Practice—ADOPTED, 1920.

Preparation of New Packing.—The waste must be loosened, placed in a saturating vat and kept completely submerged in car oil, at a temperature of not less than 70 degrees Fahrenheit, for a period of at least forty-eight hours to insure thorough saturation. It shall then be drained for the purpose of removing the excess oil, until the packing is in a resilient or elastic condition.

Prepared packing in storage should be turned over at least once each twenty-four hours, or the oil which has accumulated in the bottom of the container shall be drawn off and poured over the top of the prepared packing.

Preparation of Renovated Packing.—All packing, when removed from journal boxes for the purpose of periodical repacking or renovating, should be pulled into a container, avoiding contact with the ground or any other place where it may pick up dirt, and taken to the waste-reclaiming plant. This packing must not be reused until renovated.

In reclaiming packing it should be first picked over carefully and dirt, metal, etc., shaken out, the knotted strands of waste pulled apart, and then placed in hot oil in renovating tank for a short time, working it with a fork for the purpose of thoroughly washing and loosening it. It should then be rinsed in clean oil, then drained for the purpose of removing the excess oil.

Cleaning Boxes.—Before packing a journal box the oil cellar shall be thoroughly cleaned of all dirt, sand, scale and grit, and if water is present it must be removed. When new journal boxes are applied, or when reapplying journal boxes, the interior of the box, including the dust-guard well, shall be so treated, and close-fitting dust guards and lids should be applied.

Cleaning and Applying Bearings.—Before applying journal bearings they shall be thoroughly clean, have a smooth bearing surface, free from irregularities, and shall have a proper bearing. Under no circumstances is it permissible to use sand paper, emery paper or emery cloth for the purpose of removing irregularities from the bearing surface. A half-round file or scraper should be used. Care must be taken that the wedge has a good contact on the crown of journal bearing. The surface of the journal should be smooth and thoroughly clean before bearing is applied. When applying a journal bearing a coat of lubricating oil must be applied to the bearing surface of same. Never wipe the bearing surface of the journal bearing with waste.

Application of Packing.—(a) Inner.—In packing a journal box, twist somewhat tightly a rope of packing and place it in the extreme back part of the box, as shown at A in Fig. 1432. Make sure that it is well up against the journal so as to properly lubricate the fillet on the journal and keep out the dust.

(b) Main.—Apply sufficient packing (preferably in one piece) to fill the space shown at B in Fig. 1432. Take care to have this packing bear evenly along full length of the lower half of the journal. The packing should not be too tight but should be tight enough to overcome any tendency to settle away from the journal. The packing should extend to approximately the center line of the journal but not above at any point, and should be pressed down evenly at sides that no loose ends may work up under the journal bearings.

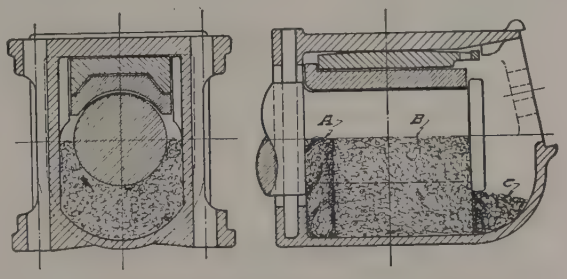


FIG. 1536—DIAGRAM SHOWING APPLICATION OF PACKING.

(c) Outer.—Apply a third piece of firmly twisted packing as shown at C in Fig. 1432, and pack tightly in order to prevent displacement of the main packing. There should be no loose ends hanging out of the box as they would tend to draw out the oil.

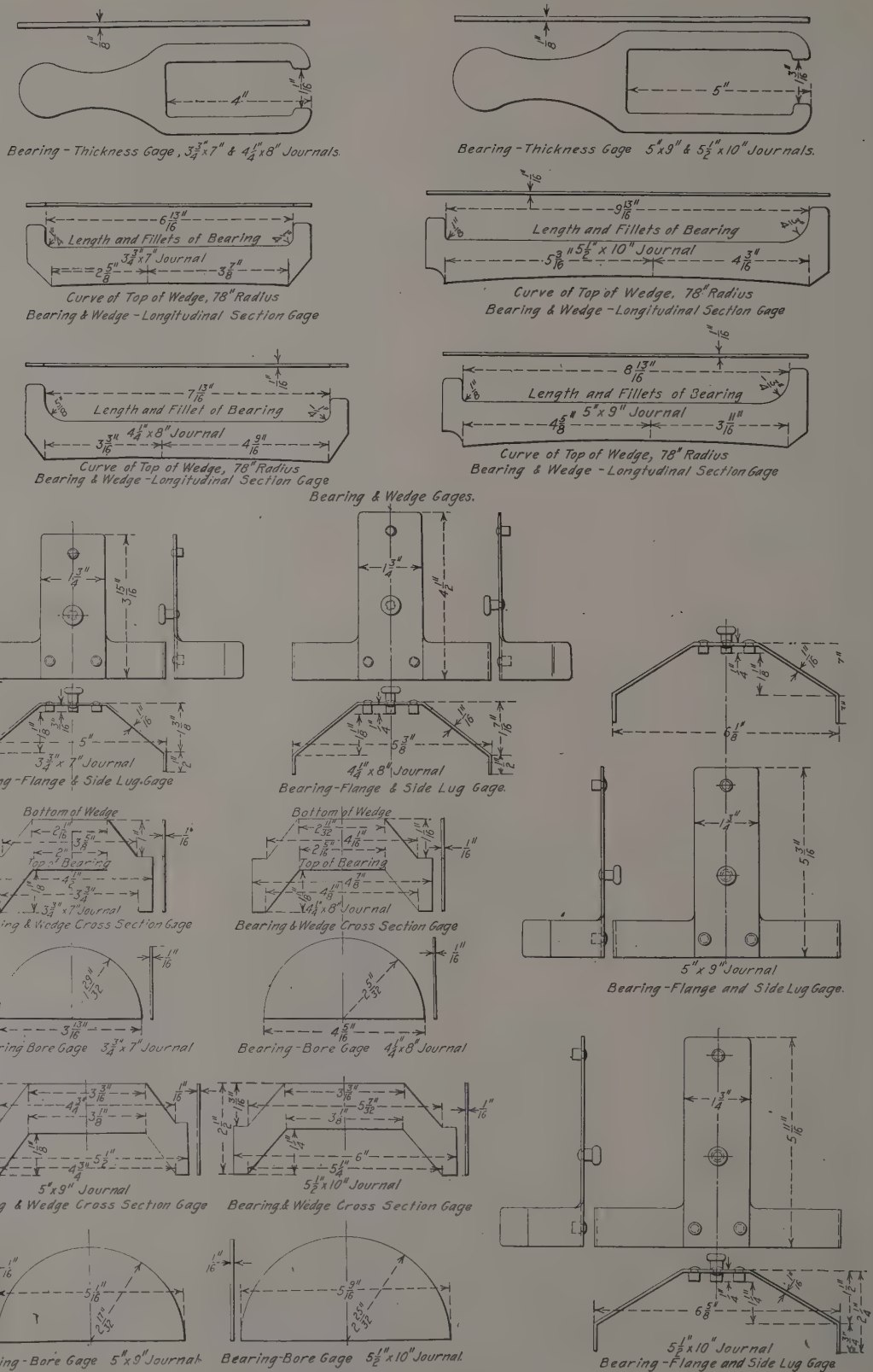
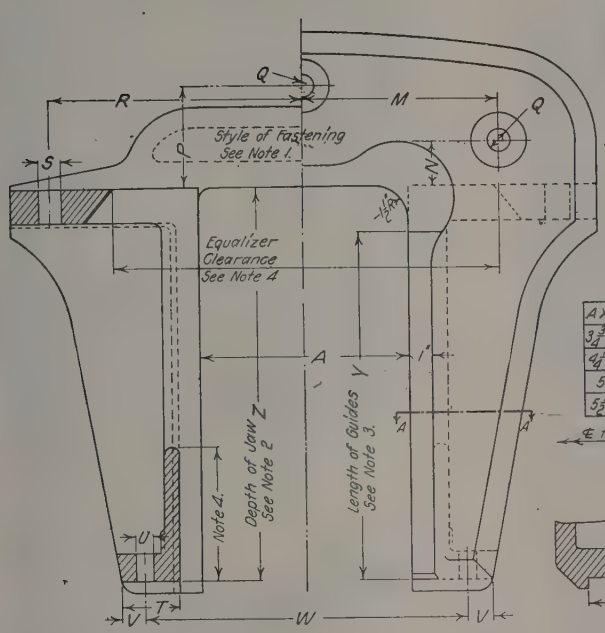

Bearing - Thickness Gage, 3¾"x7" & 4¼"x8" Journals.
Bearing - Thickness Gage 5"x9" & 5½"x10" Journals.
Length and Fillets of Bearing
3¾"x7" Journal
Curve of Top of Wedge, 78" Radius
Bearing & Wedge - Longitudinal Section Gage
Length and Fillets of Bearing
5½"x10" Journal
Curve of Top of Wedge, 78" Radius
Bearing & Wedge - Longitudinal Section Gage
Length and Fillet of Bearing
4¼"x8" Journal
Curve of Top of Wedge, 78" Radius
Bearing & Wedge - Longitudinal Section Gage
Length and Fillets of Bearing
5"x9" Journal
Curve of Top of Wedge, 78" Radius
Bearing & Wedge - Longitudinal Section Gage
Bearing & Wedge Gages.
3¾"x7" Journal
Bearing - Flange & Side Lug Gage
4¼"x8" Journal
Bearing - Flange & Side Lug Gage.
5"x9" Journal
Bearing - Flange and Side Lug Gage.
Bottom of Wedge
Top of Bearing
Bearing & Wedge Cross Section Gage
Bearing & Wedge Cross Section Gage
Bearing Bore Gage 3¾"x7" Journal
Bearing - Bore Gage 4¼"x8" Journal
5"x9" Journal
Bearing & Wedge Cross Section Gage
5½"x10" Journal
Bearing & Wedge Cross Section Gage
Bearing - Bore Gage 5"x9" Journal
Bearing - Bore Gage 5½"x10" Journal
5½"x10" Journal
Bearing - Flange and Side Lug Gage

Fig. 1537—A. R. A. Journal Bearings and Wedge Gages.


Style of Fastening See Note 1.
Equalizer Clearance See Note 4
Depth of Jaw See Note 2
Length of Guides See Note 3.
Note 4.
℄ to ℄ of Journals
SECTION A-A

AXLE	A	B
3 3/4" x 7"	7 1/8"	6'-3"
4 1/4" x 8"	7 1/8"	6'-3"
5" x 9"	9 1/8"	6'-4"
5 1/2" x 10"	9 1/8"	6'-5"

NOTE 1. Pedestals to be Designed of Ample Strength to Suit Style of Truck Sideframe and Arranged for Securely Fastening to the Same.

NOTE 2. Sufficient Depth of Jaws to be Provided so as to Allow for Ample Clearances Both Above and Below Boxes.

NOTE 3. Guides to be of Sufficient Length to Provide Full Bearing Surface for Journal Box Lugs.

NOTE 4. Pedestals Sides to be Securely Tied Top and Bottom Allowances Being Made for Sufficient Equalizer Clearance.

RECOMMENDED DIMENSIONS
Pedestals for Single, Bottom Equalizer Trucks Having Rectangular Section Wheel Pieces.

AXLE	M	N	P	Q	R	S	T	U	V	W	X	Y	Z
3 3/4" x 7"	8"	2"	4 1/2"	13/16"	9 1/2"	1"	3 3/8"	7/8"	11 3/16"	11 1/2"	3 1/16"	13 7/8"	15 7/8"
4 1/4" x 8"													
5" x 9"	8 1/2"	2"	4 1/8"	13/16"	11"	1 5/16"	3 7/16"	13/16"	1"	14"	3 5/8"	15 1/2"	18"
5 1/2" x 10"													

Fig. 1538—A. R. A. Recommended Dimensions for Passenger Car Truck Pedestals.

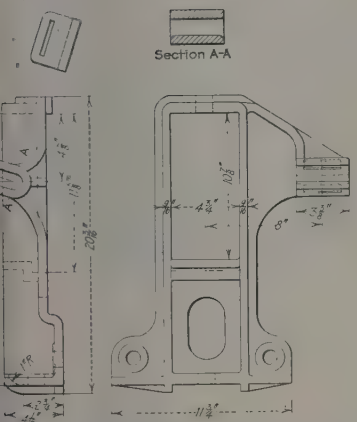


Fig. 1539—Boltless Column for 40-Ton Capacity Freight Car Truck. Dominion Steel Foundry Co., Ltd.

Fig. 1540—Cast Steel Combined Column or Bolster Guides and Spring Seats for Arch Bar Trucks. American Steel Foundries.

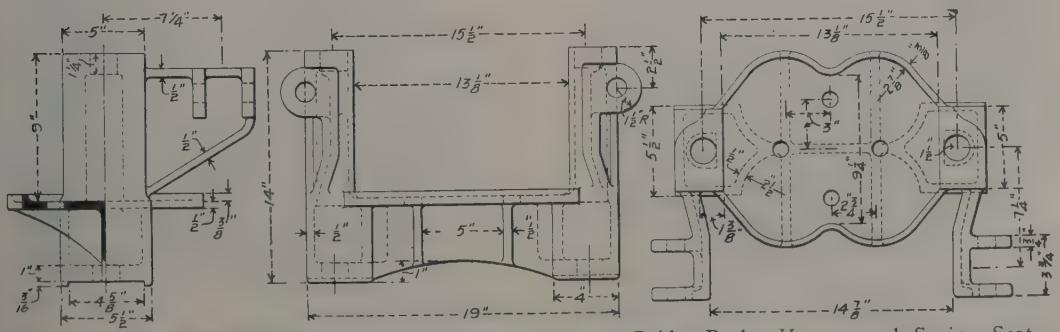


Fig. 1541—Cast Steel Combined Truck Column or Bolster Guide, Brake Hanger and Spring Seat. American Steel Foundries.

Fig. 1542—Acme Journal Box. Acme Steel & Malleable Iron Works.

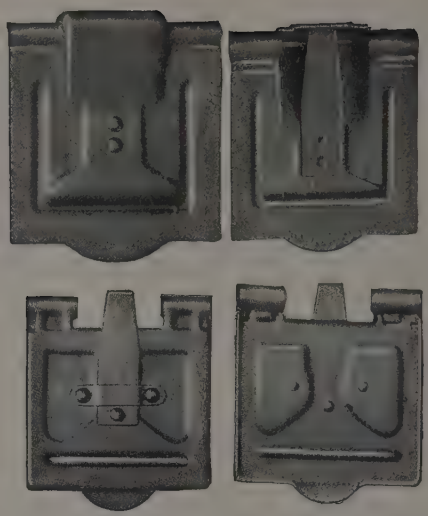


Fig. 1543—Pressed Steel Journal Box Lids. Allegheny Steel Company.

(*See also Page* 669.)

Fig. 1544—Improved Journal Box for Freight Pedestal Trucks. Gould Coupler Company.

Fig. 1545—A. R. A. Arch Bar Journal Box with Improved Coil Spring Lid. (Open.) Gould Coupler Company.

(*See also Page* 955.)

Fig. 1546—Improved Journal Box for Passenger Pedestal Trucks. Gould Coupler Company.

Fig. 1547—A. R. A. Arch Bar Journal Box with Improved Coil Spring Lid. (Closed.) Gould Coupler Company.

ASCO Hoodless Type A.R.A. Lid and Pin

The ASCO Hoodless Type A. R. A. standard journal box lid is of rigid pressed steel construction, having a Chrome-Vanadium Alloy spring, side and bottom flanges with electrically welded integral turn down scrolls adapted to accommodate and securely retain a plain headless bar pin. In designing this lid the Allegheny Steel Co. has been successful in producing a thoroughly reliable and dust-tight covering, well adapted to the requirements of railway freight and passenger car service.

Fig. 1548—Illustrating typical conditions now existing. The upper cut shows lid riding away at top due to spring not exerting sufficient pressure to hold it against road shock and the lower cut shows elongated pin hole in box lug, caused by the constant jumping of the lid on the box face.

To obtain a perfectly dust-tight contact between the lid and top edge of the box, it has been necessary to abandon the hood type of construction shown in Fig. 1549, due to the fact that such construction does not permit of any bearing under the hood. The absence of a bearing at this point leaves a direct opening into the box through which sand, grit and dirt may find easy entrance. In the ASCO journal box lid this defect has been entirely eliminated, as the hoodless type of construction permits of a full metallic contact across the entire face at the top as well as at the sides and bottom of the box.

A frequent result of improper spring design is shown in Fig. 1548. It will be observed that the lid makes only a partial contact on the sides and no contact whatever along the top. This condition is caused by the use of a spring of insufficient strength,

Fig. 1549—Rear View of Hood-Type Lid at Top Showing Direct Opening Into Box

which allows the lid to move up and down under the vibration and shocks of road service. The effect of this is to elongate the pin hole in the box lug—Fig. 1548—thereby permitting the lid to ride away from the box at the top. Troubles of this character are entirely eliminated in the ASCO construction, inasmuch as Chrome-Vanadium Alloy steel springs are used which are capable of exerting a pressure of not less than 20 lb. on the extreme lower end of the lid when in a closed position and under normal flex.

The spring is attached to the ASCO lid in such a manner as to remove all strain at the rivet. This is accomplished by the use of a double riveted strap, as shown in Fig. 1550.

The pin used with the ASCO hoodless lid has no head, slot or cotter and consists of a plain round ¾-in. bar 7½ in. long. The turn down scroll is designed to prevent the pin from working out and forms an absolutely positive lock.

The lid complete with spring, for 5½-in. by 10-in. box, weighs 5⅝ lb., which means a saving in weight of from 21 to 30 lb. per car when compared with lids of the ordinary type.

Fig. 1550—A S C O Hoodless Type A. R. A. Standard Journal Box Lid and Pin

The ASCO lids are shipped with a strip placed under the spring, between it and the body of the lid. This holds the spring in a flexed position and permits the application of the lid to a journal box without the use of a spring compressor nor any other tool but a hand hammer. The lid can be applied by one man in three or four minutes.

For other products and branch offices, see classified and alphabetical indexes.

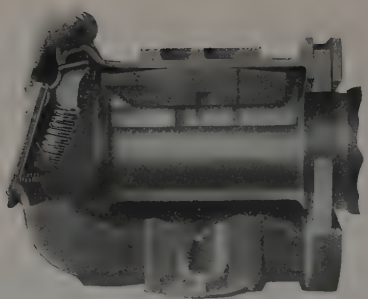


Fig. 1551—National Coiled Spring Journal Box, With Lid Closed.

Fig. 1552—National Coiled Spring Journal Box, With Lid Open.

Fig. 1553—National Coiled Spring Journal Box for Scullin Truck.

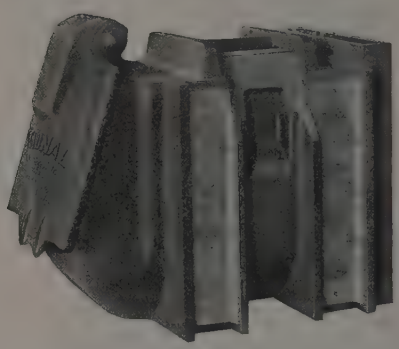


Fig. 1554—National Coiled Spring Journal Box with Steel Inserts for Passenger Trucks.

Fig. 1555—National Coiled Spring Journal Box for Vulcan Truck.

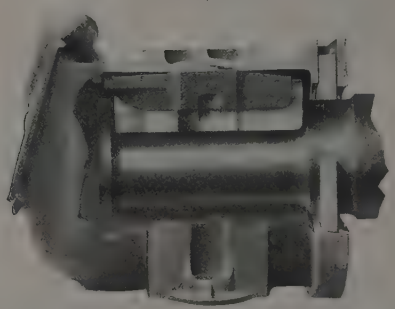


Fig. 1556—National Equalizing Wedge and Coiled Spring Journal Box.

Fig. 1557—Journal Bearing Wedge.

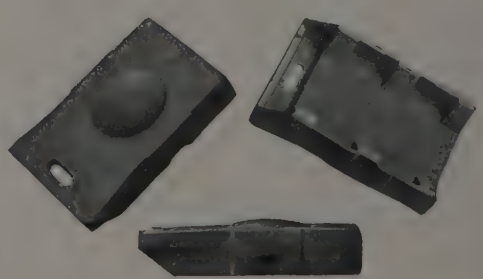


Fig. 1558—National Equalizing Wedge.

National Malleable Castings Company.

(*See also Page* 671.)

National Coiled Spring Journal Box

The design of this box and the material of which it is made, afford the greatest possible strength and durability. Being cast in one piece, all dangerous seams are eliminated, and the strength and rigidity of the box are thereby greatly increased.

The rust resisting properties peculiar to malleable iron, together with the extreme toughness

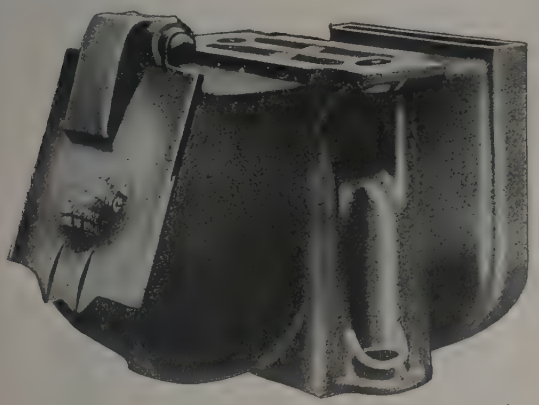


Fig. 1559—General Appearance of National Coiled Spring Journal Box

and ductility of this material make these journal boxes especially desirable for both freight and passenger service where extreme weather conditions are to be encountered, and they have been found, by both mechanical tests and long service, to be amply strong to withstand the severe service imposed upon them.

The working surface of the hinge lug, as well as all of the operating parts, are inside the box where they are kept lubricated by the oil in the box, thus insuring easy operation and protection from rust.

The hinge lug is so formed as to permit the application of the ordinary A. R. A. lid and flat spring, if in case of emergency this should be required.

The National Coiled Spring Journal Box conforms to all the essential A. R. A. standard dimen-

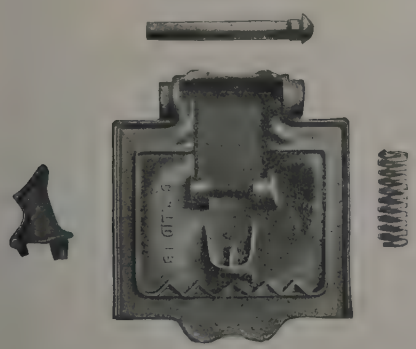


Fig. 1560—Lid and Parts, Inside View of Lid

sions, and can be furnished for freight or passenger service, for application to any type of truck now in general use, either of the A. R. A. Arch Bar or Pedestal types, and for all standard sizes of journals.

Fig. 1561 represents longitudinal sections through the lid and front of box, in the closed and open positions, and serve to explain the position and action of the operating parts.

The spring lever C pivoted to the inside face of the lid *B* receives the thrust from a coiled spring *D* seated in a pocket in the lid, and transforms this pressure by fulcruming against the hinge lug *E* into a powerful direct inward pull against the center of the lid at right angle to it and the mouth of the pocket when the lid is closed. This results in an equal pressure of lid on all edges of the box opening, assuring an oil-tight and dust-proof fit.

The lid has a socket *G* which bears on a round trunnion *H* at either side of the hinge lug, and forms bearings sufficient to retain the lid in place without the hinge pin *F*. The hinge pin however,

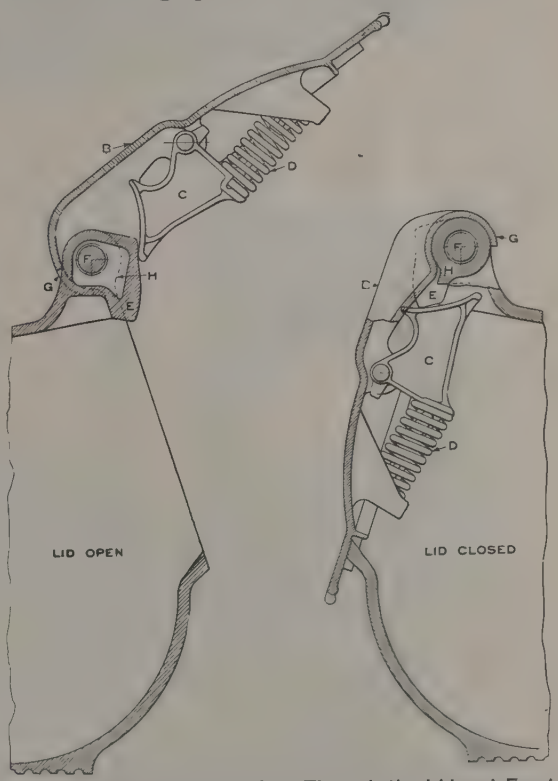


Fig. 1561—Longitudinal Sections Through the Lid and Front of Box, in Open and Closed Positions

being riveted over, makes the loss of lid and parts impossible.

When the lid is closed, the spring wedges the heel of the spring lever against the lower edge of the hinge lug, forces the lid down on the trunnions, and prevents the vibration of the lid when the train is in motion, thus eliminating excessive wear of the parts.

Other illustrations showing the National Coiled Spring Journal Box for both freight and passenger service and for various types of side frames are shown in Figs. 1551 to 1558.

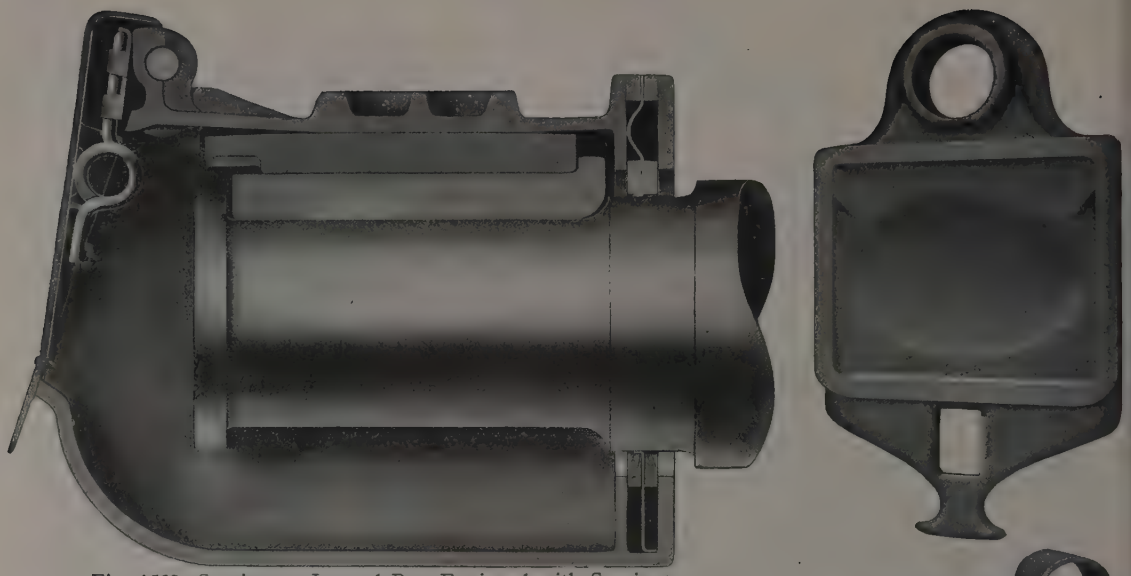


Fig. 1562—Symington Journal Box Equipped with Symington Flexible Dust Guard.

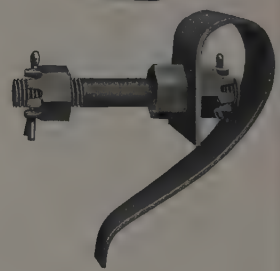


Fig. 1565—Symington Pivot Spring Lid, Spring and Bolt.

Fig. 1563—Symington Flexible Journal Box Dust Guard.

Fig. 1564—Symington Malleable Iron Torsion Spring Lid, Spring and Bolt.

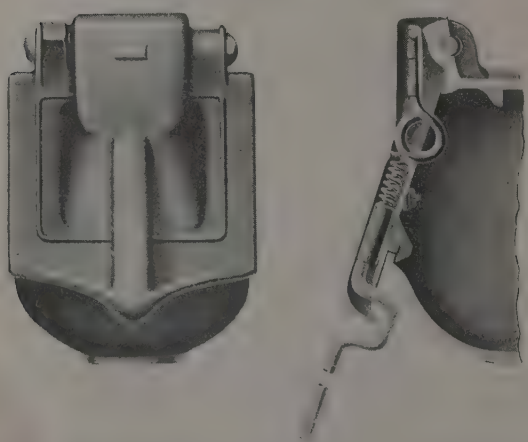


Fig. 1566—Symington Malleable Iron Self-Locking Journal Box Lid.

Fig. 1567—Symington A. R. A. Freight Journal Box with Torsion Spring Lid.

The T. H. Symington Company.

(See also Fig. 1575 and Page 673.)

Symington Freight and Passenger Journal Boxes

The essential requirements of a journal box for railway freight and passenger car equipment are that it shall provide a dust proof housing for the journal and its lubricant, maintain the brass and wedge in correct alignment, and be of proper design and adequate strength to meet the requirements of modern railway service.

Fig. 1568—Symington A. R. A. Malleable Iron Journal Box for Arch Bar Truck—Equipped with Malleable Iron Torsion Spring Lid

Symington journal boxes are manufactured of malleable iron to the specifications of the American Society for Testing Materials and are carefully inspected and gaged before shipment. They can be furnished in designs to suit all types of trucks and conform to all the essential dimensions of American Railway Association standard practice. The lid face of the journal box is accurately machined with reference to the hinge pin hole thus insuring close contact between the lid and lid face.

The hinge lug is standard and any A. R. A. lid can therefore be used but the boxes are regularly furnished with the Symington patented torsion-spring lid. This lid is made of malleable iron with projecting lips fitting closely around the top and sides of the lid opening and is hooded over and carefully fitted to the hinge lug.

The hinge bolt, made of the best grade of rivet steel, is securely riveted to the lid. Its squared portion, immediately under the head and fitting into a socket in the lid causes it to turn with the lid in opening and closing.

The Symington torsion spring is wound from 5/16 in. diameter spring rod and carefully tempered. Its capacity is ample to hold the lid firmly against the box and its design is such that it cannot take a permanent set or become weakened in service.

For passenger equipment Symington journal boxes are manufactured either of malleable iron or semi-steel. The malleable iron journal box is equipped with renewable steel liners in the pedestal ways and on the equalizer seat, affording protection against wear from pedestal jaws and equalizer bar. The ends of the pedestal way wear plates are heated and formed over the casting at the top and bottom while hot, the resulting shrinkage in cooling serving to lock them securely in place. The equalizer seat wear plates are fitted into cored recesses in the roof of the journal box. Journal boxes thus equipped give from three to four times the usual length of service of ordinary malleable boxes without liners, provided the wear plates are renewed before being worn beyond a reasonable limit.

Semi-steel boxes for passenger equipment are recommended where the service is not sufficiently severe to warrant the use of malleable boxes with steel liners. Symington semi-steel is considerably stronger and tougher than ordinary cast iron and is well adapted to resist abrasion from the pedestal jaws and the equalizer foot.

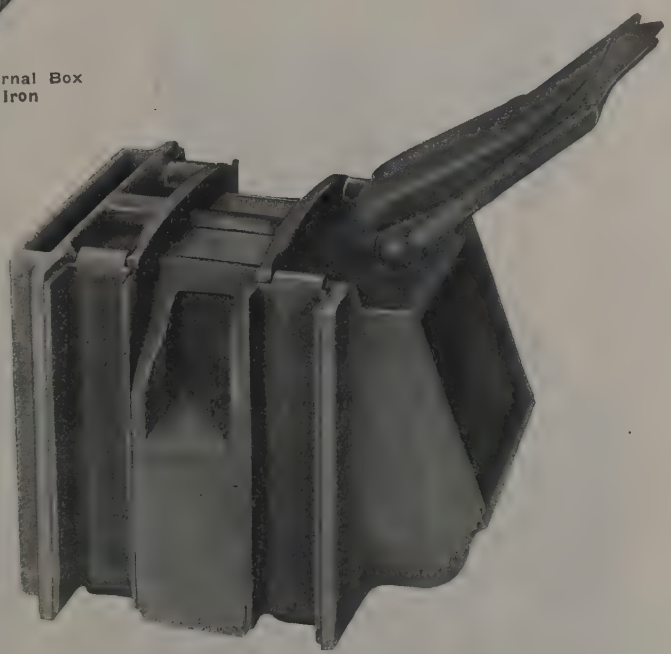


Fig. 1569—Symington A. R. A. Malleable Iron Passenger Car Journal Box, Equipped with Renewable Steel Liners in the Pedestal Ways and on the Equalizer Seat

Journal boxes for trucks of the Commonwealth type having single wide pedestals are provided with oil grooves in the pedestal ways.

For other products and branch offices, see classified and alphabetical indexes.

THE T. H. SYMINGTON COMPANY, ROCHESTER, N. Y.

Fig. 1570—McCord Steel Journal Box with Coil Spring Pinless Lid, for Arch Bar Trucks. McCord & Company.

Fig. 1571—Davis Pressed Steel A. R. A. Journal Box Lid. Davis Brake Beam Company.

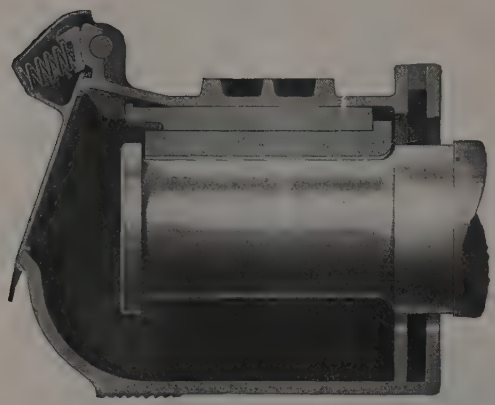


Fig. 1572—"Joliet" Journal Box and Lid. Republic Railway Equipment Company, Inc.

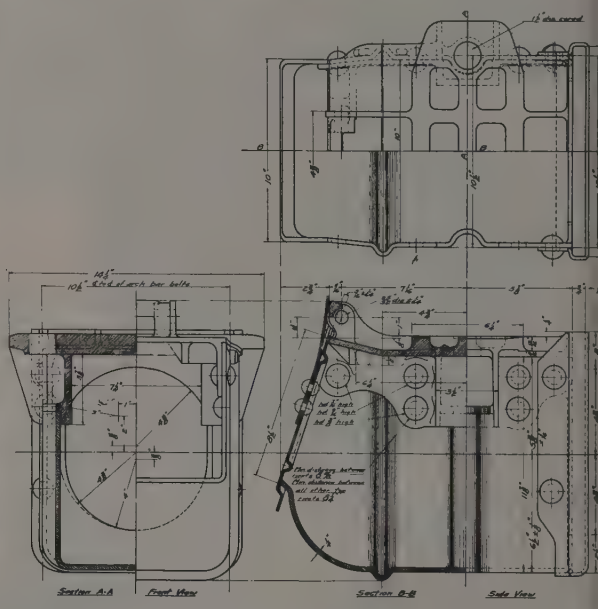


Fig. 1573—Kensington Pressed Steel Journal Box with Outside Spring Lid. Union Spring and Manufacturing Company.

(*See also Page* 675.)

Fig. 1574—Barber Roller Bearing Lateral Motion Journal Box. Standard Car Truck Company.

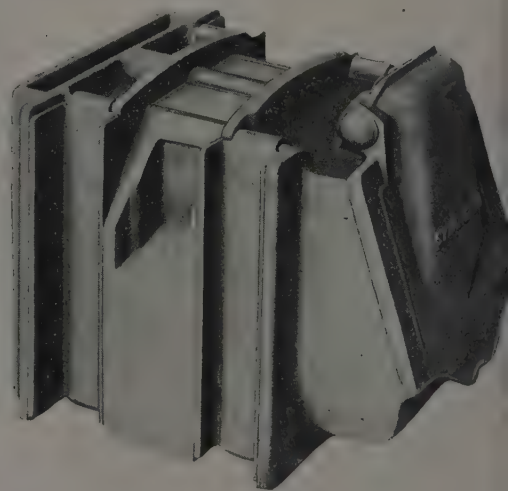


Fig. 1575—Symington Malleable Iron, Pedestal Typ Journal Box for Passenger Car Trucks, wi Renewable Steel Liners for Pedestal Ways a Equalizer Seat. The P. H. Symington Compan

(*See also Page* 673.)

Kensington Steel Journal Box

The Kensington Journal Box includes the advantages of all steel construction, with certain distinctive features in design which combine to produce a box well adapted to the requirements of railroad service.

It consists of three pieces—top, body, and dust-guard pocket. The top is made of cast steel, the body is ¼ in. and the dust guard pocket 3/16 in. thick, both composed of pressed steel plate, securely fastened to the top section by means of ¾-in. rivets driven by hydraulic pressure.

The box is designed strictly in accordance with A.R.A. standard dimensions. It will in consequence accommodate the standard lid, wedge, bearing and dust guard. As the back of the body is pressed solid, to the full depth required by A.R.A. specifications and as no rivets are located below the oil line, it is therefore, absolutely oil tight.

One of the distinctive features of the Kensington Journal Box is its extreme rigidity. It cannot get out of square, even if the tie bar pull becomes excessive. This rigidity is due to the inside flanges of the cast steel top and the continuous corrugations running around three sides of the pressed steel body.

In order to relieve the connecting rivets of any excessive strain, slots have been provided in the lower edge of the inside brackets, into which the pressed steel body is solidly driven. The sides are held, along the top, in a similar manner by means of lugs projecting from the top casting. These lugs are located on each side of the corrugation, which is therefore securely tied at its starting point, to the cast steel top and imparts its full stiffness to the box.

To avoid a possible shearing strain on the rivets, the top of the pressed steel body is fitted neatly against the flanges of the top casting. This casting contains all the bearing surfaces, and as it is easily gauged and ground before being assembled, the frequent trouble of wedge and bearing not going into place has been entirely overcome.

The top casting absorbs all vertical, lateral and longitudinal stresses which may come upon the axle and, being made entirely of steel, it offers great resistance to these stresses. A further advantage of the movable steel top casting, is the possibility of reclaiming this section after an accident, when the other parts of the box may be so distorted that they cannot be straightened. The top has a considerable salvage value and can be returned to service simply by cutting out ten rivets and refitting a new body.

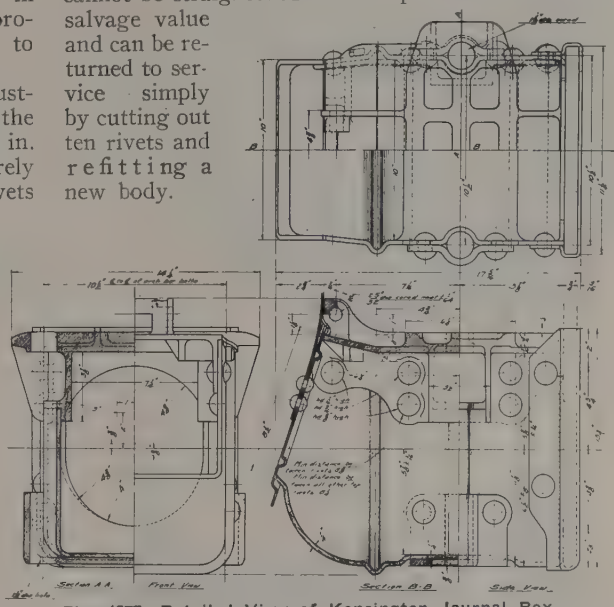


Fig. 1577—Detailed View of Kensington Journal Box

The economy obtained by the use of Kensington Journal Boxes is an important feature; they overcome the frequent box breakage caused by side blows from an axle striking the back of a box. Owing to its pressed steel structure, the Kensington Journal Box will only be dented by a blow that would break a box of less sturdy construction.

The weight of a 5½-in. by 10-in. Kensington Journal Box is 80 pounds, including the lid, which is 12 to 15 pounds lighter than a malleable box of the same size, and about 25 pounds lighter than a grey iron box.

Fig. 1576—Kensington Steel Journal Box Showing Lid Open and Closed

The Kensington Journal Boxes illustrated in Figs. 1573, 1576-7 are equipped with "Union" No. 3 pressed steel dust proof journal box lids, having outside and inside spring connection. These boxes are in service on many leading railroads; the rigidity and stiffness of their construction insures satisfactory service and long life.

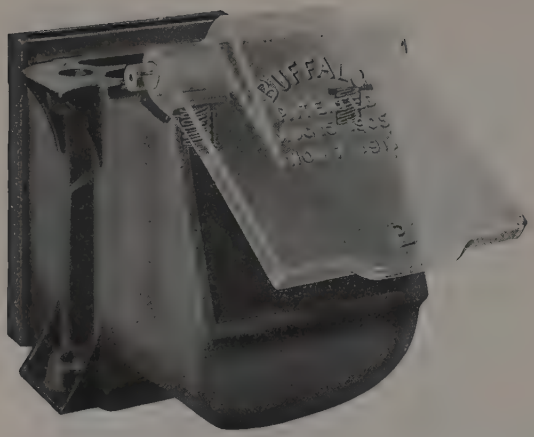


Fig. 1578—Buffalo Journal Box. The Pratt & Letchworth Company.

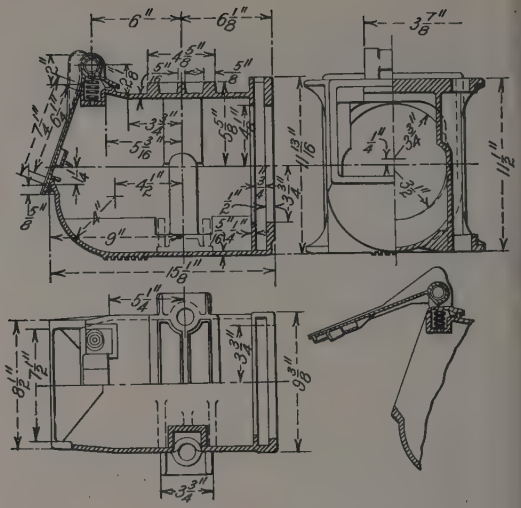


Fig. 1579—Buffalo Journal Box for 5 in. by 9 in. Journals. The Pratt & Letchworth Company.

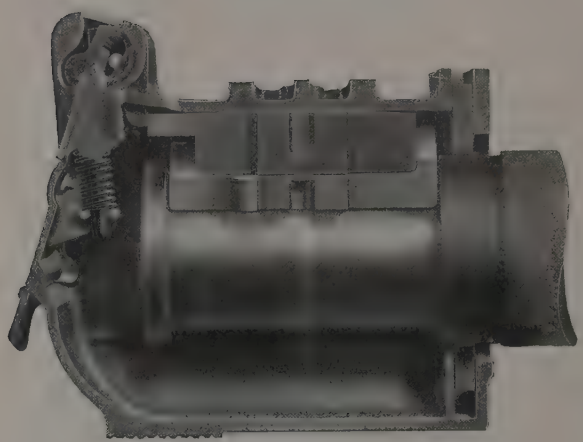


Fig. 1580—McCord Malleable Iron Journal Box with A. R. A. Dust Guard and Wedge; Lid in Closed Position, Showing Locking Lips. McCord & Company.

Fig. 1581—McCord Composite Journal Box. McCord & Company.

Fig. 1582—McCord Steel Journal Box with Coil Spring Malleable Iron Lid, for Freight Pedestal Trucks. McCord & Company.

Fig. 1583—McCord Malleable Iron Pedestal Truck Journal Box with Continuous Steel Inserts for Protection of Pedestal Channels. McCord & Company.

Axles

N 1899 IT WAS DECIDED that the standard axles should be known by letters. Readopted as standard in 1920, the same classification was extended to journal boxes and ntained parts, trucks and cars; two axle trucks to be esignated as 2A, 2B, 2C, etc.; three axle trucks to be esignated as 3A, 3B, 3C, etc.; four axle cars to be desigated as 4A, 4B, 4C, etc.; six axle cars to be designated 6A, 6B, 6C, etc.

Axle A, with journals, 3¾ by 7 inches, is designed to rry 15,000 pounds. Adopted, 1873; modified, 1920.

Axle B, with journals, 4¼ by 8 inches, is designed to rry 22,000 pounds. Adopted, 1889; modified, 1920.

Axle C, with journals, 5 by 9 inches, is designed to carry ,000 pounds. Adopted, 1898; modified, 1920.

Axle D, with journals, 5½ by 10 inches, is designed to rry 40,000 pounds. Adopted, 1899; modified, 1920.

Axle E, with journals, 6 by 11 inches, is designed to carry ,000 pounds. Adopted, 1913; modified, 1920.

Axle F, with journals, 6½ by 12 inches, is designed to rry 60,000 pounds. Adopted, 1920.

Specifications for Carbon Steel Axles

Standard—ADOPTED, 1914; REVISED, 1920.

1. *Scope.*—(a) These specifications cover axles up to and including those 6½ in. in diameter at the center.* Axles over 6½ in. in diameter at the center shall be purchased under the latest issue of the Specifications for Annealed Carbon Steel Axles, or Specifications for Quenched and Tempered Alloy Steel Axles.

(b) Axles up to and including those 6 in. in diameter at the center may be unannealed but all axles over 6 in. in diameter at the center shall be annealed.

I. MANUFACTURE.

2. *Process.*—(a) Steel shall be made by the open-hearth or electric process.

(b) All axles over 6 in. in diameter at the center shall be annealed by allowing the finished forgings to become cold after forging, then uniformly reheating to the proper temperature to refine the grain, and allowing to cool uniformly.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon, per cent	0.38-0.52
Manganese, per cent	0.40-0.70
Phosphorus, not over, per cent	0.05
Sulphur, not over, per cent	0.05

4. *Ladle Analyses.*—An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the test ingot. Analysis shall conform to requirements specified in Section 3; copy shall be given purchaser or his representative.

5. *Check Analyses.*—Analysis may be made by the pur-

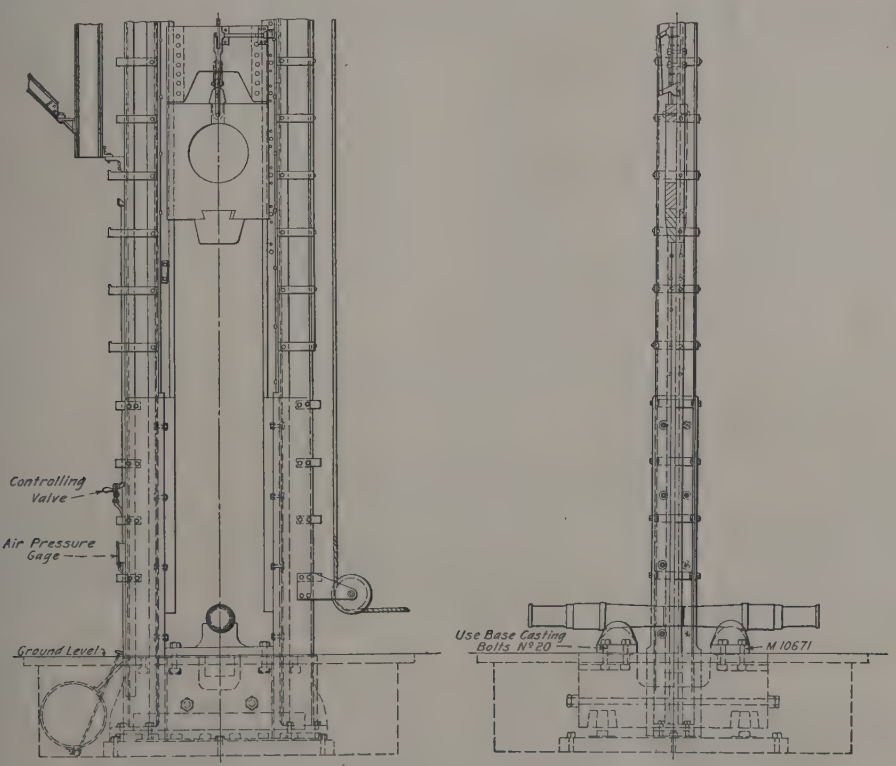


FIG. 1584—A.R.A. RECOMMENDED PRACTICE FOR AXLE TEST.

chaser from one axle representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 3. The drillings for these analyses shall be from one end of test axle at any point midway between the center and surface, using a 5/8 in. drill.

III. Physical Properties and Tests.

6. *Drop Tests.*—(a) The test axle shall be so placed on supports 3 ft. apart that the tup will strike it midway between the ends. It shall stand without fracture five blows from a tup of 2,240 lb. falling from a height H, such that H in feet equals the square of the diameter of the axle at the center in inches, $H = d^2$. The axle shall be turned through 180 deg. after the first and third blows.

(b) The permanent set produced by the first blow shall not exceed that given by formulas, in which L = length of axle in inches; d = diameter of axle at center in inches.

For axles over 65 in. in length:

$$\frac{L}{1.9d} - \frac{d}{2} + \frac{1}{2} \text{ in.} \quad \ldots\ldots\ldots\ldots (1)$$

For axles 65 in. or under in length:

$$\frac{L}{1.9d} - \frac{d}{2} + 1 \text{ in.} \quad \ldots\ldots\ldots\ldots (2)$$

(c) The American Railway Association has adopted five standard sizes of axles, the requirements for which, based on the above formula (1), are given in the following table:

Size of Axle, In.			Height of Drop, Ft.	Number of Blows	Maximum Permanent Set, In.
Journal	Diameter at Center	Length.			
3¾ by 7	4¼	83¼	18	5	8¾
4¼ by 8	4¾	84½	22½	5	7½
5 by 9	5⅜	86½	29	5	6¾
5½ by 10	5⅞	88½	34½	5	5½
6 by 11	6 7/16	90¾	41½	5	4¾

(d) The maximum permanent set is the difference between the distance from a straight edge to the middle point of the axle, measured before the first blow, and the distance measured in the same manner after the blow. The straight edge shall rest only on the collars or the ends of the axle.

(e) The temperature of the test axle shall be between 40° and 120° F.

7. *Drop-test Machine.*—The anvil of the drop-test machine shall be supported on 12 springs, as shown on the A. R. A. drawings, and shall be free to move in a vertical direction, and shall weigh 17,500 lb. The radii of the striking face of the tup and of the supports shall be 5 in.

CLASSIFICATION OF AXLE	SIZE OF JOURNAL	DIMENSION																
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	3¾" × 7"	8"	7"	2⅝"	7 1/16"	13/16"	23/32"	1½"	4 3/16"	3⅜"	4 3/16"	5⅛"	5 1/16"	4 3/16"	4 3/16"	3'-10"	5'-3"	6'-3"	6'-11 9/16"
B	4¼" × 8"	8"	8"	2"	7 1/16"	13/16"	23/32"	1½"	4 3/16"	4 3/16"	5 1/16"	5⅛"	6 5/16"	5 1/16"	4 3/16"	3'-10"	5'-3"	6'-3"	7'-0 3/16"
C	5" × 9"	8"	9"	2"	7 1/16"	13/16"	23/32"	1½"	6 5/16"	5"	6 5/16"	6 5/16"	6 3/16"	6 3/16"	5⅜"	3'-10"	5'-3"	6'-4"	7'-2 5/16"
D	5½" × 10"	8"	10"	2"	7 1/16"	13/16"	23/32"	3"	6 5/16"	5½"	6 5/16"	7"	7 5/16"	6 5/16"	5⅜"	3'-10"	5'-3"	6'-5"	7'-4 5/16"
E	6" × 11"	8"	11"	2 1/16"	8 1/16"	1 3/16"	8"	3"	7 1/16"	6"	7 1/16"	7 5/16"	8"	7 1/16"	6 1/16"	3'-6 5/16"	5'-2 5/16"	6'-6"	7'-6 3/16"
F	6½" × 12"	8"	12"	2 1/16"	8 1/16"	1 3/16"	8"	3"	7 1/16"	6½"	7 1/16"	8 1/16"	8 5/16"	7 1/16"	6 1/16"	3'-6 5/16"	5'-2 5/16"	6'-7"	7'-8 1/16"

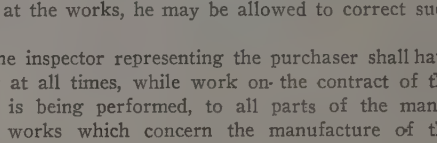


Fig. 1585—A.R.A. STANDARD DIMENSIONS FOR CAR TRUCK AXLES.

8. *Number of Tests.*—One drop test shall be made from each melt. The weight of axles offered from any one melt shall not be less than the equivalent of the weight of thirty 6 x 11 in. axles.

IV. Workmanship and Finish.

9. *Workmanship.*—(a) All axles shall be made and finished in a workmanlike manner and all journals and wheel seats shall be rough turned. In centering, unless otherwise specified, 60-deg. centers shall be used, with large diameter of counter-sink not less than 7/8 in. and with clearance drilled ½ in. deep.

(b) Freight equipment axles, unless otherwise specified, shall have the wheel seats and journals rough turne Engine truck and passenger car axles to be rough turn all over, except collars. The rough turning to be do with a tool of such shape that the surface is free fro ridges and chatter marks.

10. *Finish.*—The axles shall be free from injurious d fects and shall have a workmanlike finish.

V. Permissible Variations and Weights.

11. *Permissible Variation.*—The axles shall confor in size and shape to the standard A. R. A. drawing Length shall not be less than shown and not more than in. over. Diameters shall not be less than those shown more than 1/8 in. over on smooth forged axles, or 1/16 i over on rough turned portions.

VI. Marking and Storing.

12. *Marking.*—The manufacturer's name or brand, m number, the month and year when made, shall be legib stamped on each axle on the unfinished portion, unle otherwise specified.

13. *Storing.*—If, as a result of the inspection and tes more axles are accepted than the order calls for, such a cepted axles in excess shall be stamped by the inspect with his own name, and will then be piled and allowed remain in stock at the works, subject to further orde from the purchasing agent. On receipt of further orde axles once accepted will not be subject to further test. all cases the inspector will keep an accurate record of t melt numbers and the number of axles in each melt whi are stored and will transmit this information with ea report.

VII. Inspection and Rejection.

14. *Inspection.*—(a) The inspector shall examine ea axle in each melt for workmanship, defects, and to s whether the axles conform to the dimensions given on t order or tracing, or whether they conform to the specific tions. All axles not satisfactory in these respects shall n be considered further. If in this inspection defects a found which the manufacturer can remedy while the i spector is at the works, he may be allowed to correct su defects.

(b) The inspector representing the purchaser shall ha free entry at all times, while work on the contract of t purchaser is being performed, to all parts of the man facturer's works which concern the manufacture of t material ordered. The manufacturer shall afford the i spector, free of charge, all reasonable facilities to satis him that the material is being furnished in accordance wi these specifications.

(c) The purchaser may make the tests to govern t acceptance or rejection of material in his own laborato or elsewhere. Such tests, however, shall be made at t expense of the purchaser.

15. *Rejection.*—Material which, subsequent to abo tests at the mills or elsewhere, and its acceptance, develo imperfections shall be rejected and shall be replaced the manufacturer at his own expense.

16. *Rehearing.*—Samples tested in accordance with Se tion 5, which represent rejected material, shall be pr served fourteen days from date of test report.

Hammered Steel Axles

It is extremely important that car axles be made of a close grain homogeneous steel which will stand the severe shocks, repeated stresses and continuous ɔurnal wear that arise in regular everyday train ɛrvice. It is not alone necessary that the maɛrial of which car axles are made shall be of

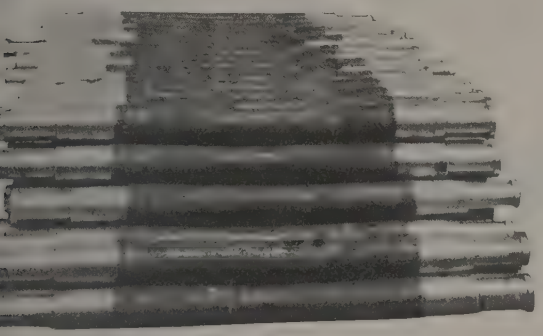


Fig. 1586—A Group of Finished Johnson Car Axles

igh quality—the process of manufacture and ıe manner in which the material is handled durıg the manufacturing process is of prime imporance.

The J. R. Johnson & Company, Inc., has for ɛars paid very particular attention to both these actors in car axle manufacture. Since its ineption in 1866—about 60 years ago—it has conɛntrated entirely on this work and has so perɛcted its processes of manufacture that its axles ıave long enjoyed a high reputation for long ervice and reliability.

One of the chief and very important characterstics of every Johnson Axle is the fact that it is ıammer forged throughout from the full sized ɔillet. The shoulders, middles and journals are ıll formed in special dies entirely under the hamıer which gives a definite concentration of metal ıt the points where it is most needed. Fig. 1587 illustrates clearly the shape and finish of a rough forged Johnson axle, showing how the journals are hammer swaged thus giving dense metal to resist wear, instead of being merely "hogged out" in the lathes.

Johnson axles are made from carefully selected steel billets purchased only from makers of proven forging quality under competitive conditions, which insures steel of highest quality. These billets are purchased under rigid specifications to meet in every respect the requirements of the A. R. A. and the A. S. T. M. axle specifications and in this way only the pick of the output of the best steel makers is used in Johnson axles.

The manufacturing method followed in the making of the Johnson axle is the real reason for the service rendered by them. Making only car and locomotive axles and closely similar forgings, such as crank pins and piston rods, their reputation and success depend entirely on the sustained high quality of their axles. That this has been rigidly maintained is shown by their long continued and ever increasing success as "Axle Specialists since 1866."

The interesting comparison of old and new Johnson car axles shown in Fig. 1588 indicates the progress made in car and axle design. The bent axle which is of wrought iron was made in 1868 by this company for the Chesapeake & Ohio. It was the largest size car axle then attempted and in order to prove the thoroughness of the hammer work and internal welding, and as a test of the safety of such a size axle, it was bent double, as shown, to test its quality. Beside the Johnson axles of today this old iron axle of over half a century ago stands as a far away mile post of progress in size and strength, but as a symbol of old fashioned quality, reliability and integrity now as then.

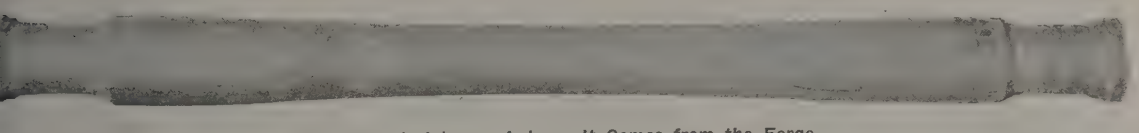


Fig. 1587—A Johnson Axle as It Comes from the Forge

Fig. 1588—A Johnson Axle of Half a Century Ago and Now

The J. R. Johnson & Company, Inc., handle in addition to car and locomotive axles such work as forged bars, short shafting, crank pins, piston rods, round forgings, smooth forged or rough turned, solid or hollow bored.

For other products and branch offices, see classified and alphabetical indexes.

J. R. JOHNSON & COMPANY, INC., RICHMOND, VA.

"Standard" Passenger and Freight Car Axles

To secure safety in service and long life it is essential that car axles be made from steel of the proper composition, forged under proper conditions and carefully annealed or heat treated. The present heavy and high capacity equipment both in freight and passenger service require this. The Standard Steel Works Company, with its long established and scientifically developed plant, is particularly well equipped for car axle manufacture and has for many years made a careful study of it.

The axles are carefully annealed or heat treated as required in a special heat treating department which is fully equipped with furnaces capable of accurate temperature control—which is very necessary for satisfactory results—the temperature measurements being carried out by an elaborate installation of pyrometers. The object of annealing or heat treatment is to remove all internal strains which is a direct result of the forging and to refine the grain structure. For annealing, the axle is allowed to cool relatively slowly, either in the air or in the furnace while the heat treatment involves quenching and tempering in oil or water as required. The latter

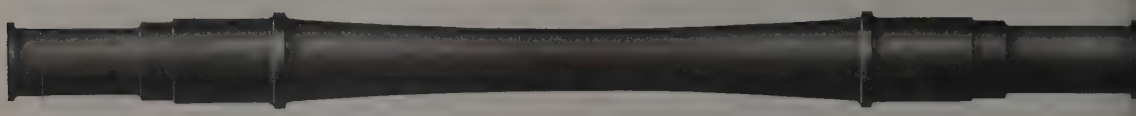


Fig. 1589—"Standard" Axle for Passenger and Freight Cars

For "Standard" axles open-hearth steel made to exact specifications is used. The axles are forged from ingots produced by the Standard Steel Works Company. This is of special importance as it gives the company complete control of the processes of manufacture from the raw stock to the finished axle. The axles are forged under steam hydraulic presses or under steam hammers of adequate capacity. Of the former, there are several ranging from 600 to 2,500 tons capacity and the capacity of the steam hammers range upward to 8,000 lb.

particularly must be carefully done to insure satisfactory results. The heat treating plant of the Standard Steel Works Company is equipped with oil and water tanks for quenching the axles either in the horizontal or vertical position.

All axles are thoroughly inspected and frequent tests made throughout the process of manufacture. They are subjected to a final acceptance test upon completion. All heat treated axles are subjected to a proof drop test before they leave the plant.

Fig. 1590—Finished Car Axles Ready for Shipment

For other products and branch offices, see classified and alphabetical indexes.

STANDARD STEEL WORKS COMPANY, PHILADELPHIA, PA.

Wheels

THE MANUFACTURE AND USE OF CAR WHEELS has been given the consideration of a committee of the American Railway Association for many years and tandards and Recommended Practice adopted. The specications include both cast and forged wheels. Many papers nd reports have been submitted, some of the more imporint being as follows:

The report of the M. C. B. committee in the 1901 Proeedings, page 182, relates to an investigation on the quesion of locating the inner face of cast iron wheels to the age point and the thickness of metal between the bore nd ring core; also recommending minimum weights for heels for use under passenger cars of 60,000, 80,000 and 00,000 lb. capacities.

The report of the committee in the 1902 Proceedings, page 265, is largely a progress report and recommends that the roads keep careful records of the breakage of cast iron wheels.

A progress report on the design, weight and material of cast iron wheels for cars of 60,000, 80,000 and 100,000 lb. capacity, will be found in the 1903 M. C. B. Proceedings, page 163.

A topical discussion on the performance of the 1904 cast iron wheel will be found in the 1905 M. C. B. Proceedings, page 295.

The standard dimensions and specifications governing the manufacture and use of car wheels as adopted by the American Railway Association are as follows:

Cast Iron Wheels

Recommended Practice—ADOPTED, 1893; REVISED, 1920.

I. Material and Chill.

1. *Material.*—The wheels shall show clean, gray iron n the plates, except at chaplets, where mottling to not nore than ½ in. from same will be permitted.

2. *Chill.*— (a) The depth of pure white iron shall not xceed 1 in. nor be less than ⅓ in. in the middle of the read.

(b) It shall not exceed 1 in. in the middle of the tread nor be less than ⅜ in. in throat for wheels having a maxmum weight of 650 lb.

(c) It shall not exceed 1 in. in the middle of the tread nor be less than 7-16 in. in the throat for wheels having a naximum weight of 700 lb.

(d) It shall not exceed 1 in. in the tread nor be less han ½ in. in the throat for wheels having a maximum weight of 750 lb. and 850 lb.

(e) The depth of white iron shall not vary more that ¼ in. around the tread on the rail line in the same wheel.

II. Physical Properties and Tests.

3. *Sampling.*—When ready for inspection, the wheels shall be arranged in groups, all wheels of the same date being grouped together, and for each 100 wheels which pass inspection and are ready for shipment, two representative wheels shall be taken at random, one of which will be subjected to the drop test.

4. *Drop Test.*—The wheels shall conform to the following drop-test requirements:

(a) The test wheel shall be so placed on the three supports, with flange turned downward, that the tup will strike centrally on the hub. When tested in accordance with the following conditions, the wheel shall stand the following specific number of blows:

TABLE I

Weight of Wheel, Pounds	Weight of Trip, Pounds	Height of Drop, Feet	Number of Blows
650	200	9	10
700	200	10	12
750	200	12	12
850	200	15	12

5. *Thermal Test.*—Should the test wheel stand the given number of blows without breaking into two or more pieces, the inspector will then subject the other wheel to the following test:

(a) Preparation.—The wheel shall be laid with the flange downward in the sand and a channel way 1½ in. wide and 4 in. deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of the channel way and the clean flange must form as much of the bottom as its width will cover.

(b) Test.—The above described channel must be filled with molten cast iron, which shall be hot enough, when poured, so that the ring which is formed, when the metal is cold, shall be solid or free from wrinkles or layers. The time when pouring ceases must be noted, and two minutes later an examination of the wheel must be made. If the wheel is found broken in pieces or if any cracks in the plate extend through or into the rim, all wheels of the same tape size as the wheel broken will be rejected.

6. *Drop-test Machine.*—The three supports shall not be more than 5 in. wide. The anvil shall be supported on rubble masonry at least two feet deep and shall weigh not less than 1,700 lbs. The striking face of the tup shall be 8 in. in. in diameter and be flat.

III. Retest.

7. *Number of Tests.*—In making the drop test, should the test wheel break into two or more pieces with less than the required number of blows, then the second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test it shall be optional with the inspector whether he shall test the third wheel or not. If he does not do so, or if he does and the third wheel stands the test, the 100 wheels will be accepted as filling the requirements of the drop test.

IV. Dimensions, Taping and Gaging.

8. *Dimensions.*—The normal diameter of the wheel produced by the chill must be the A. R. A. standard 33 in., measured at a point 2⅝ in. from the outside of the tread of the wheel. Wheels furnished under this specification shall not vary more than 5-16 in. above or below the nor-

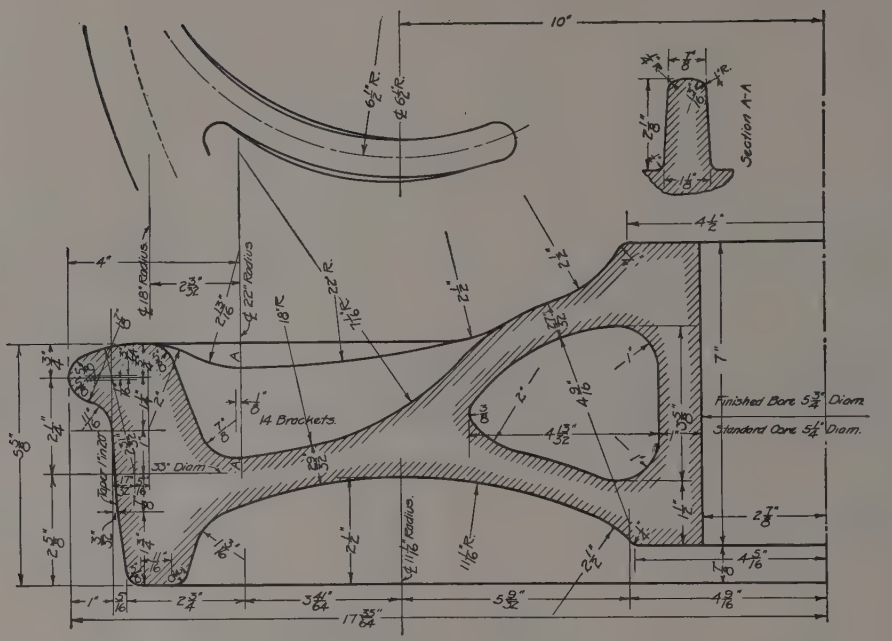


FIG. 1591— A. R. A. RECOMMENDED PRACTICE FOR 33 IN. CAST IRON WHEELS FOR CARS OF MAXIMUM GROSS WEIGHT NOT TO EXCEED 95,000 LBS.

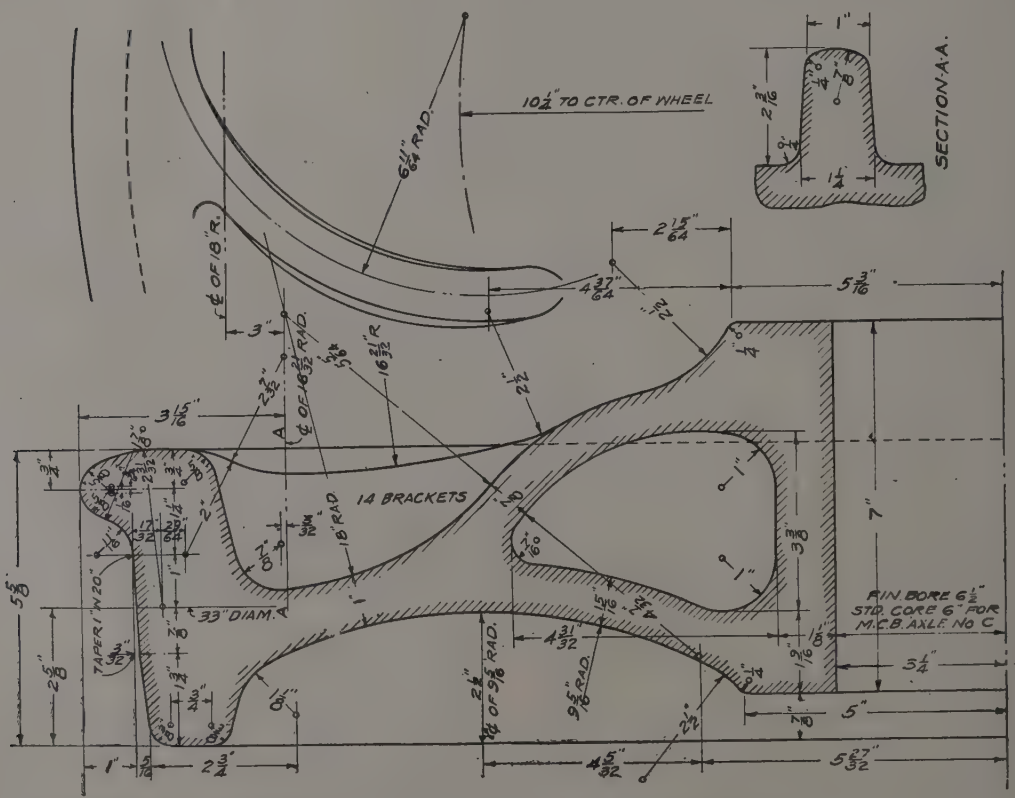


FIG. 1592—A. R. A. RECOMMENDED PRACTICE FOR 33 IN. CAST IRON WHEELS FOR CARS OF MAXIMUM GROSS WEIGHT NOT TO EXCEED 132,000 LBS.

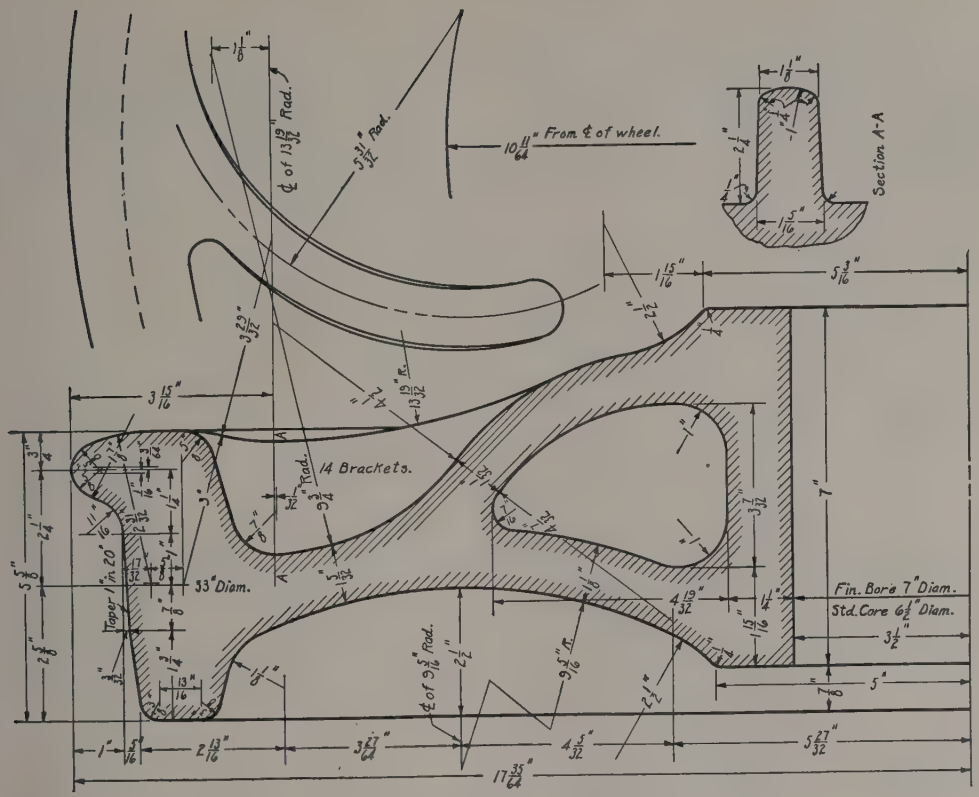


FIG. 1593—A. R. A. RECOMMENDED PRACTICE FOR 33 IN. CAST IRON WHEELS FOR CARS OF MAXIMUM GROSS WEIGHT NOT TO EXCEED 161,000 LBS.

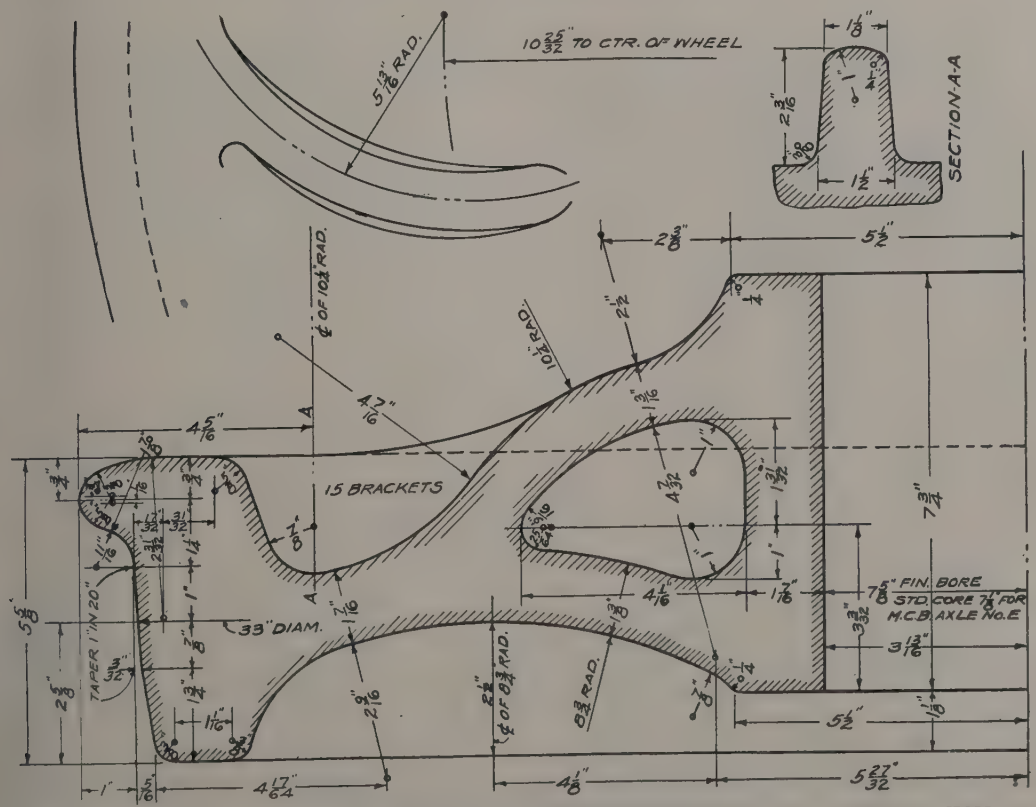


FIG. 1594—A. R. A. RECOMMENDED PRACTICE FOR 33 IN. CAST IRON WHEELS FOR CARS OF MAXIMUM GROSS WEIGHT NOT TO EXCEED 210,000 LBS.

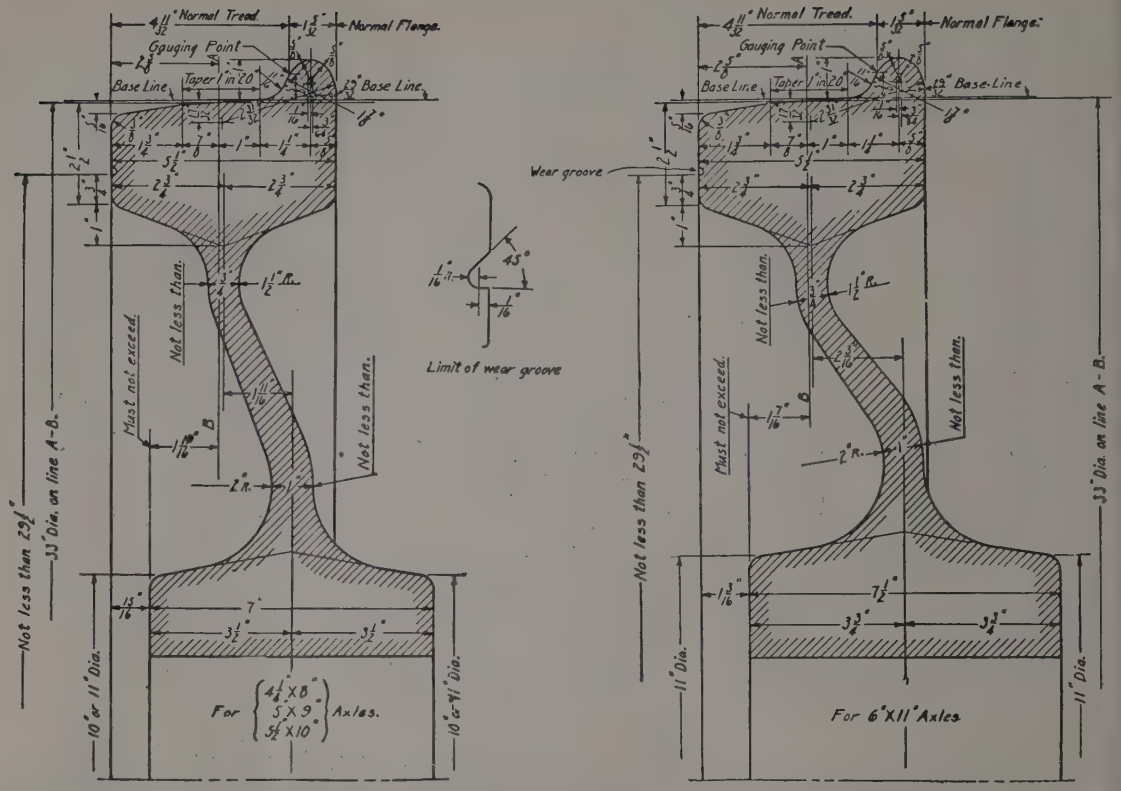


FIG. 1595—STANDARD FOR WROUGHT STEEL WHEELS 33 IN. DIAM. FOR 4¼ X 8 IN., 5 X 9 IN., 5½ X 10 IN. AND 6 X 11 IN. AXLES.

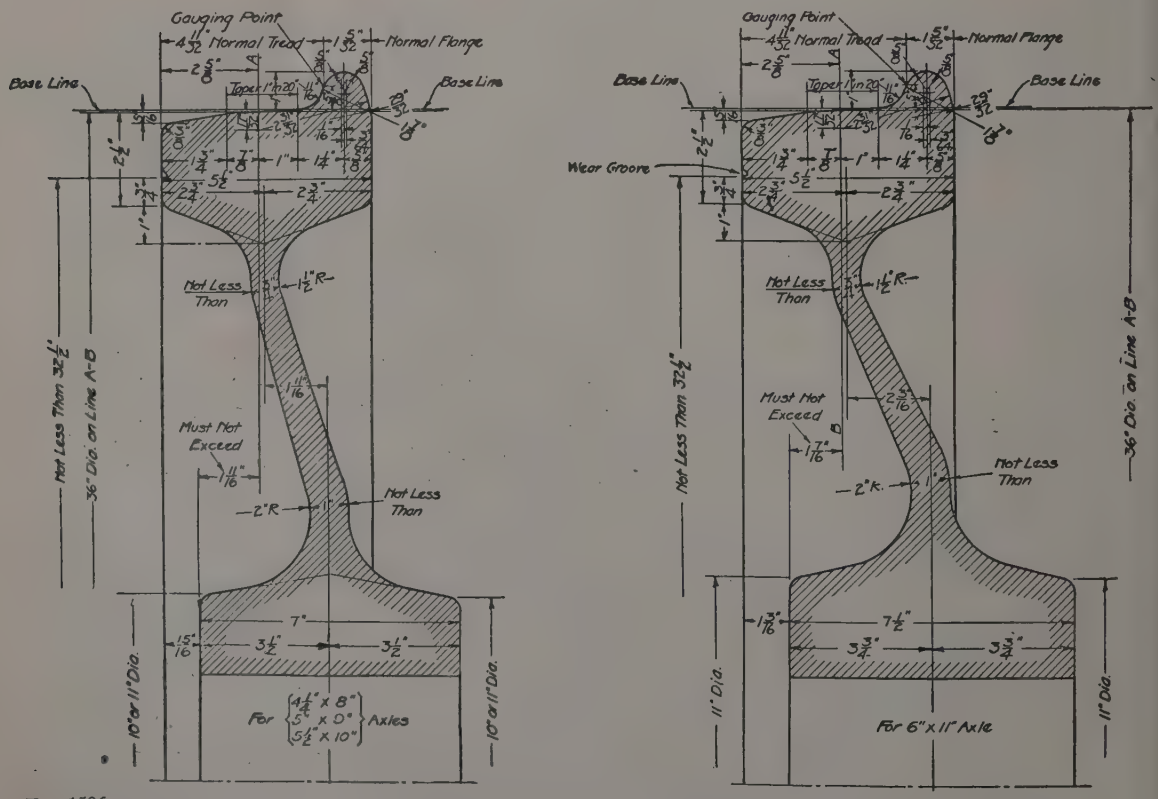
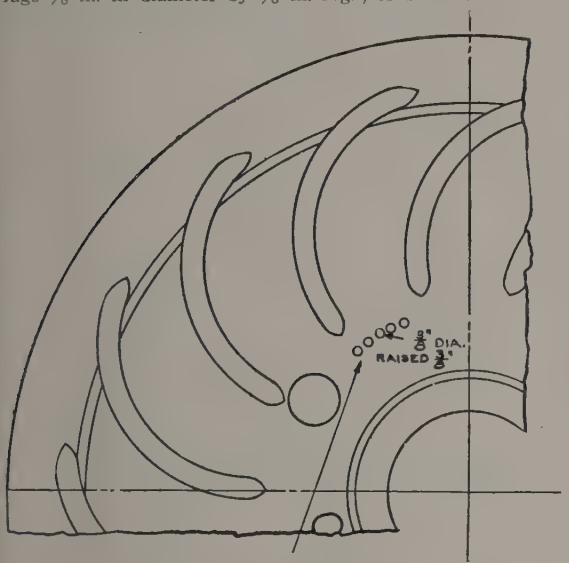


FIG. 1596—STANDARD FOR WROUGHT STEEL WHEELS 36 IN. DIAM. FOR 4¼ X 8 IN., 5 X 9 IN., 5½ X 10 IN. AND 6 X 11 IN. AXLES.

mal size measured on the circumference and the same wheel shall not vary more than 1-16 in. in diameter.

The thickness of the flange shall be regulated by the maximum and minimum flange thickness gages adopted by the American Railway Association — Mechanical Division.

9. *Taping.*—All wheels shall be taped with A. R. A. standard design of wheel circumference tape; five small lugs ⅜ in. in diameter by ⅜ in. high, to be cast on inner



These instructions are for new wheels coming from the foundry and under no circumstances are any of these lugs to be cut off after the wheel is received from the foundry. Wheels shall be made with five small lugs cast on the hub. When taping the wheel a sufficient number of these lugs are to be cut off allowing the proper number to remain to represent the tape size.

FIG. 1597—LUG CAST ON HUB FOR RECORDING TAPE SIZE.

plate near hub as shown in Fig. 1597, the middle lug to represent the normal diameter of 103.67 in circumference; the first lug, the smallest diameter, the last lug, the largest.

V. WEIGHTS.

10. (a) All wheels furnished under these specifications shall conform to the respective sections shown by the A. R. A. drawings for different weights of wheels, and weights shall be as follows:

Maximum Gross Weight of Car Pounds	Maximum Weight of Wheel Not Exceeding Pounds	Minimum Weight of Wheel Not Less Than Pounds
95,000	650	640
132,000	700	690
161,000	750	740
210,000	850	835

NOTE.—Weights given in the above table are based on A. R. A. Standard drawings, covering wheel design, adopted in 1917 and 1920.

(b) *Cores.*—In case of wheels ordered with cores smaller in diameter than the standard, the additional weight should be considered as an addition to the normal weight and paid for by the purchaser.

11. *Under Weight.*—Wheels that are under minimum weight will be set aside and not further considered.

12. *Over Weight.*—Wheels that are over the maximum weights will be at the expense of the manufacturer.

VI. WORKMANSHIP AND FINISH.

13. *Workmanship.*—Chills shall have an inside profile that, in the finished wheel, will produce the exact form of the flange and tread contour shown by the A. R. A. drawings adopted in 1917 and 1920.

14. *Finish.*—The body of the wheel must be smooth and free from slag, shrinkage or blow-holes. The tread shall be free from deep and irregular wrinkles, slag, chill cracks and sweat or beads in the throat, and swelled rims.

VII. MARKING.

15. *Marking.*—All wheels shall be numbered consecutively in accordance with the instructions from the railroad company purchasing them, and shall have the initials of such railroad company, also the wheel number, the weight of the wheel and month, day and year when made, plainly formed on the inside plate of casting. No two wheels shall have the same number. All wheels shall also have the name and place of manufacture plainly formed on the outside plate in casting. Wheels conforming to the requirements and furnished under this specification shall have plainly formed on the outside plate, A. R. A., 1920, for wheels of nominal weight of 650 and 750 lb., and A. R. A., 1917, for wheels having a nominal weight of 700 and 850 lb.

VIII. REJECTION LIMITS.

16. *Rejection.*—(a) If in any lot of wheels submitted for test the test wheel fails to meet the requirements of the drop, chill or thermal test, then all the wheels in tape number and weight corresponding to the test wheel will be rejected.

(b) High Chill.—In case the rejection is for high chill, weak breaking strength or failure in the thermal test, the test will be continued in the next higher number of tape size.

(c) Low Chill.—If the rejection is for low chill, the test will be continued in the next lower number tape size.

(d) In all cases where wheels are rejected, the letter "C" must be chipped out of the legend "M. C. B." or the letter "R." out of the legend "A. R. A." on the outside face of each wheel. This to be done only when the wheels fail to pass the thermal or drop test, or have some physical defect which impairs their service ability.

Solid Wrought Carbon Steel Wheels

Standard—ADOPTED, 1917; REVISED, 1920.

1. *Scope.*—These specifications cover all solid wrought carbon steel wheels for locomotives and cars.

I. MANUFACTURE.

2. *Process.*—The steel shall be made by the open-hearth or electric process.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

	PER CENT.	
	Acid.	Basic.
Carbon	0.60—0.80	0.65—0.85
Manganese	0.55—0.80	0.55—0.80
Silicon	0.15—0.35	0.10—0.30
Phosphorus, not over	0.05	0.05
Sulphur, not over	0.05	0.05

4. *Ladle Analyses.*—To determine whether the material conforms to the requirements specified in Section 3, an

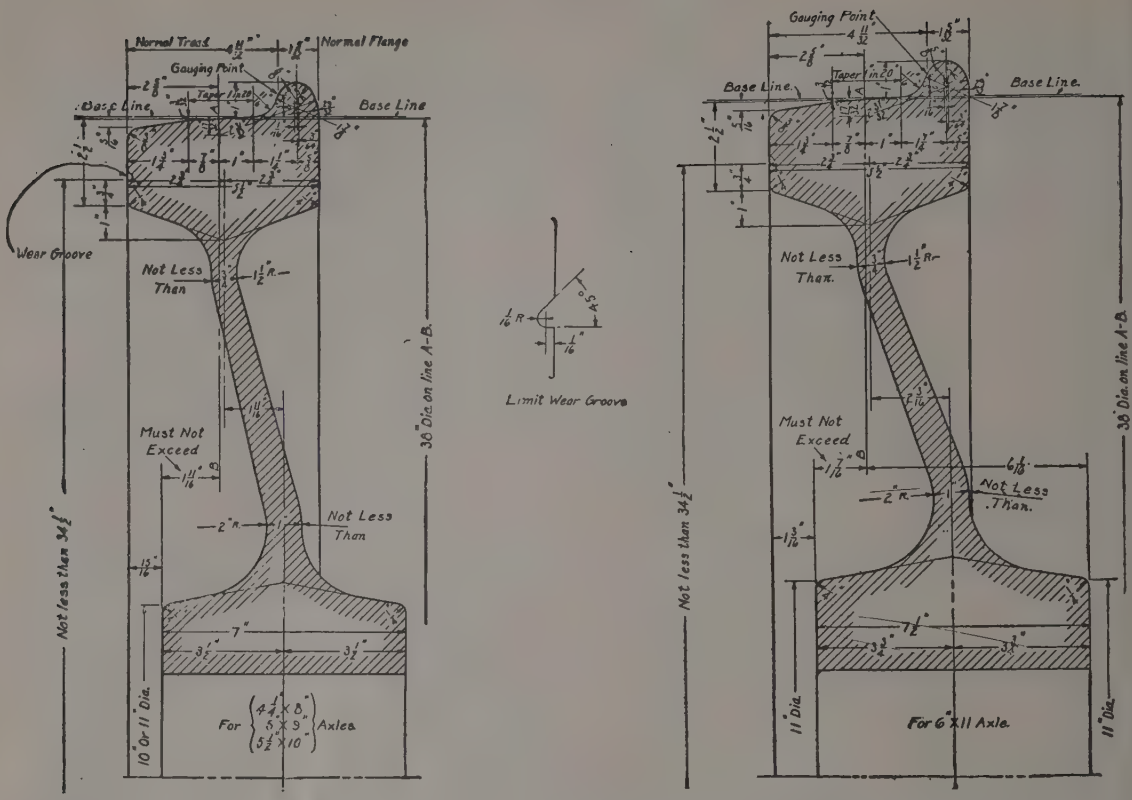
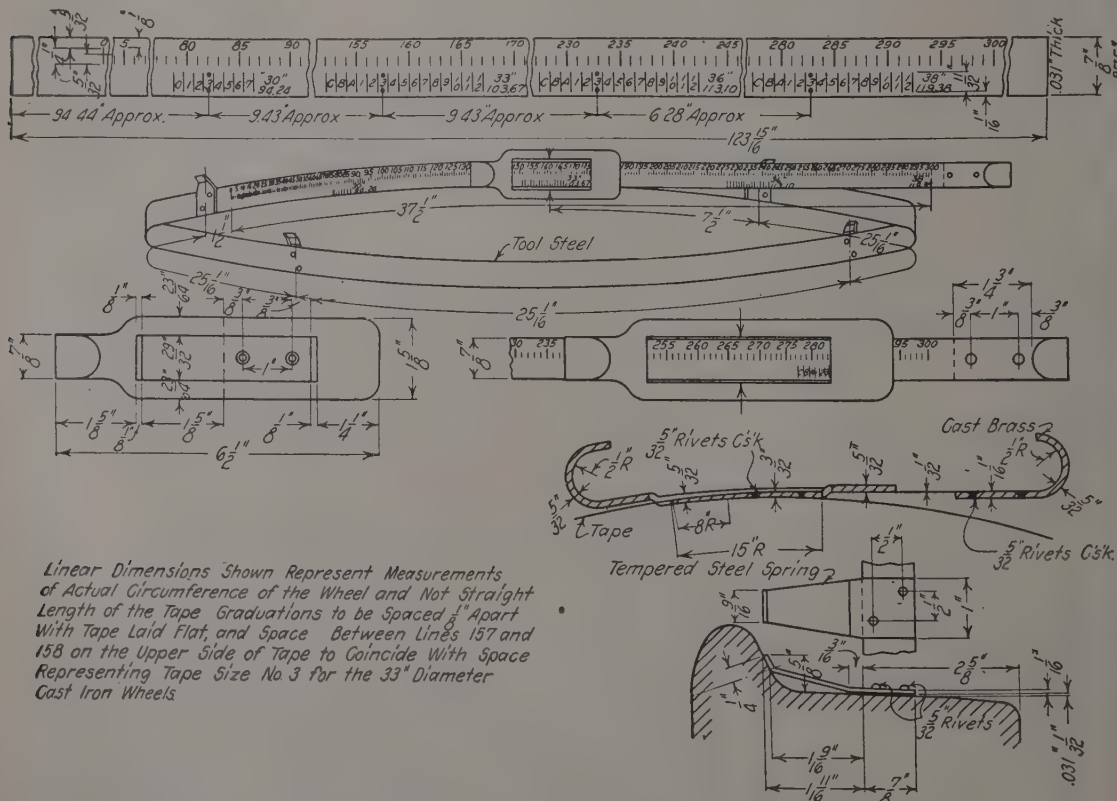


FIG. 1598—STANDARD FOR WROUGHT STEEL WHEELS 38 IN. DIAM. FOR 4¼ x 8 IN., 5 x 9 IN., 5½ x 10 IN. AND 6 x 11 IN. AXLES.



Linear Dimensions Shown Represent Measurements of Actual Circumference of the Wheel and Not Straight Length of the Tape Graduations to be Spaced 1/8" Apart With Tape Laid Flat, and Space Between Lines 157 and 158 on the Upper Side of Tape to Coincide With Space Representing Tape Size No. 3 for the 33" Diameter Cast Iron Wheels.

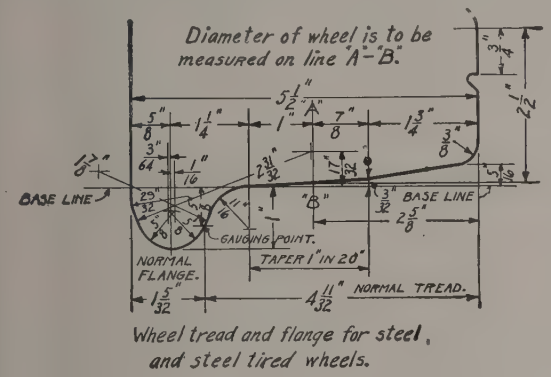
FIG. 1599—STANDARD WHEEL CIRCUMFERENCE MEASURE FOR CAST IRON, STEEL AND STEEL TIRED WHEELS.

analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. A copy of this analysis shall be given to the purchaser or his representative.

5. *Check Analyses.*—A check analysis may be made by the purchaser from any one or more wheels representing each melt, and this analysis shall conform to the requirements specified in Section 3. A sample may be taken from any one point in the plate; or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drilling for analysis shall be taken by boring entirely through the plate parallel to the axis of the wheel; they shall be clean from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

III. Tolerances.

6. *Tolerances.*—(a) Wheels should be furnished rough-bored and with faced hubs, and have a contour of tread and



Wheel tread and flange for steel, and steel tired wheels.

Limit of wear groove.

Fig. 1600—Wheel tread and flanges for steel and steel tired wheels.

flange as rolled or machined according to Fig. 1600. They should conform to dimensions specified within the following tolerances:

(b) Height of flange.—The height of flanges should not be more than 1/16 in. over and must not be under that specified.

(c) Thickness of flange.—Thickness of flange shall not vary more than 1/16 in. over or under that specified.

(d) Throat radius.—The radius of the throat shall not vary more than 1/16 in. over or under that specified.

(e) Thickness of rim.—The thickness of rim to be measured between the limit of wear groove and the top of the tread at the point where it joins the fillet at throat of flange. The average thickness of service metal of all wheels in any shipment must not be less than 1¾ in., measured from the limit of wear groove to top of tread. The thickness of rim should in no case be more than 3/16 in. under that specified.

(f) Width of rim.—The width of rim shall not be more than ⅛ in. less nor more than ⅛ in. over that specified.

(g) Thickness of plate.—The thickness of the plate of the wheel shall not be less than ¾ in. at the point where the plate joins the fillet at the rim and not less than 1 in. at the point where the plate joins the fillet at the hub. Intermediate mimimum thickness to be proportional.

(h) Limit of wear groove.—The limit of wear groove to be located as shown in Fig. 1600.

(i) Diameter of bore.—The diameter of rough bore shall not vary more than 1/16 in. above or below that specified. When not specified, the rough bore shall be ¼ in. less in diameter than the finished bore, subject to the above limitations.

(j) Hub diameter.—The hub may be either 10 in. or 11 in. in diameter, as specified, for car and tender wheels and outside hub of engine-truck wheels and 13½ in. and 15 in. in diameter for inside hubs on engine-truck wheels. Maximum variation of ⅛ in. below. The thickness of the wall of the finished bored hub shall not vary more than ⅜ in. at any two points on the same wheel.

(k) Hub length.—The length of hub shall not vary more than ⅛ in. over or under that specified.

(l) Depression of hub.—The depression of the hub must be made so that the distance from the outside face of the hub to the line "AB" shall not exceed 1 11/16 in. for wheels used on 5½ in. axles and under, and 1 7/16 in. for wheels used on 6 by 11 in. axles. For engine-truck wheels the distance from the inside face of the hub to the line "AB" shall not be less than 3 9/16 in.

(m) Black spots in hub.—Black spots will be allowed within 2 in. of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.

(n) Eccentricity of bore.—The eccentricity between the tread at its center line and the rough bore shall not exceed 3/64 in.

(o) Block marks on tread.—The maximum height of block marks must not be greater than 1/64 in.

(p) Rotundity.—All wheels shall be gaged with a ring gage, and the opening between the gage and tread at any one point shall not exceed 1/16 in.

(q) Plane.—Wheels shall be gaged with a ring gage placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of 1/16 in. from the plane of the same gage when so placed.

(r) Tape sizes.—Wheels shall not vary more than five tapes under nor nine tapes over the size called for.

(s) Mating.—The tape sizes shall be marked in plain figures on each wheel. Wheels must be mated to tape sizes and shipped in pairs.

(t) Gage.—Gages and tapes used shall be the A. R. A. Standard or Recommended Practice, as follows:

Wheel circumference measure	Fig. 1599
Maximum flange thickness gage	Fig. 1601
Minimum flange thickness gage	Fig. 1601
Rotundity gage	Fig. 1602
Gage for meauring service metal	Fig. 1605
Plane gage	Fig. 1603

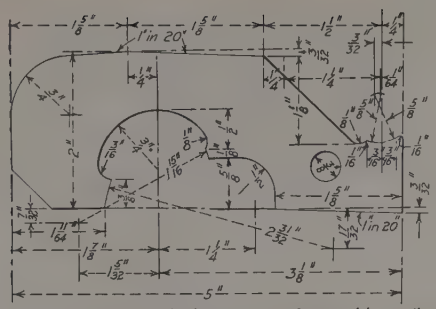
IV. Branding.

7. *Branding.*—The name or brand of the manufacturer, date and manufacturer's serial number shall be legibly stamped on each wheel, also purchaser's initials and serial number, is specified, in accordance with Fig. 1606. The tape size shall be legibly marked on each wheel.

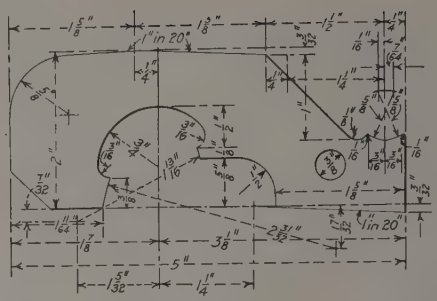
V. Finish.

8. *Finish.*—(a) The wheel shall be free from injurious defects, and shall have a workmanlike finish.

(b) Wheels shall not be offered for inspection if covered with paint, rust, or any other substance, to such an extent as to hide defects.

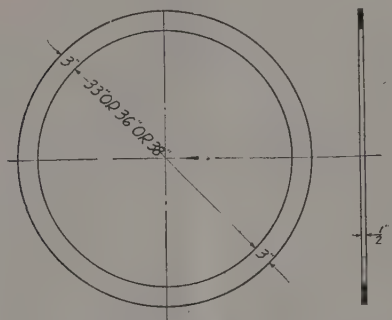


Maximum Flange Thickness Gage for Cast Iron Wheels and Maximum Flange Thickness, Height and Throat Radius Gage for Solid Steel and Steel Tired Wheels.



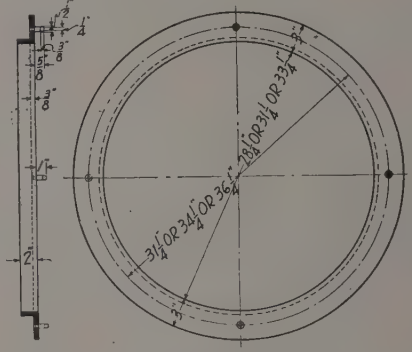
Minimum Flange Thickness Gage for Cast Iron Wheels and Minimum Flange Thickness, Height and Throat Radius Gage for Solid Steel and Steel Tired Wheels.

FIG. 1601—STANDARD FLANGE THICKNESS GAGES FOR CAST IRON WHEELS AND FLANGE THICKNESS, HEIGHT AND THROAT RADIUS GAGE FOR SOLID STEEL WHEELS AND STEEL TIRED WHEELS.



ROTUNDITY GAUGE.
FOR 33" OR 36" OR 38 SOLID STEEL WHEELS.

FIG. 1602—STANDARD ROTUNDITY GAGE FOR 33, 36 OR 38 IN. STEEL WHEELS.



PLANE GAUGE.
FOR SOLID STEEL WHEELS

FIG. 1603—STANDARD PLANE GAGE FOR SOLID STEEL WHEELS.

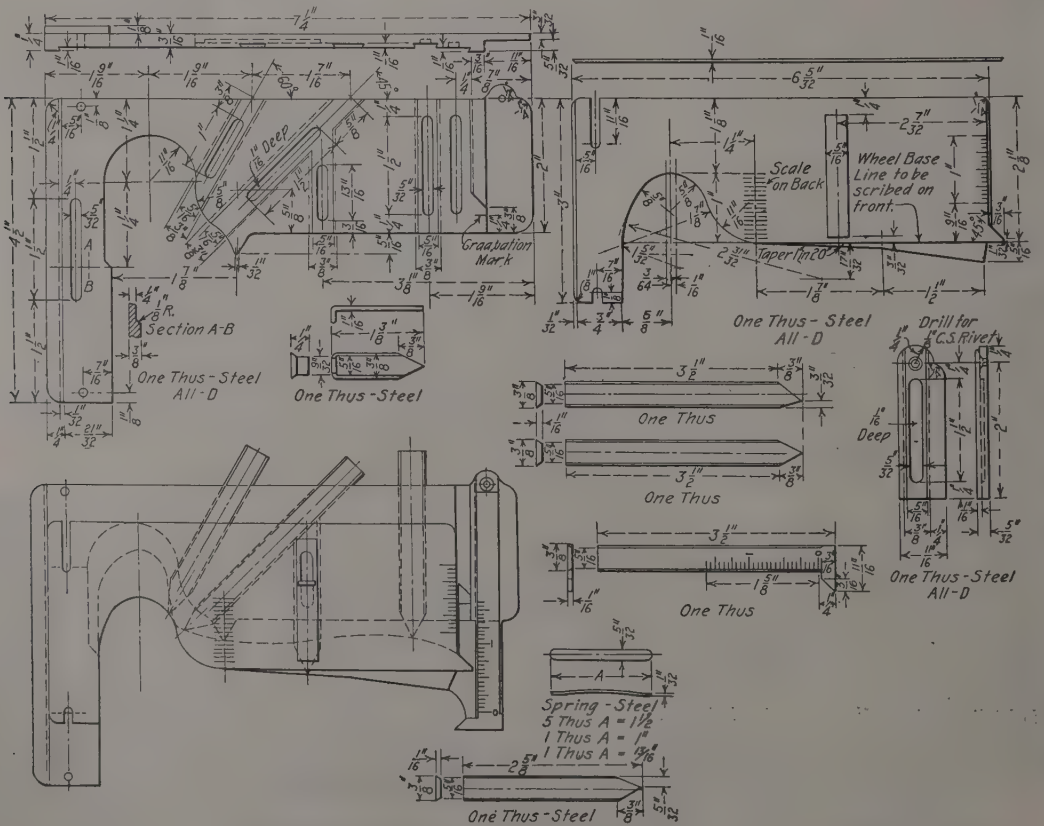
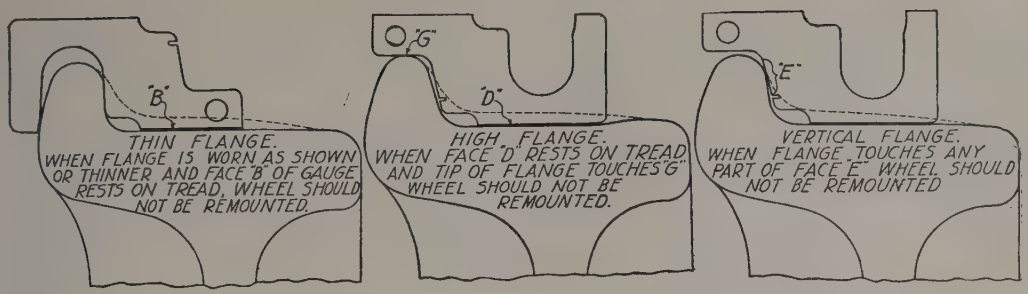

Graduation Mark
Section A-B
One Thus - Steel All - D
One Thus - Steel
Scale on Back
Wheel Base Line to be scribed on front.
Taper in 20"
One Thus - Steel All - D
Drill for C.S. Rivet
One Thus
One Thus
One Thus
One Thus - Steel All - D
Spring - Steel
5 Thus A = 1 1/2
1 Thus A = 1"
1 Thus A = 13/16
One Thus - Steel

FIG. 1604—A. R. A. RECOMMENDED PRACTICE FOR GAGE FOR MEASURING STEEL WHEELS TO RESTORE CONTOUR.


B
THIN FLANGE.
WHEN FLANGE IS WORN AS SHOWN OR THINNER AND FACE 'B' OF GAUGE RESTS ON TREAD, WHEEL SHOULD NOT BE REMOUNTED.
G
D
HIGH FLANGE.
WHEN FACE 'D' RESTS ON TREAD AND TIP OF FLANGE TOUCHES 'G' WHEEL SHOULD NOT BE REMOUNTED.
E
VERTICAL FLANGE.
WHEN FLANGE TOUCHES ANY PART OF FACE 'E' WHEEL SHOULD NOT BE REMOUNTED

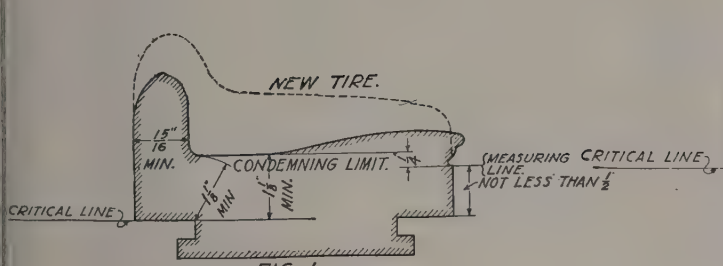


FIG. 1
STEEL TIRE.
RETAINING RING FASTENING.

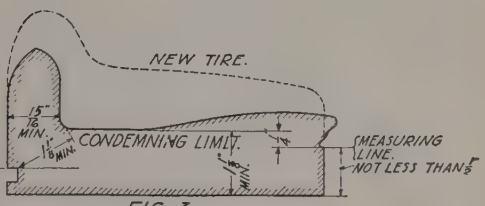


FIG. 3.
STEEL TIRE.
RETAINING RING FASTENING.

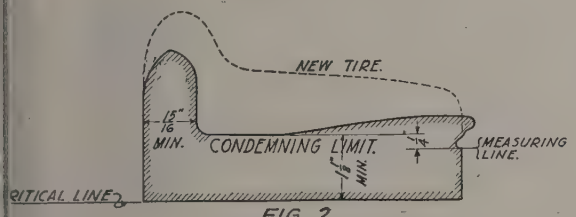


FIG. 2.
STEEL TIRE.
SHRINKAGE FASTENING ONLY.

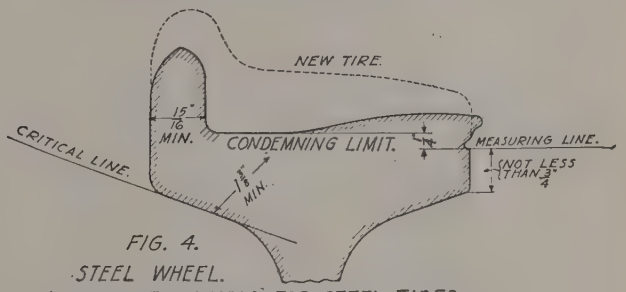
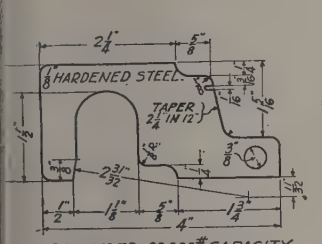
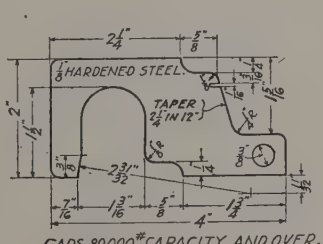
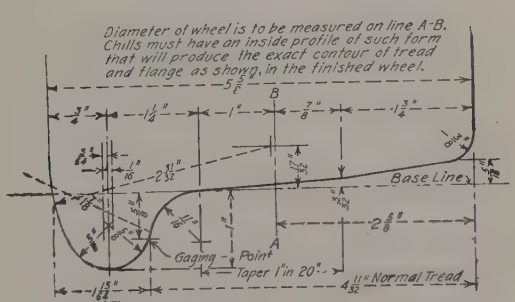


FIG. 4.
STEEL WHEEL.
MINIMUM THICKNESS FOR STEEL TIRES.

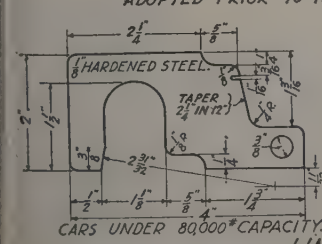


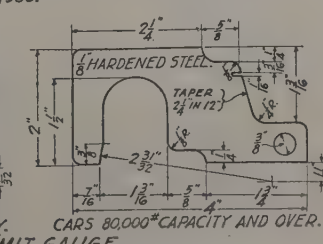


LIMIT GAUGE.
FOR REMOUNTING CAST IRON WHEELS, CAST PRIOR TO THE M.C.B. STANDARD TREAD AND FLANGE ADOPTED PRIOR TO 1909.


Diameter of wheel is to be measured on line A-B. Chills must have an inside profile of such form that will produce the exact contour of tread and flange as shown, in the finished wheel.
5 5/8"
B
A
Base Line
Gaging Point
Taper 1" in 20"
Normal Tread
Normal Flange

Wheel Tread and Flange for Cast Iron Wheels





LIMIT GAUGE.
FOR REMOUNTING CAST IRON WHEELS WITH M.C.B. STANDARD TREAD AND FLANGE ADOPTED IN 1909.

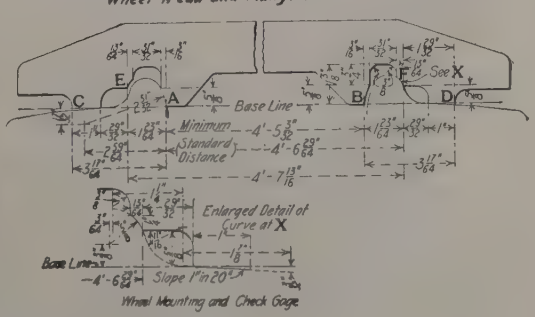


FIG. 1605—GAGES FOR CAST IRON WHEELS AND STEEL TIRED WHEELS.

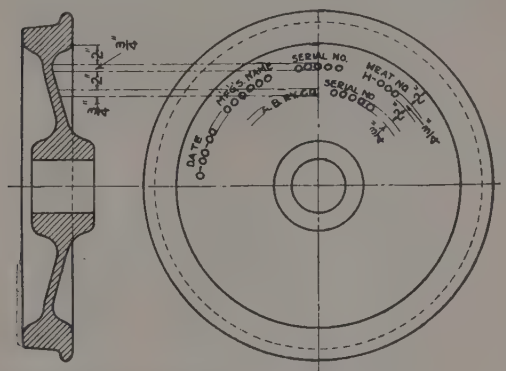
VI. Inspection.

9. *Inspection.*—(a) Inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturers' works which concern the manufacture of the material ordered.

(b) The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary gages to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment, and free of charge to the purchaser.

(c) The purchaser may make the tests to govern the acceptance or rejection of material in his own laboratory or elsewhere as may be decided by the purchaser. Such tests, however, shall be made at the expense of purchaser.

(d) Wheels which show injurious defects while being finished by the purchaser shall be rejected, and manufacturer promptly notified.



BRANDING OF SOLID STEEL WHEELS

Instructions for Using Gage for Measuring Steel Wheels to Restore Contour

Move adjustable front and four adjustable pointers to extreme upper position, swing pivoted pointer slightly to the right, then place gage on wheel as shown in Fig. 1604 on page 688. Swing pivoted pointer to left so as to engage limit of wear groove and move four adjustable pointers downward until each is in contact with tread or flange. Swing pivoted pointer to right and remove gage.

Move pivoted pointer to normal position and move sliding front downward until lower edge of same coincides with the lowest point of the four movable pointers.

The projecting point on the right of sliding front will now indicate on the pivoted scale the amount of service metal remaining after restoring standard contour.

On the back of sliding front will be read the depth of the cut necessary at junction of fillet and tread to restore standard contour. This same information may also be read from the scale on the right of the sliding front by means of the graduation mark on the body of the scale adjacent thereto.

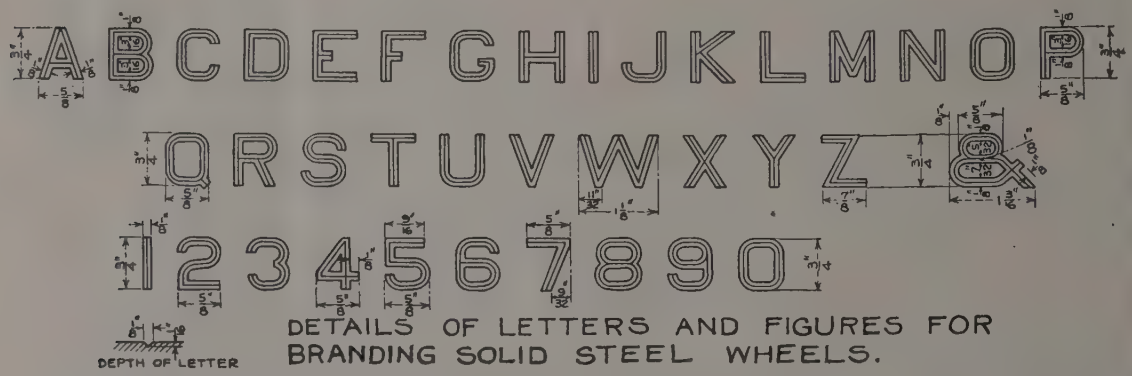

A B C D E F G H I J K L M N O P
Q R S T U V W X Y Z &
1 2 3 4 5 6 7 8 9 0
DEPTH OF LETTER
DETAILS OF LETTERS AND FIGURES FOR
BRANDING SOLID STEEL WHEELS.

Fig. 1606—A. R. A. recommended practice for branding solid steel wheels and details of letters and figures.

The contour of wheel should be taken at several points so that the point of maximum wear may be obtained.

(e) Samples tested in accordance with Section 5, which represent rejected wheels, shall be preserved for two weeks from the date of test report.

(f) The initials and serial number of the purchaser, referred to in Section 7, shall be obliterated from all rejected wheels in the presence of the inspector.

Mounting Wheels

Recommended Practice—adopted, 1897; revised, 1916.

First.—Wheels with flanges worn to a thickness of 1 1/16 inches or less shall not be remounted.

MOUNTING PRESSURES, IN TONS

Axle	Wheel Seat Diameter	Cast Iron Wheels		Steel Wheels	
		Minimum	Maximum	Minimum	Maximum
A	5⅛ in.	30	45	45	60
B	5¾ in.	35	50	50	70
C	6½ in.	40	60	60	80
D	7 in.	45	65	65	85
E	7⅛ in.	50	70	70	95

Second.—The thickness of flanges of wheels fitted on the same axle should be equal and never vary more than 1/16 in.

Third.—In mounting wheels, new or second-hand, the mounting and check gage should be used as follows:

After one wheel is pressed into position, place the stop "A" or "B" of the check gage against the inside of the flange of the wheel with the thinner flange with the corresponding tread stop "C" or "D" against the tread of the wheel. Press the other wheel on the axle until the opposite tread stop comes in contact with the tread with the corresponding gage point "E" or "F" in contact with the outside of the thicker flange.

Fourth.—The wheel seats on all axles must be turned to

a uniform diameter throughout the entire length of each wheel seat, and must be smooth and free from ridges, so as to provide an even bearing for the wheel fit throughout. The mounting of wheels on axles which have the wheel fit tapered is not permissible.

A committee report on the practices of mounting wheels on axles and the pressure to be used will be found on page 470 of the 1910 Proceedings of the Master Car Builders Association. Special papers on the subject of car wheels have also been prepared and presented at the conventions.

Instructions for Using Standard Wheel Circumference Measure for Steel, Steel-Tired, and Cast Iron Wheels

Standard

Place tape about circumference of wheel, having the brackets in contact with flange. The normal circumference for wheels of each of the different diameters is indicated by the space marked "3." Steel and steel-tired wheels should be rejected if the scribed lines on the head piece fall to the left of the space marked "C" or to the right of the space marked "½." Cast iron wheels should be rejected if the scribed line on the head piece falls to the left of the space marked "1" or to the right of the space marked "5."

The continuous markings on the upper side of the tape, as shown on drawing in Fig. 1599 on page 686, may be used for mating worn wheels.

Terms and Gaging Points for Wheels and Track

Standard—ADOPTED, 1894.

1.—*Track Rails* are the two main rails forming the track.

2.—*Gage of Track* is the shortest distance between the heads of track rails.

3.—*Base Line*, for wheel gages, is a line parallel to the axis of the wheels drawn through the point of intersection of tread with a line perpendicular to the axis, and passing through the center of the throat curve.

4.—*Inside Gage of Flanges* is the distance between backs of flanges of a pair of mounted wheels measured on the base line.

5.—*Gage of Wheels* is the distance between the outside face of flanges of a pair of mounted wheels measured on a line parallel to the base line, but 5/8 in. farther from the axis of the wheels.

6.—*Thickness of Flange* is the distance measured parallel to the base line between two lines perpendicular thereto, one drawn through the point of measurement of "inside gage of flanges," and the other drawn through the point of measurement of "gage of wheels."

7.—*Width of Tread* is the distance measured parallel to the base line from a line perpendicular thereto, drawn through the point of measurement of "gage of wheels" to the outer edge of tread.

8.—*Check Gage Distance* is the distance measured parallel to the base line between two lines perpendicular thereto, one drawn through the point of measurement of "inside gage of flanges" on either wheel, and the other drawn through point of measurement of "gage of wheels" on mate wheel.

9.—*Over All Gage* is the distance parallel to base line from outer edge of one wheel to the outer edge of mate wheel.

The above mentioned wheel gage distances are either directly or by inference as follows, having been modified in 1909:

	Feet	Inches
Inside Gage of Flanges	4	5 7–32
Gage of Wheels	4	7 11–16
Thickness of Flange	..	1 15–64
Width of Tread	..	4 11–32
Check Gage Distance	4	6 29–64
Over All Gage	5	4½ 4⅜

Steel Tires

Recommended Practice—ADOPTED, 1913; REVISED, 1920.

1. *Classes.*—(a) These specifications cover three classes of tires.

(b) The purpose for which these classes are frequently used are as follows:

Class A, for driving tires for passenger locomotives;

Class B, for driving tires for freight locomotives and tires for locomotive-truck, tender-truck, trailer and car wheels, and miscellaneous service;

Class C, for driving tires for switching locomotives.

I. MANUFACTURE.

2. *Process.*—(a) The steel shall be made by the open-hearth or electric process.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon:	Per cent.
Class A	0.50—0.70
Class B	0.60—0.80
Class C	0.70—0.85
Manganese	0.50—0.75
Phosphorus	not over 0.05
Sulphur	not over 0.05
Silicon	0.15—0.35

4. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus, sulphur and silicon. This analysis shall be made on drillings taken at least ¼ in. beneath the surface of a test ingot taken during

the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—Analyses to represent each melt may be made by the purchaser from turnings taken from a tire or from a tension test specimen, if the tension test is

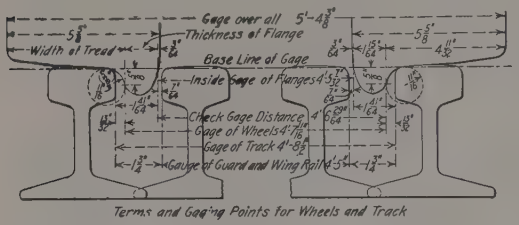
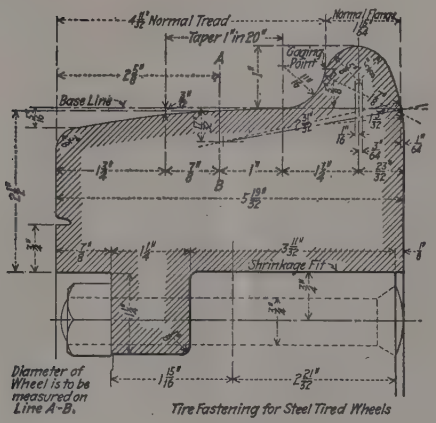

Gage over all 5'-4⅞"
Thickness of Flange
Width of Tread
Base Line of Gage
Inside Gage of Flanges 4'-5⅛"
Check Gage Distance 4'-6⅜"
Gage of Wheels 4'-7⅛"
Gage of Track 4'-8½"
Gauge of Guard and Wing Rails 4'-5"
Terms and Gaging Points for Wheels and Track

FIG. 1607—WHEEL AND TRACK GAGES.



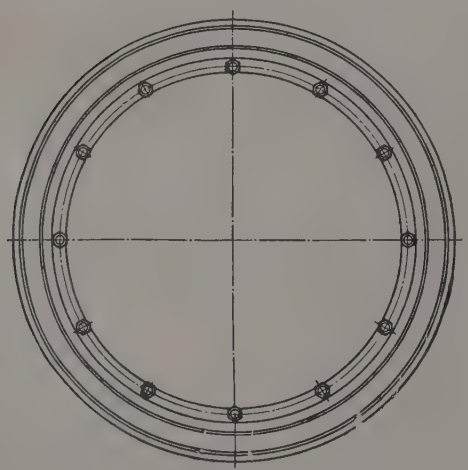


FIG. 1608—RECOMMENDED PRACTICE FOR TIRE FASTENING FOR STEEL TIRED WHEELS.

specified. The chemical composition thus determined shall conform to the requirements specified in Section 3.

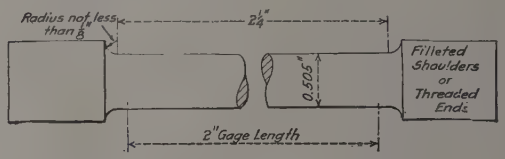
III. PHYSICAL PROPERTIES AND TESTS.

6. *Tension Tests.*—If tension tests from representative bars in accordance with Section 7 are specified by the purchaser the tensile properties shown shall conform to the following minimum requirements:

	Class A.	Class B.	Class C.
Tensile strength, pounds per square inch	105,000	115,000	125,000
Elongation in 2 inches, per cent.	12	10	8
Reduction of area, per cent.	16	14	12

7. *Tension-Test Specimens.*—(a) The tension-test specimen representing each melt shall be taken from a test ingot taken during the pouring of the melt and shall have received approximately the same amount of work as the tires which it represents.

(b) The specimen shall conform to the dimensions shown.



The ends shall be of a form to fit the holder of the testing machine in such a way that the load shall be axial.

8. *Number of Tests.*—(a) If specified by the purchaser one tension test shall be made from each melt.

(b) If any test specimen shows defective machining or develops flaws it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any test specimen is less than that specified in Section 6 and any part of the fracture is more than ¾ in. from the center of the gage length as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

9. *Retests.*—If the results of the tension test for any melt do not conform to the requirements of Section 6 a retest may be made on a specimen cut from a tire of the same melt furnished at the expense of the manufacturer. This retest shall give results conforming to the requirements of Section 6.

IV. MATING.

10. *Mating.*—The tires shall be grouped as to outside diameters and shipped in sets.

V. PERMISSIBLE VARIATIONS IN DIMENSIONS.

11. *Permissible Variations.*—Tires may be furnished with all surfaces as rolled, and shall conform to the dimensions specified within the following permissible variations:

(a) *Height of Flange.*—The height of flange shall not be less but may be 1-16 in. more than that specified.

(b) *Thickness of Flange.*—The thickness of flange shall not vary more than 1-16 in. from that specified.

(c) *Radius of Throat.*—The radius of throat shall not vary more than ⅛ in. over nor more than 1-16 in. under that specified.

(d) *Width of Tire.*—The width of tire shall not vary more than ⅛ in. over nor more than 1-16 in. under that specified.

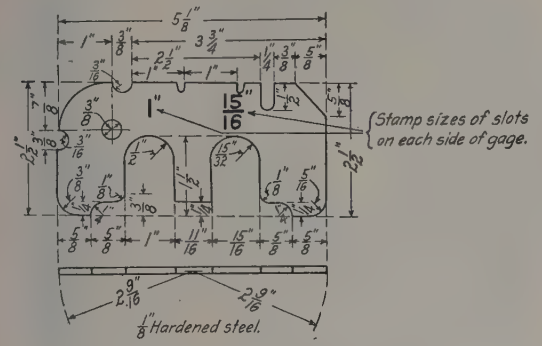
(e) *Inside Diameter.*—The rough inside diameter shall not be more, but may be ¼ in. less than that specified. When finished inside diameter only is specified, the rough diameter shall be from 3-16 to 7-16 in. less than this diameter.

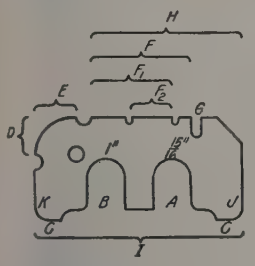
(f) *Outside Diameter.*—Unless otherwise specified the outside diameter when 54 in. or under shall not be less, but may be ½ in. more than that specified and when over 54 in. shall not vary more than ⅛ in. under nor more than ⅜ in. over that specified.

(g) *Set Diameters.*—The tires shall be furnished in sets and the variation in outside diameters in each set shall not exceed 1-16 in. for tires 33 in. or under in outside diam-

eter, nor exceed 3-32 in. for tires over 33 in. in outside diameter.

(h) *Rotundity.*—Tires shall not be out of round more than 1-16 in. for tires 33 in. or under in outside diameter,





Slots **A** and **B**, $\frac{3}{4}$" and 1" respectively are for gaging flanges worn thin, gage is to be used with heel **C** on tread of wheel.

Corners **D** and **E**, $\frac{1}{2}$" and 1" respectively are for measuring height of vertical wheel flange wear, above tread.

Lengths **F**, **F**$_1$ and **F**$_2$, ($2\frac{1}{2}$", 2" and 1" respectively) are for gaging the length of shelled out or flat spots on wheel tread.

Slot **G**, $\frac{1}{2}$" wide, is for gaging the thickness of worn journal collars.

Length **H**, $3\frac{1}{2}$" is for gaging chipped rims.

Over all Length **I**, $5\frac{5}{8}$" is for gaging distance between point of knuckle and guard arm of couplers, measured perpendicularly to the guard arm.

Radii **J** and **K**, $\frac{1}{16}$" and $\frac{1}{8}$" respectively, are for checking the fillets of journals.

FIG. 1609—WHEEL DEFECT, WORN COUPLER LIMIT, WORN JOURNAL COLLAR AND JOURNAL FILLET GAGE.

nor more than 3-32 in. for tires over 33 in. in outside diameter.

VI. FINISH.

12. *Finish.*—The tires shall be free from injurious defects and shall have a workmanlike finish.

VII. MARKING.

13. *Marking.*—The name or brand and serial number of the manufacturer shall be legibly stamped on the tire close to the inside edge, where they will not be removed at the last turning. Set numbers shall be legibly stenciled on each tire.

VIII. INSPECTION AND REJECTION.

14. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the tires ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the tires are being furnished in accordance with these specifications. Unless otherwise specified all tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment.

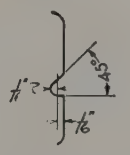
15. *Rejection.*—Tires which show injurious defects while being finished by the purchaser will be rejected, and the manufacturer shall be notified.

16. *Rehearing.*—Samples tested in accordance with Section 5, which represent rejected tires, shall be preserved for two weeks from the date of the test report.

Minimum Thickness for Steel Tires

Standard—ADOPTED, 1917.

Minimum thickness for steel tires shall be 1 in., to be measured normal to the tread and radial to the curved portions of the flange through the thinnest part within $4\frac{1}{4}$ in. from the back of the flange; the thickness from the latter point to the outer edge of tread to be not less than $\frac{1}{2}$ in. at thinnest part.



Limit of Wear Groove

FIG. 1610

To facilitate inspection, a small groove shall be cut in the outer face of all tires when wheels are new, at a radius of $\frac{1}{4}$ in. less than that of the tread of tire when worn to the prescribed limit. This groove to be of the shape as shown in Fig. 1610.

The report of the committee in the 1905 Proceedings, page 269, is concerned largely with the question of a guarantee from wheel makers.

In 1906 the committee recommended certain changes in the thickness of the flange and the taper of the tread which were adopted by letter ballot.

The committee report for 1907 related largely to revisions of the drawings and rules to make them conform with the new standards.

The report in the 1908 Proceedings, page 235, is concerned with detailed recommendations.

Other reports will be found in the M. C. B. Proceedings, 1910, page 378; 1911 Proceedings, page 204; 1912 Proceedings, page 134; 1913 Proceedings, page 284; 1914 Proceedings, page 102; 1915 Proceedings, page 96; the report in the 1916 Proceedings, page 183, contains an elaborate study of flange and tread failures.

Fig. 1611—Single Plate Chilled Cast Iron Wheel. Lobdell Car Wheel Company.

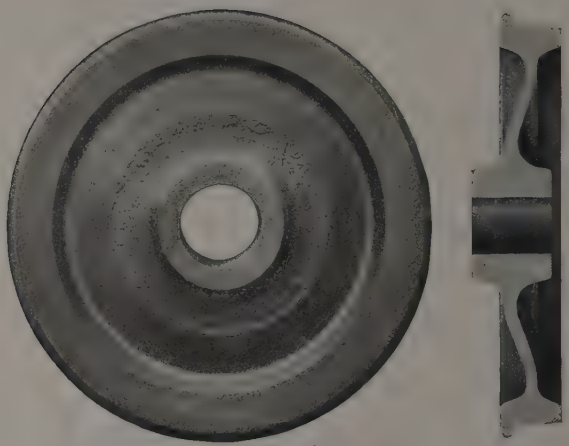


Fig. 1612—Solid Forged and Rolled Steel Car Wheel. Carnegie Steel Company.

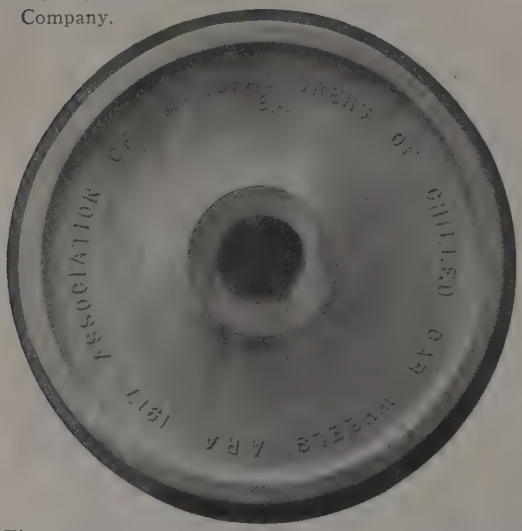
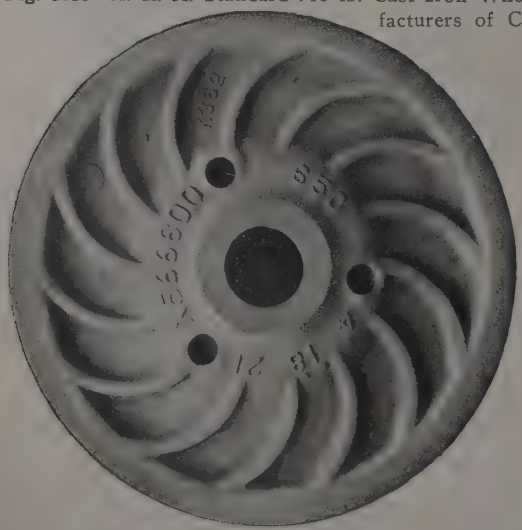


Fig. 1613—A. R. A. Standard 700 lb. Cast Iron Wheel for 40-Ton Capacity Freight Cars. Association of Manufacturers of Chilled Car Wheels.



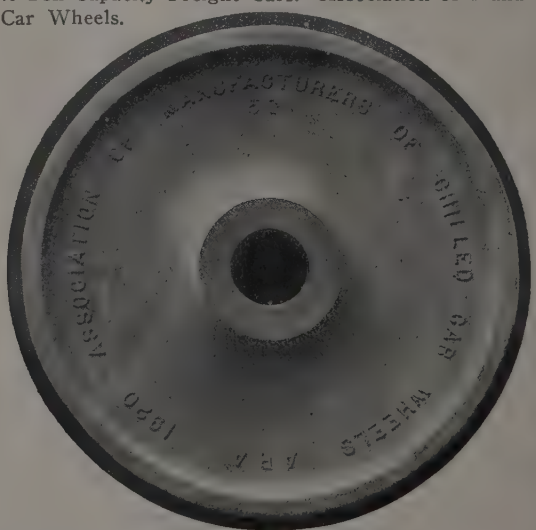


Fig. 1614—A. R. A. Standard 650 lb. Cast Iron Wheel for 30-Ton Capacity Freight Cars. Association of Manufacturers of Chilled Car Wheels.

(*See also Page* 695.)

Chilled Iron Car Wheels

The Association of Manufacturers of Chilled Car Wheels was organized in 1909 for the purpose of making a study of the car wheel under all the exacting conditions of its service and to formulate recommendations to manufacturers and users which should ultimately result in improvement of the product and its service. Its principal achievements have been the establishment of four standard patterns of car wheels and their substitution for the hundreds of special patterns used by commercial manufacturers and railways manufacturing their own wheels. The correctness of the general design has been established by continuous service since 1909 and upon this as a basis the Association is continuing its study with the view of securing greater service and reduced cost to the railways. The Association includes 50 wheel foundries in the United States and Canada, having a capacity of 20,000 wheels a day.

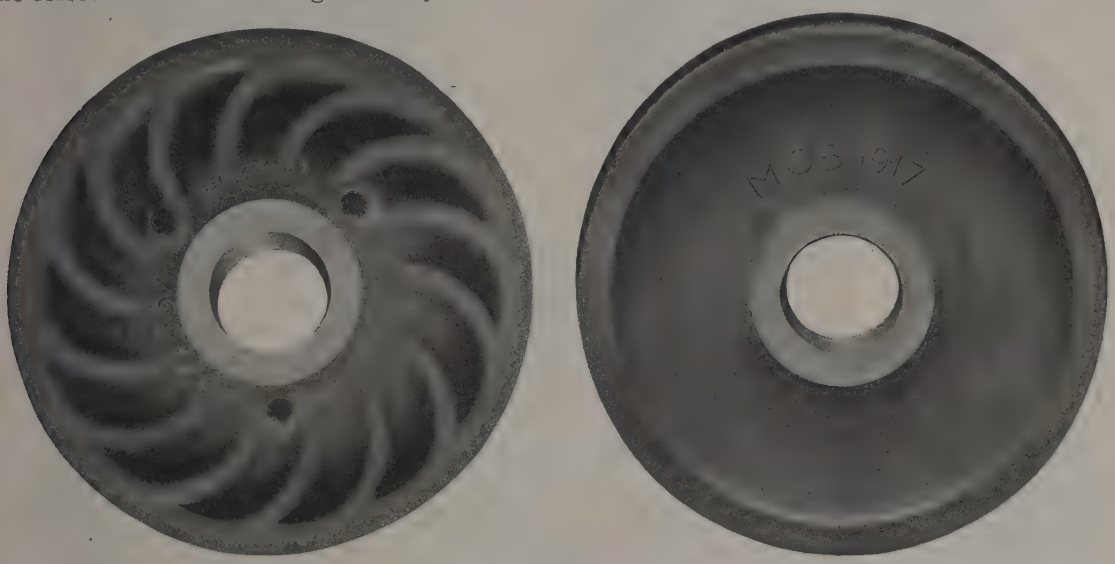


Fig. 1615—850-Lb. Wheel for 70-Ton Capacity Cars

Chilled iron wheels are used on 95 percent of the 2,500,000 freight cars in railway service in the United States, or about 25,000,000 wheels in all classes of service. The chilled iron wheel, since its introduction in 1850, has always been the standard vehicle of transportation for rail-borne traffic.

Four standard sizes of chilled iron wheels have been designed by the Mechanical Division of the American Railway Association for the four general classes of freight cars, based on capacity. They are as follows:

650 lb. wheel for cars of 30 tons capacity.
700 lb. wheel for cars of 40 tons capacity.
750 lb. wheel for cars of 50 tons capacity.
850 lb. wheel for cars of 70 tons capacity.

Some of the properties of the chilled iron wheel that have led to its general adoption are:

Hardness of tread, giving maximum service for the minimum loss of metal.

The co-efficient of friction between wheel and brake shoe is much greater than that developed by steel under the same pressure. This is of great advantage in reducing strain on the brake rigging and trucks, adding to the effective capacity of air cylinders and air pumps.

Chilled iron wheels will carry heavy loads without distortion or cold-rolling of the surface metal, and always retain their rotundity; eccentric wheels cause broken rails.

Flat spots do not "iron out" and cause eccentricity; the noise caused by a small flat spot on a chilled iron wheel calls for its early removal before any damage is done.

Many economic advantages are obtained by the use of the chilled iron wheel, among which may be mentioned the following:

Durability of brake shoes on chilled iron is appreciably greater than on steel, according to the type of shoe. Slow-wearing insert shoes commonly used on chilled wheels cannot be used on steel wheels because of the severe scoring action that would result.

The abrasion between a chilled iron flange and steel rail is much less than between a steel flange and steel rail. The reduction in loss of metal from both the flange and the rail constitutes an item of considerable economic importance.

So much of train resistance as is due to friction between flange and rail and to slipping of tread is less with chilled iron wheels; and is another important item of economy.

Scrap value of chilled iron wheels is relatively greater than of most other materials, due largely to the scattered location of wheel foundries and the consequent reduction in transportation costs.

Expensive lathes are not required for machining the wheel treads, thus obviating the necessity of making a large investment in shop facilities and expensive machinery.

For other products and branch offices, see classified and alphabetical indexes.

ASSOCIATION OF MFRS. OF CHILLED CAR WHEELS, CHICAGO, ILL.

Recommended Weights of Davis Cast Steel Wheels.

33 Inch Freight Wheels

Size of Journal.	Weight Each.
4¼x8"	600 lbs.
5x9"	600 lbs.
5½x10"	600 lbs.
6x11"	665 lbs.

33 Inch Passenger and Tender Wheels

Size of Journal.	Weight Each.
4¼x8"	640 lbs.
5x9"	640 lbs.
5½x10"	640 lbs.
6x11"	665 lbs.

36 Inch Passenger and Tender Wheels

Size of Journal.	Weight Each.
4¼x8"	700 lbs.
5x9"	700 lbs.
5½x10"	700 lbs.
6x11"	740 lbs.

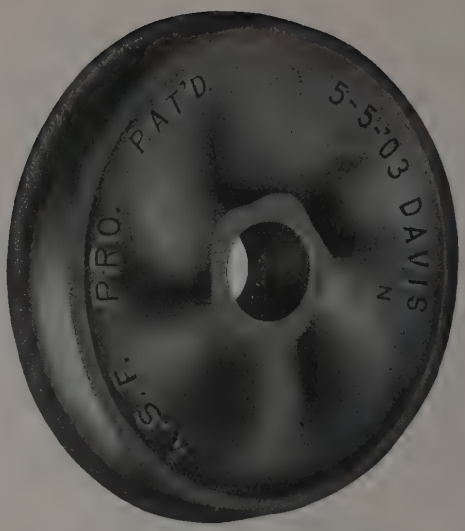


Fig. 1616—Davis Cast Steel Wheel for Freight Cars. American Steel Foundries.
(*See also Page* 697.)

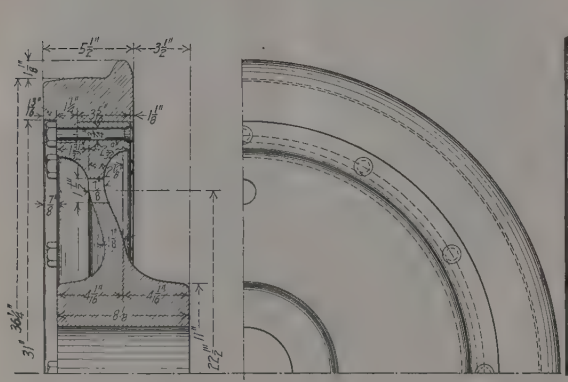


Fig. 1617—Bolted Type Coach Wheel with Cast Steel Plate Center.
Railway Steel Spring Company.

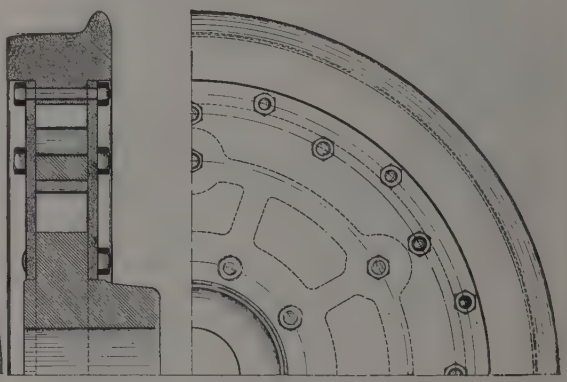


Fig. 1618—Paige Plate Coach Wheel. Cast Iron Spider with Steel Plates Secured by Bolts.
Railway Steel Spring Company.

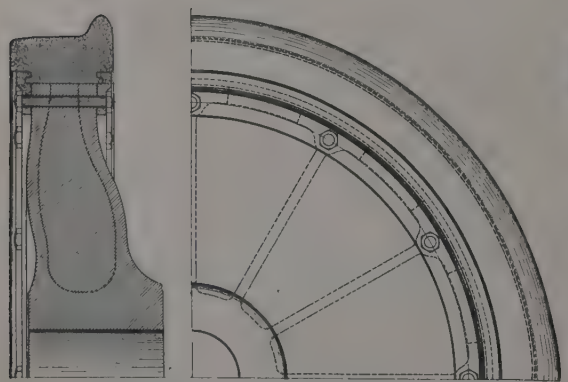


Fig. 1619—Allen No. 9 Coach Wheel. Cast Iron Double Plate Center with Tire Secured by Shrinkage and Mansell Retaining Rings.
Railway Steel Spring Company.

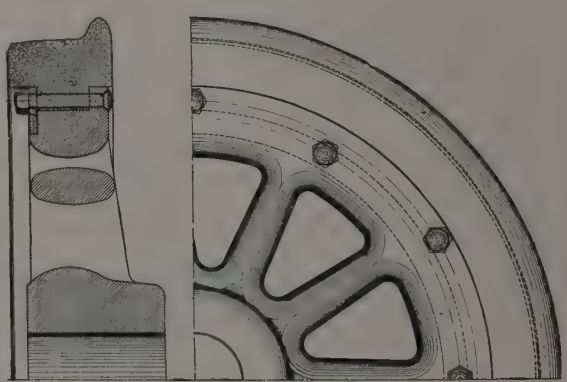


Fig. 1620—Paige Spoke Coach Wheel. Cast Iron Spoke Center with Tire Secured by Shrinkage, Retaining Rings and Bolts.
Railway Steel Spring Company.

The Davis Steel Wheel

Progress, of the kind and degree represented by Davis cast steel wheel, has an important influence upon railroad operating practices and costs. This type of wheel has made it possible to take unusual advantage of the strength of steel by not only the use of a scientifically correct structural shape but also the control of chemical properties at different regions of the wheel section.

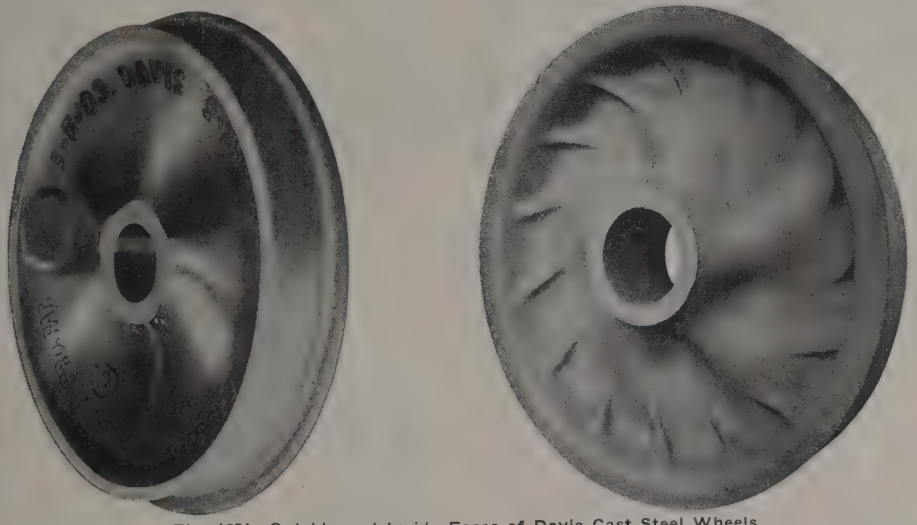


Fig. 1621—Outside and Inside Faces of Davis Cast Steel Wheels

The Davis Steel Wheel is a one-piece one-wear steel wheel consisting of a double heat treated and toughened tread and flange of high manganese composition and a low carbon open-hearth steel plate and hub.

This tread and flange metal, in addition to being hard and tough, is of high tensile strength. These properties enable it to resist wear, withstand shock and the tendency toward disintegration occasioned by the excessive wheel loads and severe brake shoe heating action of the heaviest present day service. It insures perfect safety, a high mileage on one-wear and reduces to a minimum wheel removals caused by flat sliding, brake burning, etc.

The one-wear feature effects a marked reduction in wheel maintenance costs by eliminating the frequent removal and turning necessary when multiple-wear wheels are used, with all of the incidental charges connected with this operation, such as, renewal of truck parts, shimming cars to maintain coupler heights, etc.

The strength of the metal and this one-wear feature permit of a design that will on an average weigh approximately 150 lb. per wheel or 1,200 lb. per car less than any other type of wheel. This item not only effects a marked saving in train operating expenses, but also makes it possible under the A. R. A. rules to add this saving in weight to the capacity of the car and thereby increase its revenue-producing value.

The Davis Steel Wheel is made in a revolving mould, the first metal entering being treated with ferro-manganese in its passage from the ladle to the mould. The centrifugal action forces the manganese steel to the circumference of the mould to form the tread and flange of the wheel. There is no interruption in the pouring and it is immediately followed by and blends into a soft ductile steel which forms the plate and hub. The wheels are carefully annealed, cleaned and rough-bored. The treads are machined perfectly round and to exact contour, after which they are water-toughened.

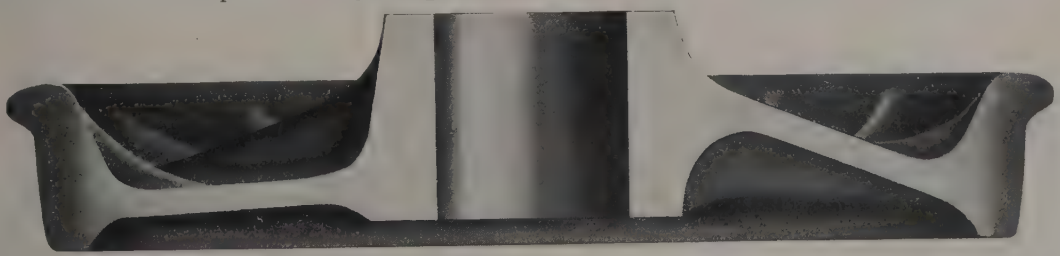


Fig. 1622—Sections Showing Strong, Corrugated Plate Construction of the Davis Steel Wheel. Shaded Area at the Tread and Flange Indicates Manganese Steel.

Special attention is given to the production and inspection of every Davis Wheel, each wheel being separately tested for hardness and given a drop test before being shipped. This insures quality of material and reliable service.

For other products and branch offices, see classified and alphabetical indexes.

AMERICAN STEEL FOUNDRIES, CHICAGO, ILLINOIS

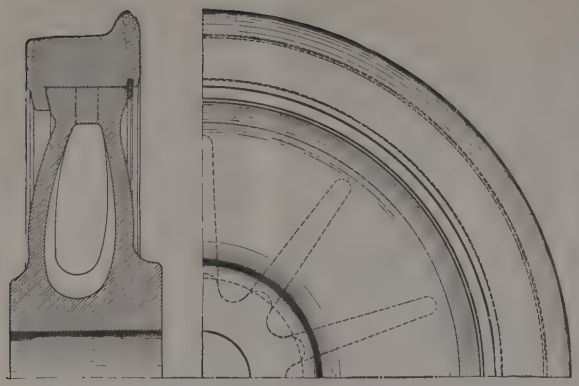


Fig. 1623—National No. 2 Coach Wheel. Cast Iron Double Plate Center, Having Internal Ribs, with Tire Secured by Shrinkage and Gibson Retaining Ring.

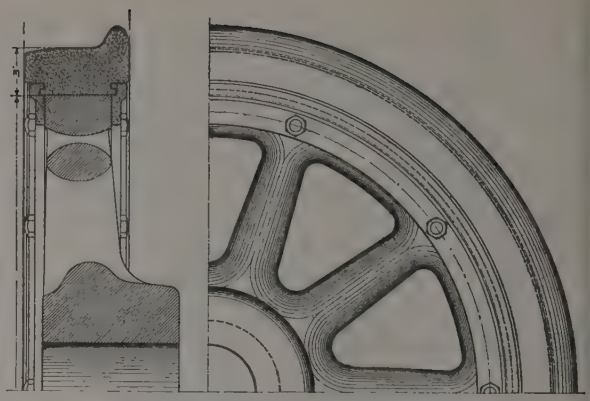


Fig. 1624—National No. 3 Coach Wheel. Cast Iron Spoke Center with Tire Secured by Shrinkage and Mansell Retaining Rings.

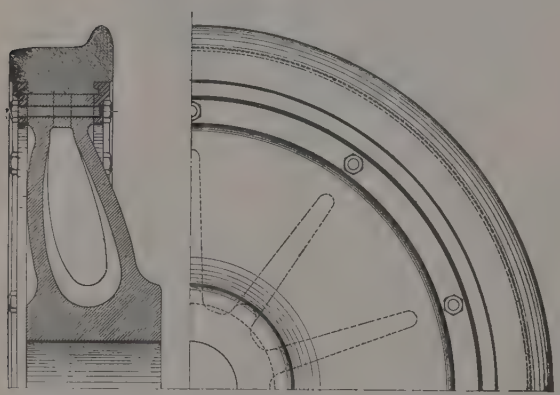


Fig. 1625—National No. 4 Coach Wheel. Cast Iron Double Plate Center, Having Internal Ribs, with Tire Secured by Shrinkage and Mansell Retaining Rings.

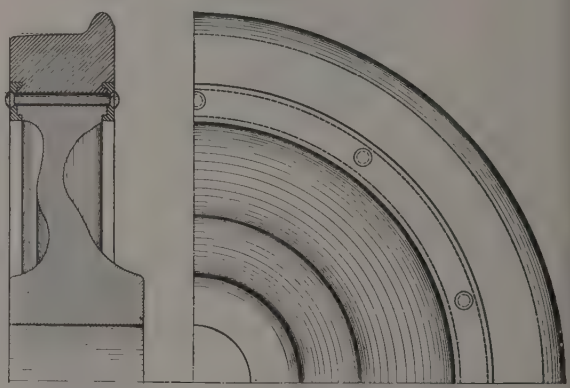


Fig. 1626—National No. 6 Coach Wheel. Cast Steel Disc Center with Tire Secured by Shrinkage and Double Lip Retaining Rings.

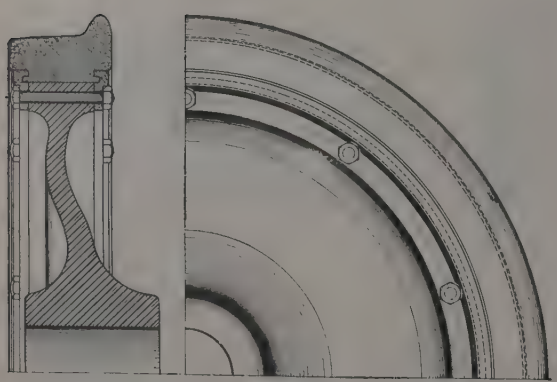


Fig. 1627—National No. 6 Coach Wheel. Cast Steel Disc Center with Tire Secured by Shrinkage and Mansell Retaining Rings.

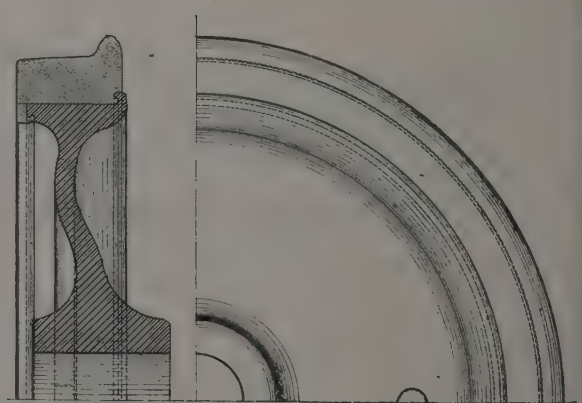


Fig. 1628—Boies No. 2 Coach Wheel. Cast Steel Disc Center with Tire Secured by Shrinkage and Integral Lock.

Railway Steel Spring Company.

The Full-Value Wrought Steel Wheel

The large number of wheels used, the consequent sums of money involved in their purchase and the maintenance expenses for which they are responsible, make the selection of this class of railway equipment one of the most important problems confronting purchasing agents and railway mechanical officials.

Rules and regulations governing certain standards which must be met by manufacturers and users have been covered quite thoroughly in specifications which have been published by the American Railway Association and by the American Society for Testing materials. As the subject is such a large one and involves so many cases where practical expediency must be taken into consideration, both sets of specifications are characterized by tolerances and limiting sizes or other qualities, all of which leave to the manufacturer quite liberal limits within which to bring his product. The natural result is that the wheels in use today are far from uniform and those available vary also; yet there are certain standards which, if followed, will return to the user a maximum of service value, and it is this objective which has been back of the efforts of the Forged Steel Wheel Company in the production of a Full-Value Wheel.

The "Fulvalyew" specifications according to which The Full-Value Wheel is manufactured, are based upon the fact that in relation to the usable material of wrought steel wheels there exists a service zone for which the hitherto standard designs and specifications fail to assure the legitimate requirement being met. The resulting conditions have been such that many users have been led to call for a nominal rim thickness of 3 in. in order to get the maximum of allowable service body. However, with the advent of the "Fulvalyew" specifications and The Full-Value Wheel, the old 2½ in. standard rim thickness is vindicated, and there prevails no longer any necessity for the railways to incur the added expense of having wheels made with the nominal 3 in. rim thickness when the opportunity now exists for securing wheels with the standard 2½ in. rim thickness which will return an equivalent value in service. Wheels made according to these specifications meet every requirement fixed by the American Railway Association.

The 33 in. Full-Value Wheel has a maximum diameter corresponding to tape size 171, or 33.54192 in.; a minimum diameter corresponding to tape size 157, or 32.98487 in.; and a 28 in. maximum diameter for the rim interior. The diameter of the limit groove is set at 29½ in. and the condemning limit is set at ¼ in. above the limit groove.

The allowable service zone is obvious. It varies from a diameter of 33.54192 in.—say 33½ in.—as a maximum down to the 30 in. which is specified and recognized as the minimum allowable diameter for wheels in service. Hence it becomes obvious that all prescribed requirements as to the sizes are duly and fully met, and that this wheel offers a minimum of 1.49244 in.—say 1½ in.—and a maximum of 1.77096 in.—say 1¾ in.—of allowable service body.

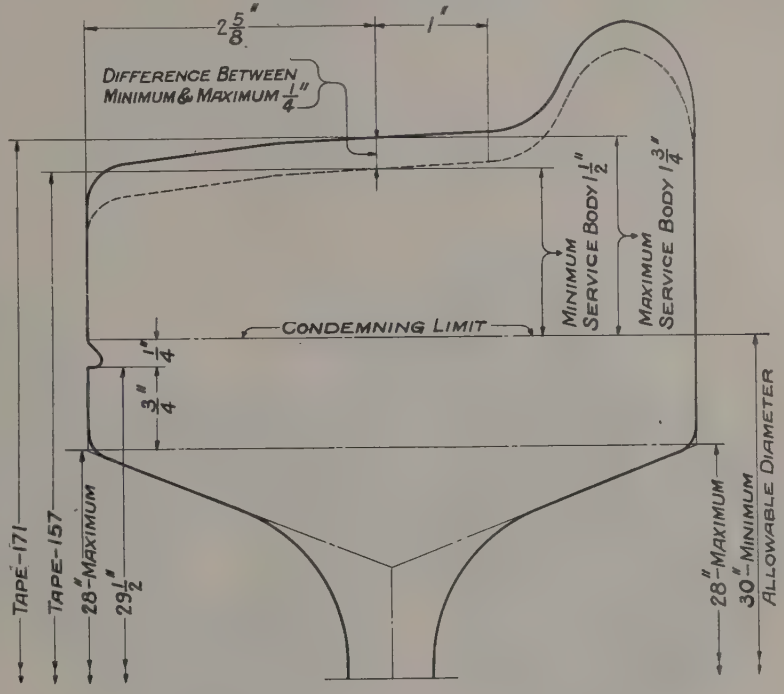


Fig. 1629—Illustration of Limiting Dimensions of The Full-Value Wheel

All other important characteristics of Full-Value wheels, the materials from which they are made, and the manufacturing processes involved, comply fully with A. R. A. specifications or with the "Fulvalyew" specifications where the latter are more rigid or cover points not included in the former. From every angle, therefore, the interests of the user of these wheels are amply guarded.

To co-operate with the railways of the United States in the solution of the problem relating to the most efficient and economical use of the solid wrought steel wheel, is the earnest desire of the Forged Steel Wheel Company. Therefore The Full-Value Wheel and the "Fulvalyew" specifications are brought to the attention of railway men, with the conviction that the users' interests are being well served thereby.

FORGED STEEL WHEEL COMPANY, PITTSBURGH, PA.

RECOMMENDED WEIGHTS OF WHEELS

Freight and Passenger Cars—Griffin Wheel Co.

Freight Car Wheels.

Normal Capacity, Pounds.	Weight of Car, Pounds.	Total Load 10% Excess, Pounds.	Weight of Wheel, Pounds.	Size of Journal.	Remarks.
60,000	30,000	96,000	650	4¼"x 8"	A. R. A.
60,000	42,000	108,000	700	4¼"x 8"	
60,000	50,000	116,000	750	4¼"x 8"	
80,000	34,000	122,000	700	5" x 9"	A. R. A.
80,000	46,000	134,000	725	5" x 9"	
80,000	52,000	140,000	750	5" x 9"	
100,000	42,000	152,000	750	5½"x10"	A. R. A.
100,000	54,000	164,000	800	5½"x10"	
140,000	48,000	202,000	850	6" x11"	A. R. A.
140,000	56,000	210,000	850	6" x11"	

Passenger Car Wheels.

Type.	Weight of Car, Pounds.	Total Load, Pounds.	Weight of Wheel, Pounds.	Size of Journal.
8-wheel	60,000	80,000	700	3¾"x7"
8-wheel	70,000	90,000	750	4¼"x8"
8-wheel	80,000	100,000	800	4¼"x8"
12-wheel	80,000	100,000	700	4¼"x8"
8-wheel	90,000	110,000	850	5" x9"
12-wheel	90,000	110,000	750	5" x9"
8-wheel	100,000	120,000	850	5" x9"
12-wheel	100,000	120,000	750	5" x9"
12-wheel	120,000	140,000	800	5" x9"

Fig. 1630—F. C. S. Wheel for Freight and Passenger Service.

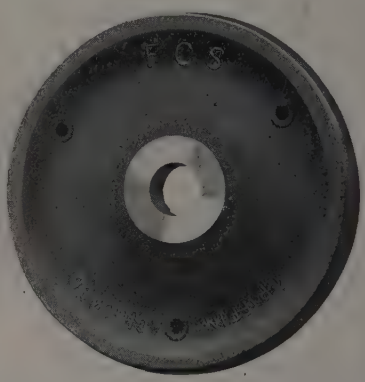


Fig. 1631—F. C. S. Wheel for Street and Interurban Service.

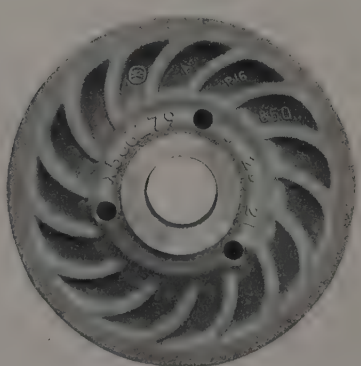


Fig. 1632—Chilled Cast Iron Wheel for 70-Ton Capacity Freight Car Truck.

Griffin Wheel Company.

Fig. 1633—F. C. S. Wheel for Street and Interurban Service.

(*See also Page* 701.)

Chilled Iron Car Wheels

In the United States, the chilled iron car wheel has been the standard for rail-borne freight traffic since railroading began. Although distinctly an American product, it is manufactured to a limited extent in Europe.

The chilled iron car wheel is used most extensively on the steam and electric railways of North America; and in Central and South America on those railroads which have adopted the American methods of railway operation. No one article has contributed so much to economy in railway practice as the chilled iron car wheel. From the days of the primitive tramway to the present stage of railway development, its use has been continuous and uninterrupted.

There are about 25,000,000 chilled iron car wheels in use in North America on approximately 2,500,000 freight cars, 10,000 passenger cars and 40,000 engine tenders. This represents about 95 per cent of the total steam railroad equipment. There are also about 500,000 chilled iron wheels used by electric railways. In addition to these, thousands of chilled iron wheels are used in mining, logging, contracting and manufacturing industries. To maintain this equipment and provide for additional rolling stock, about 4,000,000 wheels are required each year.

Fig. 1634—Outside Face of a Griffin Chilled Iron Car Wheel

Fig. 1635—Inside Face of a Griffin Chilled Iron Car Wheel

The Griffin Wheel Company, operating nine foundries in the United States, from the Atlantic to the Pacific Coasts, with an annual capacity of 2,000,000 wheels, is adequately prepared to take care of the constantly increasing demands for its product. The foundries are located at Chicago, Illinois; Pullman, Illinois; Detroit, Michigan; Boston, Massachusetts; Denver, Colorado; St. Paul, Minnesota; Kansas City, Kansas; Tacoma, Washington; Los Angeles, California; Council Bluffs, Iowa.

Before the days of the steam railway, it was discovered that when molten iron was suddenly cooled, the character of the metal was changed. On examining the fracture, it was found that the part which was cooled suddenly, or "chilled," was white, smooth-grained in appearance and extremely hard; while the balance of the metal, which cooled more slowly, was gray, coarse-grained, and of a softer and more ductile quality. This transformation is due to the peculiar action of carbon, and does not occur unless carbon is present in the iron. In the molten state, the carbon combines, or is in solution with the iron, and when suddenly cooled, remains combined with the iron, and produces what is known as "chilled iron." When the cooling takes place slowly, the carbon gradually separates from the iron, forming gray flakes of graphite between the iron molecules.

The chilled iron wheel was developed by taking advantage of this peculiar action of the carbon. The depth of the chill in the tread flange and the ductility and strength of the gray iron, in the plates and hub, are largely influenced by the temperature of the iron when poured, the rate of cooling, and the effect of foreign substances. The wearing surface of the wheel is chilled by forming part of the mold with a metallic ring or "chiller"; the balance of the mold is of sand, which permits the metal to cool slowly enough to form soft gray iron.

The perfection of a car wheel is not altogether dependent upon the facilities for casting, the size of the foundry, or its capacity for melting iron. A complete knowledge of both the physical and chemical qualities of the iron is essential; to this end the Griffin Wheel Company maintains a modern laboratory, for testing and analyzing all raw materials as well as the finished product. All of the work, from the charging of the cupola to the final inspection, is conducted in such a scientific as well as a practical manner that the result is a wheel which will give the maximum wear, with sufficient strength for the service for which it is intended.

The standard specification of the American Railway Association for chilled iron wheels is given in this chapter and recommended weights of wheels for various capacities of cars are shown on page 700.

For other products and branch offices, see classified and alphabetical indexes.

GRIFFIN WHEEL COMPANY, CHICAGO, ILL.

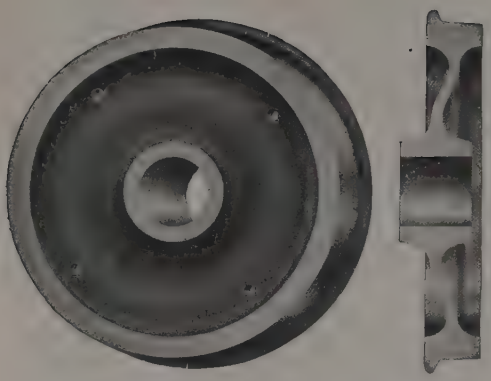


Fig. 1636—Solid Rolled Steel Wheel.

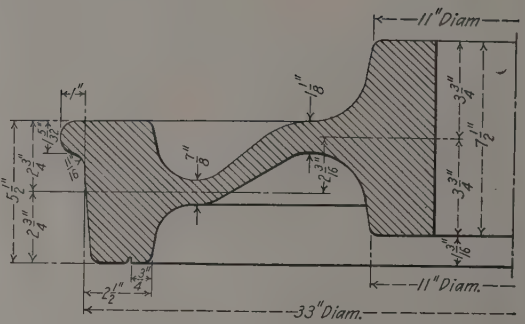


Fig. 1637—Section of Rolled Steel Wheel.

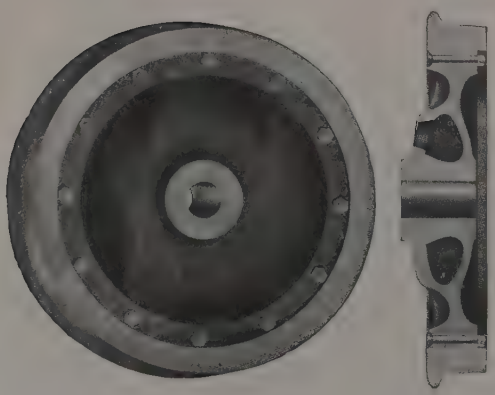


Fig. 1638—Cast Iron Plate Center with Tire Held by Shrinkage and Bolts.

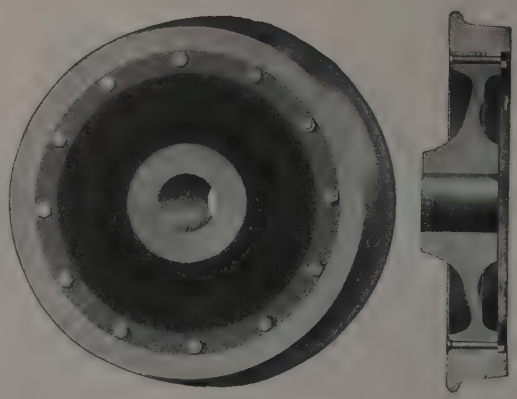


Fig. 1639—Cast Steel Plate Center with Tire Held by Shrinkage and Bolts.

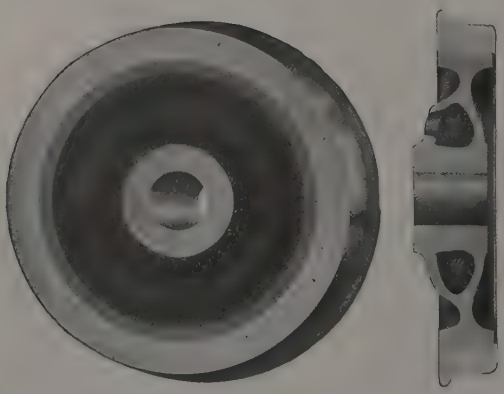


Fig. 1640—Cast Iron Plate Center with Tire Held by Shrinkage and Shoulder.

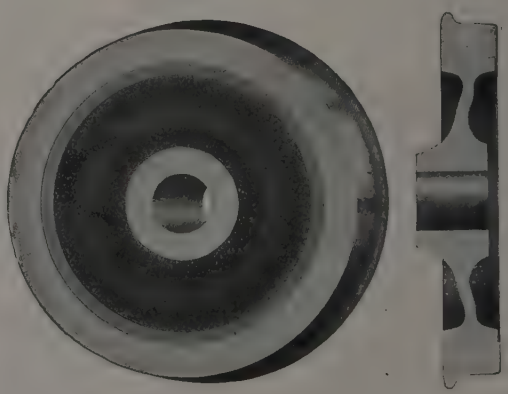


Fig. 1641—Cast Steel Plate Center with Tire Held by Shrinkage and Shoulder.

Standard Steel Works Company.

(*See also Page* 703)

Rolled Steel Wheel Manufacture

It is the practice of the Standard Steel Works Company to manufacture rolled steel wheels from individual ingots of open hearth steel. The ingots have the form of a truncated section of a cone on a short cylindrical base such as shown in Fig. 1642, and are each of the proper weight to produce a single wheel. The process of individual ingot manufacture developed by the company is such that the ingots are produced without the formation of extensive piping and any segregation is confined to a small central portion which is removed when the ingot is punched.

Fig. 1642—Blooming Press for Rolled Steel Wheels

In the first heating operation, the ingots are rolled slowly down the neck of a furnace in which the temperature rises as they advance, so that rapid heating is avoided. Each ingot when properly heated is placed under the blooming press as shown in Fig. 1642. This press, which has a capacity of 5,000 tons in the No. 1 mill and 10,000 tons in the No. 3 mill, presses the ingot to a cheese or "bloom" about 6 in. thick. Part of the hub is formed in this operation.

After the bloom has been reheated it is put under the blanking press—Fig. 1643. This press

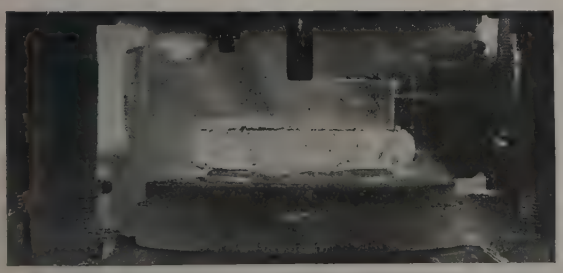


Fig. 1643—Blanking Press for Shaping Wheel

carries a pair of dies which form the "bloom" into a "blank" having the rough outline of a wheel but of a diameter from 4 to 8 in. smaller than the finished wheel, according to the size desired. The upper die carries a mandrel to maintain the bore while the hub is being formed.

After being again reheated the wheel "blank" goes to the rolling mill—Fig. 1644. A pair of side or web rolls driven by a steam engine take their bearings on the inner edges of the rim, and as they are forced together by the bell cranks, one of which is seen at the right of Fig. 1644, they reduce the section and increase the diameter of the rim. During the latter part of the rolling operation the wings of the web rolls take a

Fig. 1644—The Wheel Rolling Mill

bearing on the web or plate of the wheel. During the rolling the outer diameter of the rim is supported by a back roll which forms the contour of the tread and flange. The sides of the rim are supported by two edging rolls, one of which is seen in the center of Fig. 1644.

The wheel comes from the mill with a straight plate, and must be dished or coned to give the required hub projection and secure a more elastic form which is not so subject to excessive stresses in cooling. The coning is done on the

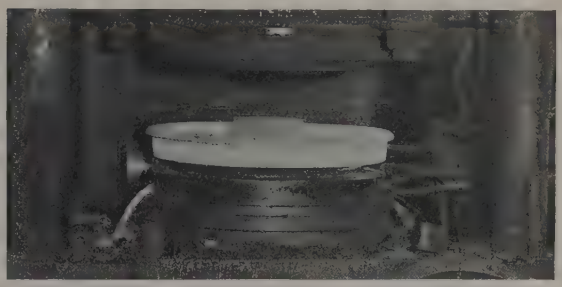


Fig. 1645—Press for Coning the Wheel After Rolling

press shown in Fig. 1645. From the coning press the wheels go to the cooling bed where they are piled in tiers five or six high to insure uniform cooling. In the machine shop the wheels are turned and are then finally inspected.

Fig. 1646—Final Inspection of the Rolled Steel Wheel

Rolled steel wheels are used for Pullman cars and other passenger cars, and for high capacity freight cars where immunity from wheel failures is of great importance.

For other products and branch offices, see classified and alphabetical indexes.

"Car Foundry" Chilled Iron Wheels

The purchase of chilled cast iron wheels is distinguished by a unique feature in that chemical analyses do not generally enter into the specifications. Therefore the responsibility which rests upon the manufacturer of this equipment is at once apparent when it is remembered that about 26,000,000 of these wheels are now in use, in the United States and Canada, not only on the steam railways, but also on street and interurban electric roads; and in mining, logging and contracting operations.

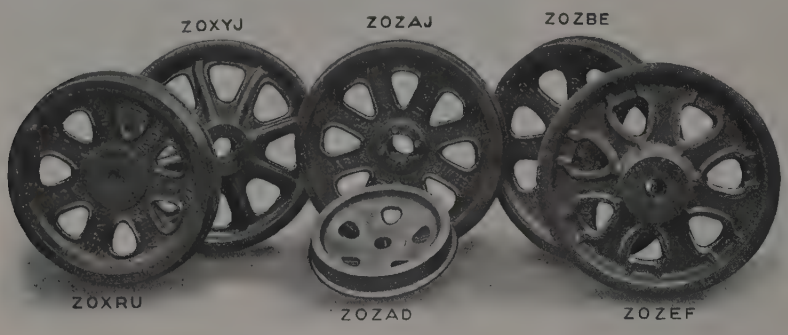


Fig. 1647—"Car Foundry" Chilled Iron Wheels for Electric Railway Cars

"Car Foundry" chilled iron wheels are made according to special formulas, and manufacturing processes are followed which many years of foundry experience, guided by the results in service, have shown to be the best suited for producing wheels of maximum wearing qualities and reliability. The care used in the foundries where these wheels are made is of exceptional importance. It is a generally accepted fact among foundrymen that in spite of perfect composition an inferior wheel will result from such faulty foundry practice as allowing wheels to become cold while pitting, or improperly maintaining pits and moulds. Improper composition may cause cracking of plates.

The performance of "Car Foundry" wheels has shown that they are economical in regard to both rail wear and brake shoe wear. These wheels are now being used in large numbers under 70-ton cars and have shown an even greater factor of safety than many similar wheels used under lighter cars.

Low rolling friction is also a characteristic of "Car Foundry" wheels and helps maintain high tonnage ratings. The extremely hard surface of the tread also will resist crushing or flowing under load so that the contour and rotundity of the wheel is maintained and the track structure is relieved of those stresses which result from the rolling action of a car due to wheel distortion.

The foundry capacity available in the plants of the American Car and Foundry Company is capable of providing 12,000 to 15,000 wheels per month. There are also complete facilities for refitting new wheels on old axles.

The types of wheels manufactured include those suitable for all types of passenger and freight cars, engine tenders, electric railway cars, and private car lines; also special and standard designs for all types of mine equipment, either plain or self-oiling, open or closed hub, closed hub with visible linchpin, roller bearing type, and motor wheels.

Fig. 1648—"Car Foundry" Wheels for Freight Cars and Engine Tenders

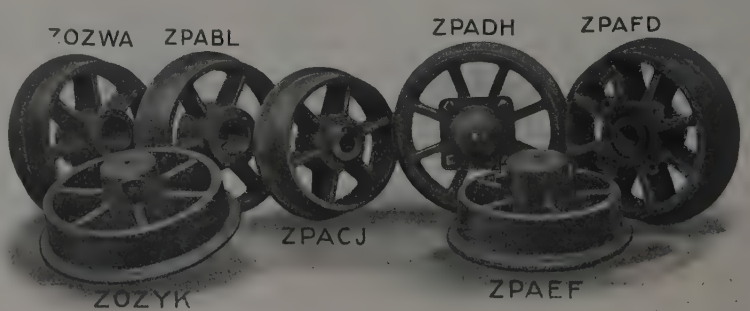


Fig. 1649—"Car Foundry" Wheels for Industrial, Mining, or Logging Cars

AMERICAN CAR AND FOUNDRY COMPANY, NEW YORK, N. Y.

For other products and branch offices, see classified and alphabetical indexes.

Springs

THE PRINCIPAL SPRINGS ON RAILWAY CARS are those used in truck construction and in draft gear; they may be of either elliptical or coil types. Specifications covering their design and manufacture adopted by the American Railway Association are as follows:

Elliptical Springs.

Recommended Practice—ADOPTED, 1917.

1. *Scope.*—These specifications cover all elliptical springs.

I. MANUFACTURE.

2. *Process.*—The steel may be made by the open-hearth, crucible or electric process.

3. *Bands.*—The bands of the springs shall be made of wrought iron conforming to the requirements of the A. R. A. Specifications for Refined Wrought-iron Bars, or if agreed upon, they may be made of "dead-soft" open-hearth steel, the carbon content of which shall not exceed 0.15 per cent. Bands of special design, subject to agreement between the manufacturer and the purchaser, may be made of cast steel conforming to the requirements of the A. R. A. Specifications for Steel Castings.

II. CHEMICAL PROPERTIES AND TESTS.

4. *Chemical Composition.*—The steel shall conform to the requirements of the A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

5. *Chemical Analyses.*—Ladle and check analysis shall be made in accordance with the requirements of the A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

6. *Number of Analyses.*—One analysis shall be made from each lot of 500 springs or less.

7. *Drillings for Analyses.*—Drillings for analyses shall be taken from pieces sheared from the bars during the process of manufacture, and not from the finished product, unless otherwise agreed upon.

III. PHYSICAL PROPERTIES AND TESTS.

8. *Physical Tests: Compression Method.*—(a) When the "compression" method is to be used, the properties specified in paragraphs (b), (c) and (d), modified if necessary to conform to the requirements of the appendix, shall be determined in the order specified. The spring shall not be rapped or otherwise disturbed during the test. The ends of the half-elliptic springs shall be supported on roller or swing bearings.

(b) The free height is the height of the spring after a test load of one and one-half times the specified working load has been applied and fully released.

(c) Loaded height and loaded length are respectively height and length when the specified working load is applied. The load shall be applied gradually and in such a way that the specified working load shall not be exceeded. If it is exceeded, the load shall be released to not more than one-half the specified working load and then increased to the specified working load. The loaded height shall not be less, but may be ⅜ in. more than that specified. The loaded length shall not vary more than ¼ in. from that specified.

(d) The permanent set of the spring is the difference, if any, between the free height and the height after the test load of one and one-half times the specified working load has again been applied and fully released. The following two requirements shall be met:

(1) The permanent set shall not exceed 1-32 in.

(2) If there is any permanent set not exceeding 1-32 in., the difference between the free height and the height after the test load of one and one-half times the specified working load has been applied and fully released two additional times, shall not be greater than the permanent set first measured.

9. *Physical Tests: Release Method.*—(a) When the "release" method is specified the properties specified in paragraphs (b), (c) and (d), modified if necessary to conform to the requirements of the appendix, shall be determined in the order specified. The spring shall not be rapped or otherwise disturbed during the test. The ends of the half-elliptic springs shall be supported on roller or swing bearings.

(b) The free height is the height of the spring after a test load of one and one-half times the specified working load has been applied and fully released.

(c) Loaded height and loaded length are respectively the height and length when a test load of one and one-half times the specified working load has been applied and is slowly released to the specified working load. If released to less than the specified working load, the load shall again be raised to one and one-half times the specified working load and then released to the specified working load. The loaded height shall not be more, but may be ⅜ in. less than that specified. The loaded length shall not vary more than ¼ in. from that specified.

(d) The permanent set of the spring is the difference, if any, between the free height and the height after the test load of one and one-half times the specified working load has again been applied and fully released. The following two requirements shall be met:

(1) The permanent set shall not exceed 1-32 in.

(2) If there is any permanent set not exceeding 1-32 in., the difference between the free height and the height after the test load of one and one-half times the specified working load has been applied and fully released two additional times, shall not be greater than the permanent set first measured.

10. *Number of Tests.*—(a) From each lot of springs which has met the requirements of Sections 11 and 13 the purchaser or his representative may select for physical tests at least 25 per cent to be tested in accordance with the "compression" method of Section 8, or, if specified, in accordance with the "release" method of Section 9 and the appendix.

(b) If any of the springs representing a lot fail to meet the requirements as to physical properties specified in Sections 8 or 9, as required, but at least one-half of the springs representing a lot do meet these requirements, each spring of the lot shall be tested, and those which meet the require-

ments shall be accepted. If more than one-half of the springs representing a lot fail to meet the requirements specified in Sections 8 or 9, as required, the lot represented will be rejected.

IV. Permissible Variations.

11. *Permissible Variations.*—The bars shall conform to the limits for spring steel bars as shown in the A. R. A. Specifications for Spring Steel Bars for Railway Springs.

V. Workmanship.

12. *Springs.*—The purchaser or his representative may examine all springs in each lot for workmanship and general dimensions.

13. *Bands.*—The bands of the springs shall not vary from the specified dimensions more than 1-16 in. in width and 1-32 in. in thickness of straps, nor more than ⅛ in. in width across the spring.

VI. Marking.

14. *Marking.*—(a) The name or brand of the manufacturer, the year and month of manufacture, and, if specified, the purchaser's class number, shall be legibly stamped on each spring at a place not detrimental to the life or service of the spring.

(b) Any stamping by the inspector shall be so placed as not to be detrimental to the life or service of the spring.

VII. Inspection and Rejection.

15. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the springs ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the springs are being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

16. *Rejection.*—(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Individual springs which, subsequent to the above tests at the mills or elsewhere and their acceptance, show defects or imperfections will be rejected and shall be replaced by the manufacturer.

17. *Rehearing.*—Samples tested in accordance with Section 4, which represent rejected material, shall be held for two weeks from the date of test report.

18. *Reworking.*—Any springs which fail to meet the requirements of the physical tests or conform to the specified dimensions may be again submitted after being reworked.

Test Fiber Stress.

19. (a) The properties and methods of testing specified in Sections 8 and 9 have been established for carbon-steel springs on the assumption that the maximum fiber stress under test shall not exceed 127,500 lb. per sq. in.*

Appendix.

**Important Note.*—The stress at 127,500 lb. per sq. in., referred to in Section 19-(a), is given solely as a limiting stress not to be exceeded in testing by the methods covered by the specifications. It is not intended as a guide in the design of springs, as the proper working fiber stress will depend on the class and design of the spring and on the service for which it is intended.

(b) For alloy-steel springs, practice has not been sufficiently well established to enable definite fiber stresses to be given. Unless otherwise agreed upon by the manufacturer and the purchaser, alloy-steel springs shall be tested under the conditions as to fiber stress specified for carbon-steel springs.

Relation Between Fiber Stress and Load.

20. To find the maximum loads under which the conditions of Section 19-(a) are fulfilled, the following formula shall be used:

$$P = \frac{2\,S\,n\,b\,h^2}{3\,L} \quad \ldots\ldots\ldots\ldots\ldots\ldots (*)$$

Where P = the load in lb.; S = the stress of the most strained fiber in lb. per sq. in.; n = the number of plates in half-elliptic springs, or half the number of plates in full elliptic springs; b = the width of each plate in inches; h = the thickness of each plate in inches; and L = the distance between supports, in inches, when the spring is loaded.

Test of Springs Not in Accordance With Preceding Rules.

21. If it is desired to purchase under these specifications springs in which the maximum fiber stress exceeds that specified in Section 19-(a), the tests shall be made as specified in Section 8 or 9, except that the test load to be applied shall not be one and one-half times the specified working load, but shall be the load which corresponds to the fiber stress of 127,500 lb. per sq. in., as determined by equation (*).

Test of Springs for Which no Working Load Is Specified.

22. If springs are ordered to free height and length only, and no working load and no loaded dimensions are specified, the tests specified in Sections 8 or 9 shall be made, using instead of the "specified working load" the load which corresponds to a fiber stress of 75,000 lb. per sq. in., as determined by equation (*).

Table to Facilitate Calculations.

23. Table 1, appended, is arranged to facilitate the calculations necessary to determine whether a spring can be tested in accordance with the specifications without exceeding the stress given in Section 19-(a). The table shows, for various lengths and for various thicknesses of plate, the loads per inch of effective width of spring cor-

TABLE NO. 1

Test Loads for Elliptic Springs, in Pounds Per Inch of Effective Width, Which Will Correspond to a Maximum Fiber Stress of 127,500 Lb. Per Sq. In.

Length of Spring,	Thickness of Plate, In.						
In.	5/16	¼	3/8	7/16	½	5/8
20	150	265	...	...	...	...	...
22	136	241	377	...	...	...	...
24	125	221	345	497	...	...	...
26	115	204	319	460	625	...	...
28	107	190	296	427	581	760	...
30	100	177	277	398	543	707	896
32	...	166	259	374	509	665	840
34	...	156	244	351	479	625	791
36	...	148	230	332	452	590	748
38	...	140	218	314	429	560	708
40	...	133	208	298	407	531	673
42	...	126	198	284	388	506	640
44	...	...	189	272	370	483	612
46	...	...	180	260	354	462	585
48	...	...	...	249	339	443	561
50	...	...	...	239	325	425	538
52	...	...	...	...	313	409	518
54	...	...	...	...	302	394	499
56	...	...	...	...	...	380	481
58	...	...	...	...	...	366	465
60	...	...	...	...	...	354	450

responding to a fiber stress of 127,500 lb. per sq. in. These are the maximum allowable test loads and shall not be exceeded in any tests.

The loads are given per inch of effective width of spring.

The effective width of spring is understood to mean the width of the indiviidual plate multiplied by the number of plates as defined in Section 20. Consequently the total load in pounds for any spring is found by multiplying the value from Table 1 by the product of the width of plate into the number of plates.

Helical Springs.

Standard—ADOPTED, 1916; REVISED, 1917.

1. *Scope.*—These specifications cover all helical springs.

I. MANUFACTURE.

2. *Process.*—The steel may be made by the open-hearth, crucible or electric process.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the requirements of the A. R. A. Specifications of Carbon Steel Bars or Railway Springs.

4. *Chemical Analyses.*—Ladle and check analyses shall by made in accordance with the requirements of the A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

5. *Number of Analyses.*—One check analysis may be made by the purchaser from each 20,000 lb. or fraction thereof of each diameter of wire.

6. *Sample for Analysis.*—(a) If the section is large a specimen weighing about ½ lb. shall be cut from any part of the spring, or if the spring is small the entire spring may be taken. If the sample is cut off hot it shall be cooled in such a way as not to harden it. The inspector shall stamp the sample with his private mark as soon as it is cut off.

(b) The drillings for check analysis shall be made from the samples so selected; the drill to be approximately one-half the diameter of the wire. The drillings shall be mixed from the total drillings obtained by passing entirely through the section of the wire.

III. PHYSICAL PROPERTIES AND TESTS.

7. *Physical Tests.*—(a) The properties specified in paragraphs (b), (c), (d) and (e), modified, if necessary, to conform to the requirements of the appendix, shall be determined in the order specified. The spring shall not be rapped or otherwise disturbed during the test.

(b) The solid height of the spring is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load of at least one and one-quarter times that necessary to bring all coils in contact. The solid height shall not vary more than ⅛ in. from that specified.

(c) The free height is the height of the spring when the load specified in paragraph (b) has been released, and is determined by placing a straight-edge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straight-edge at the approximate center of the spring. The free height shall not vary more than ⅛ in. from that specified.

(d) The loaded height of the spring is the difference between the plates of the testing machine when the specified working load is applied. The loaded height shall not vary more than ⅛ in. over nor more than 1-16 in. under that specified.

(e) The permanent set of the psring is the difference, if any, between the free height and the height after the spring has been compressed solid three times in rapid succession, with the test load specified in paragraph (b), measured at the same point and in the same manner. The permanent set shall not exceed 1-32 in.

8. *Number of Tests.*—(a) A lot for physical test shall consist of not more than 500 individual coils, regardless of the grouping.

(b) From each lot of springs which has met the requirements of Sections 10 and 11, the purchaser or his representative may select for physical test at least 10 per cent, to be tested in accordance with the requirements of Section 7 and the appendix.

9. *Retests.*—If any of the springs representing a lot fail to meet the requirements as to physical properties specified in Section 7, but at least one-half of the springs representing a lot do meet these requirements, each spring of the lot shall be tested, and those which meet the requirements shall be accepted. If more than one-half of the springs representing a lot fail to meet the requirements specified in Section 7, the lot will be rejected.

IV. PERMISSIBLE VARIATIONS.

10. *Bars.*—The gage of the bars shall be within the limits as specified in the A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

11. *Springs.*—(a) The outside dimensions of the springs, excepting the height, shall not vary more than 1-16 in. from that specified.

(b) When under the specified working load, at the loaded height, the spring shall be of uniform pitch within 15 per cent of the diameter of the wire throughout the length of the bar, excluding the tapered section.

V. WORKMANSHIP.

12. *Workmanship.*—The springs shall be of a uniform pitch, with the ends tapered to give a reasonably square, firm bearing. The points of the bars shall not protrude beyond the outside diameter of the springs.

V. MARKING.

13. *Marking.*—(a) The name or brand of the manufacturer, the year and month of manufacture and, if specified, the purchaser's class number, shall be legibly stamped on each spring at a place not detrimental to the spring.

(b) Any stamping by the inspector shall be so placed as not to be detrimental to the life of service of the spring.

VII. INSPECTION AND REJECTION.

14. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the springs ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the springs are being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

15. *Rejection.*—(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Individual springs which, subsequent to the above tests at the mills or elsewhere and their acceptance, show defects or imperfections will be rejected and shall be replaced by the manufacturer.

16. *Rehearing.*—Samples tested in accordance with Sec-

tion 3, which represent rejected material, shall be held for two weeks from the date of test report.

17. *Reworking.*—Any springs which fail to meet the requirements of the physical tests or conform to the specified dimensions may be again submitted after being reworked.

APPENDIX.

**Important Note.*—The stress of 90,000 lb. per sq. in., referred to in Section 18 (a), is given solely as a limiting stress not to be exceeded in testing by the methods covered by the specifications. It is not intended as a guide in the design of springs, as the proper working fiber stress will depend upon the class and design of the spring and upon the service for which it is intended.

TEST FIBER STRESS.

18. (a) The properties and methods of testing specified in Section 7 have been etstablished for carbon-steel springs on the assumption that the maximum fiber stress under test shall not exceed 90,000 lb. per sq. in.*

(b) For alloy-steel springs practice has not been sufficiently well established to enable definite fiber stresses to be given. Unless otherwise agreed upon by the manufacturer and the purchaser, alloy-steel springs shall be tested under the conditions, as to fiber stress, specified for carbon-steel springs.

RELATION BETWEEN FIBER STRESS AND LOAD.

19. To find the maximum load under which the conditions of Section 18 (a) are fulfilled the following formula shall be used:

$$P = \frac{3.1416\ S\ d^3}{8\ M} \quad \ldots\ldots\ldots\ldots\ldots\ldots (*)$$

Where P = the load in pounds, S = the stress ot the most strained fiber in pounds per sq. in., d = the diameter of the bar in inches, and M = the mean diameter of the helix in inches; this is found by subtracting the diameter or thickness of bar from the outside diameter of spring.

TEST OF SPRINGS NOT IN ACCORDANCE WITH PRECEDING RULES:

20. If it is desired to purchase under these specifications springs in which the maximum fiber stress exceeds that specified in Section 18 (a), the tests shall be made as specified in Section 7, except that the maximum test load to be applied in determining the properties specified in Section 7 (b) and (e) shall not be sufficient to compress the spring solid, but shall be the load which corresponds to a fiber stress of 90,000 lb. per sq. in., as determined by equation (*).

TABLE TO FACILITATE CALCULATIONS.

21. Table I appended arranged to facilitate the calculations necessary to determine whether a spring can be tested in accordance with the specification without exceed-

TABLE No. 1.

TEST LOADS FOR HELICAL SPRINGS, IN LB., WHICH WILL CORRESPOND TO A MAXIMUM FIBER STRESS OF 90,000 LB. PER SQ. IN.

Outside Diameter of Spring, In.	DIAMETER OF BAR, INCHES.																					Outside Diameter of Spring, In.
	1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	
2	640	1 145	1 895	2 950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
2¼	555	995	1 630	2 530	3 730	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2¼
2½	495	880	1 310	2 215	3 250	4 620	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2½
2¾	445	785	1 180	1 970	2 880	4 080	5 580	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2¾
3	400	710	1 070	1 770	2 580	3 650	4 980	6 630	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
3¼	.....	650	985	1 610	2 340	3 300	4 500	5 970	7 800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3¼
3½	.....	.....	910	1 475	2 140	3 010	4 100	5 420	7 080	9 020	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3½
3¾	.....	.....	.....	1 360	1 970	2 770	3 750	4 970	6 450	8 250	10 390	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3¾
4	.....	.....	.....	1 265	1 830	2 560	3 470	4 600	5 950	7 590	9 550	11 800	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
4¼	.....	.....	.....	.....	1 710	2 390	3 230	4 260	5 540	7 030	8 830	10 880	13 270	.....	.....	.....	.....	.....	.....	.....	.....	4¼
4½	.....	.....	.....	.....	1 600	2 230	3 020	3 980	5 150	6 550	8 200	10 100	12 350	14 900	.....	.....	.....	.....	.....	.....	.....	4½
4¾	.....	.....	.....	.....	.....	2 100	2 830	3 730	4 830	6 120	7 680	9 450	11 500	13 850	16 700	.....	.....	.....	.....	.....	.....	4¾
5	.....	.....	.....	.....	.....	1 980	2 670	3 510	4 540	5 750	7 200	8 850	10 750	12 950	15 600	18 500	.....	.....	.....	.....	.....	5
5¼	.....	.....	.....	.....	.....	.....	2 520	3 310	4 290	5 410	6 780	8 330	10 120	12 150	14 650	17 300	20 200	.....	.....	.....	.....	5¼
5½	.....	.....	.....	.....	.....	.....	2 390	3 140	4 050	5 130	6 400	7 880	9 580	11 500	13 800	16 300	19 100	22 700	.....	.....	.....	5½
5¾	.....	.....	.....	.....	.....	.....	.....	2 980	3 850	4 870	6 070	7 450	9 050	10 850	13 050	15 400	18 000	21 400	24 000	.....	.....	5¾
6	.....	.....	.....	.....	.....	.....	.....	2 840	3 660	4 630	5 770	7 080	8 600	10 300	12 350	14 600	17 000	20 300	23 200	26 600	30 400	6
6¼	.....	.....	.....	.....	.....	.....	.....	.....	3 500	4 410	5 500	6 740	8 220	9 800	11 750	13 850	16 450	19 300	21 500	25 200	28 800	6¼
6½	.....	.....	.....	.....	.....	.....	.....	.....	3 340	4 220	5 250	6 440	7 850	9 350	11 200	13 200	15 400	18 300	20 500	24 000	27 400	6½
6¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	4 040	5 030	6 150	7 500	8 950	10 700	12 600	14 700	17 500	19 300	22 800	26 100	6¾
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	3 870	4 820	5 900	7 180	8 550	10 200	12 050	14 000	18 700	18 000	21 800	24 800	7
7½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4 450	5 450	6 620	7 880	9 450	11 100	12 850	15 300	17 100	19 800	22 800	7½
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6 150	7 300	8 730	10 250	11 900	14 150	15 800	18 400	21 000	8
8½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5 730	6 800	8 150	9 550	11 100	13 100	14 700	17 100	19 500	8½
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6 380	7 620	8 950	10 350	12 250	13 700	15 900	18 200	9
9½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7 150	8 400	9 730	11 550	12 800	14 900	17 000	9½
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7 920	9 180	10 850	12 000	14 100	16 000	10
10½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8 700	10 300	11 400	13 300	15 100	10½
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9 750	10 850	12 600	14 300	11
11½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10 300	12 000	13 600	11½
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11 400	12 900	12

Carbon Steel Bars for Railway Springs.

Standard—ADOPTED, 1917.

1. *Scope.*—(a) These specifications cover two classes of bars, determined by their carbon ranges as specified in Section 3.

(b) The purposes for which these classes are frequently used, depending upon the design and upon the stresses and services to be imposed, are as follows:

Class A, for elliptical and helical springs.

Class B, for helical springs.

I. MANUFACTURE.

2. *Process.*—The steel shall be made by the open-hearth

process, by the crucible process or the electric process.

II. Chemical Properties and Tests.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Elements Considered	Class A	Class B
Carbon, per cent	0.90—1.10	0.95—1.15
Manganese, max. per cent	0.50	0.50
Phosphorus, max. per cent	0.05	0.05
Sulphur, max. per cent	0.05	0.05

4. *Ladle Analyses.*—An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, a copy of which shall be given to the purchaser or his representative. This analysis shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—Analyses may be made by the purchaser from finished bars representing each melt, which shall conform to the requirements specified in Section 3.

III. Permissible Variations in Gage.

6. *Permissible Variations.*—The dimensions of the bars shall not vary from those ordered more than the amount shown in the following table:

FLATS

Size	Width, In. Over	Width, In. Under	Thickness, In. Up to 3/8 In., Inclusive Over	Thickness, In. Up to 3/8 In., Inclusive Under	Thickness, In. Over 3/8 to 3/4 In., Inclusive Over	Thickness, In. Over 3/8 to 3/4 In., Inclusive Under
1 to 2 in., incl.	0.015	0.015	0.015	0.005	0.015	0.010
Over 2 to 4 in., incl.	0.047	0.015	0.015	0.005	0.015	0.010
Over 4 to 5 in., incl.	0.047	0.032	0.015	0.005	0.015	0.010
Over 5 to 6 in., incl.	0.062	0.032	0.015	0.005	0.015	0.010

ROUNDS AND SQUARES

Size	Diameter or Thickness, In. Over	Under
Up to 5/16 in., incl.	0.005	0.005
Over 5/16 to 7/16 in., incl.	0.007	0.005
Over 7/16 to 5/8 in., incl.	0.009	0.005
Over 5/8 to 7/8 in., incl.	0.010	0.006
Over 7/8 to 1 in., incl.	0.011	0.007
Over 1 to 1 1/8 in., incl.	0.012	0.008
Over 1 1/8 to 1 1/4 in., incl.	0.013	0.009
Over 1 1/4 to 1 3/8 in., incl.	0.014	0.010
Over 1 3/8 to 1 1/2 in., incl.	0.016	0.011
Over 1 1/2 to 2 in., incl.	0.019	0.012

IV. Finish.

7. *Finish.*—The finished bars shall be free from injurious defects and shall have a workmanlike finish.

V. Marking.

8. *Marking.*—The bars shall, when loaded for shipment, be properly separated and marked with the name or brand of the manufacturer and the melt number for identification.

VI. Inspection and Rejection.

9. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the bars ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the bars are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

10. *Rejection.*—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 5 shall be reported within five working days from receipt of samples.

(b) Bars which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

11. *Rehearing.*—Samples tested in accordance with Section 5, which represent rejected bars, shall be held for two weeks from the date of test report.

Chrome Molybdenum Alloy Steel Helical Springs—Classes L, M, N and O.

Tentative—ADOPTED, 1921.

To Supersede Present Standard Classes, B, C, D and H.

I. Manufacture.

1. *Process.*—The steel may be made by the open-hearth, crucible or electric furnace process.

II. Chemical Properties and Tests.

2. *Chemical Composition.*—The steel shall conform to

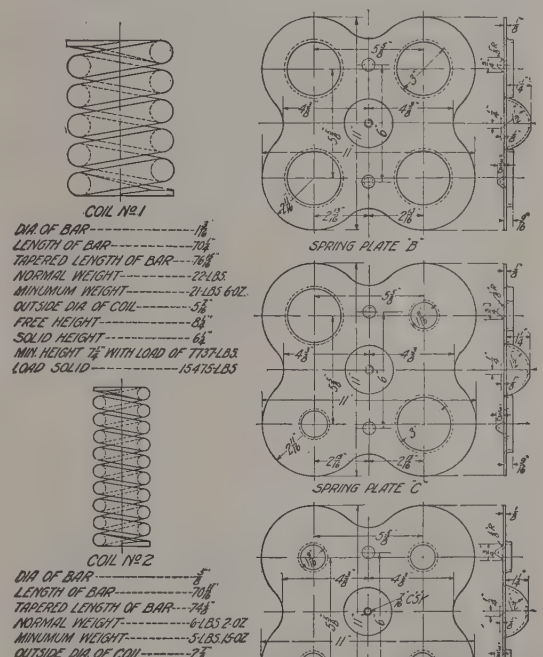

COIL No.1
DIA. OF BAR---1 1/8"
LENGTH OF BAR---70 1/8"
TAPERED LENGTH OF BAR---76 1/8"
NORMAL WEIGHT---22 LBS.
MINIMUM WEIGHT---21 LBS 6 OZ.
OUTSIDE DIA OF COIL---5 1/8"
FREE HEIGHT---8 1/8"
SOLID HEIGHT---6 1/4"
MIN. HEIGHT 7 1/4" WITH LOAD OF 7137 LBS.
LOAD SOLID---15475 LBS
SPRING PLATE "B"
SPRING PLATE "C"
COIL No.2
DIA OF BAR---1"
LENGTH OF BAR---70 1/8"
TAPERED LENGTH OF BAR---74 1/8"
NORMAL WEIGHT---6 LBS 2 OZ.
MINIMUM WEIGHT---5 LBS. 15 OZ.
OUTSIDE DIA OF COIL---2 3/8"
FREE HEIGHT---8 1/8"
SOLID HEIGHT---6 1/4"
MIN. HEIGHT 7 1/4" WITH LOAD OF 2130 LBS.
LOAD SOLID---4260 LBS
ENDS GROUND
SPRING PLATE "D"

Fig. 1650—Springs and Spring Caps for Freight Car Trucks—Classes L, M, N, O and P.

the following requirements as to the chemical composition:

Elements Considered.	
Carbon, per cent	.40— .50
Manganese, per cent	.40— .60
Chromium, per cent	.80—1.10
Molybdenum, per cent	.30— .50
Phosphorus, maximum, per cent	.04
Sulphur, maximum, per cent	.045
Silicon, maximum, per cent	.25

3. *Check Analyses.*—An analysis may be made by the purchaser from a sample representing each 20,000 lbs., or fraction thereof, of each size of spring steel involved. The chemical composition thus determined shall conform to the requirements specified in Section 2 of this specification.

4. *Sample for Analysis.*—(a) If the section is large, a specimen weighing about ½ lb. shall be cut from any part of the spring, or if the spring is small, the entire spring may be taken. If the sample is cut off hot, it shall be

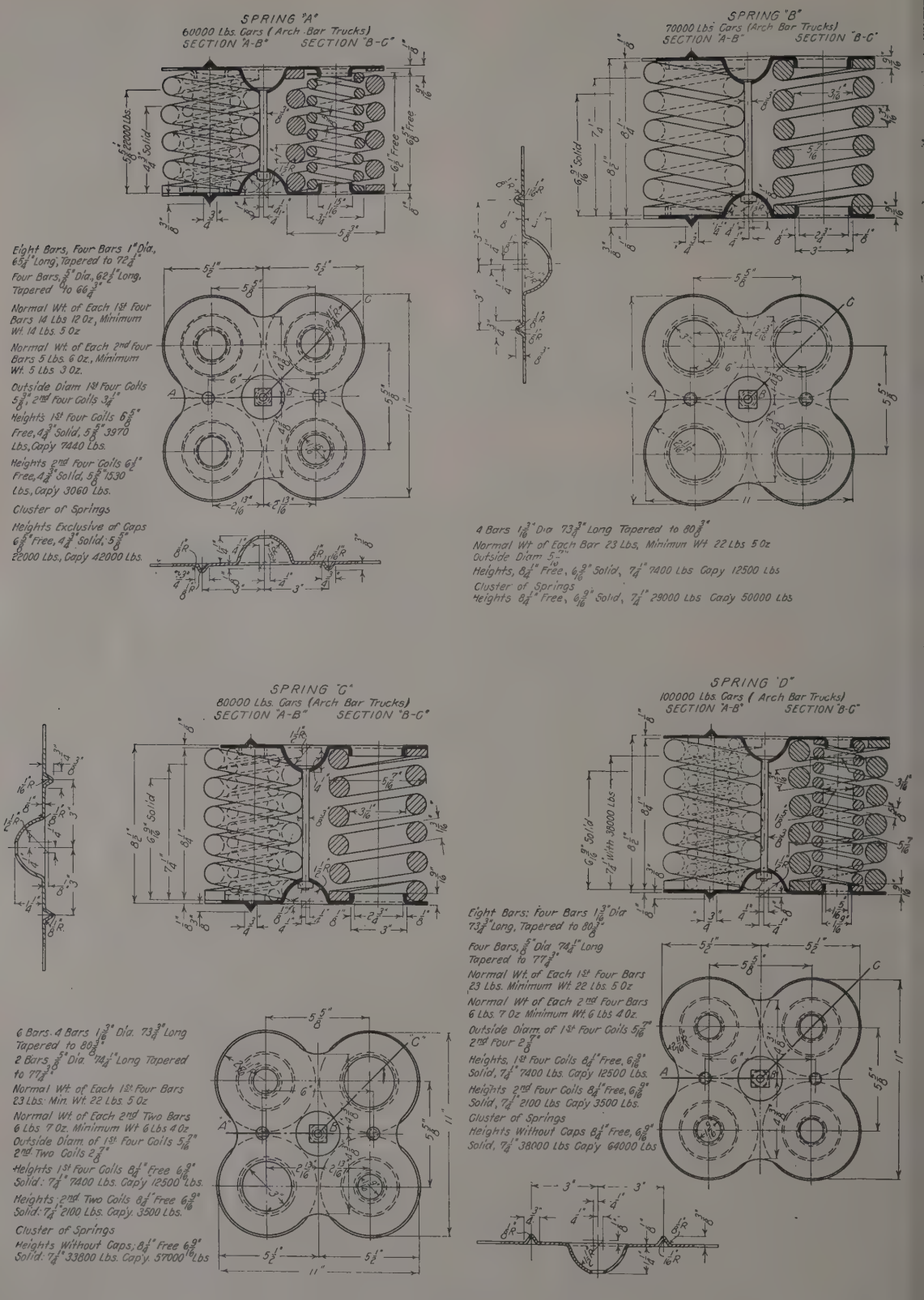
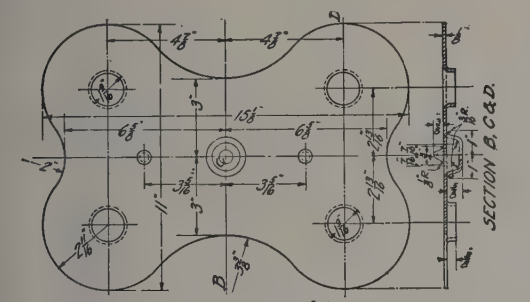
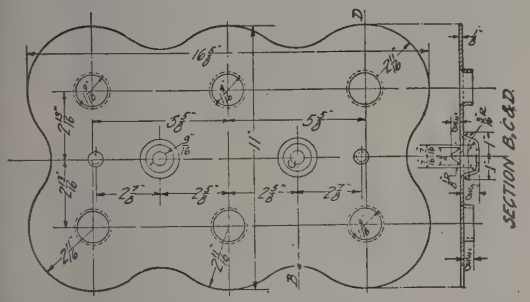

SPRING "A"
60000 Lbs. Cars (Arch Bar Trucks)
SECTION "A-B"
SECTION "B-C"
Eight Bars, Four Bars 1" Dia., 63/4" Long, Tapered to 72/4"
Four Bars, 7/8" Dia., 62 1/2" Long, Tapered to 66 3/8"
Normal Wt. of Each 1st Four Bars 14 Lbs 12 Oz., Minimum Wt 14 Lbs. 5 Oz
Normal Wt. of Each 2nd four Bars 5 Lbs. 6 Oz., Minimum Wt. 5 Lbs 3 Oz.
Outside Diam 1st Four Coils 5 7/8", 2nd Four Coils 3 1/4"
Heights 1st Four Coils 6 5/8" Free, 4 3/4" Solid, 5 5/8" 3970 Lbs, Capy 7440 Lbs.
Heights 2nd Four Coils 6 1/2" Free, 4 3/4" Solid, 5 3/8" 1530 Lbs., Capy 3060 Lbs.
Cluster of Springs
Heights Exclusive of Caps 6 5/8" Free, 4 3/4" Solid, 5 3/8" 22000 Lbs, Capy 42000 Lbs.
SPRING "B"
70000 Lbs Cars (Arch Bar Trucks)
SECTION "A-B"
SECTION "B-C"
4 Bars 1 3/16" Dia 73 3/8" Long Tapered to 80 3/8"
Normal Wt of Each Bar 23 Lbs, Minimum Wt 22 Lbs 5 Oz
Outside Diam 5 5/8"
Heights, 8 1/4" Free, 6 9/16" Solid, 7 1/4" 7400 Lbs Capy 12500 Lbs
Cluster of Springs
Heights 8 1/4" Free, 6 9/16" Solid, 7 1/4" 29000 Lbs Capy 50000 Lbs
SPRING "C"
80000 Lbs. Cars (Arch Bar Trucks)
SECTION "A-B"
SECTION "B-C"
6 Bars. 4 Bars 1 3/16" Dia. 73 3/8" Long Tapered to 80 3/8"
2 Bars, 7/8" Dia 74 1/4" Long Tapered to 77 3/8"
Normal Wt. of Each 1st Four Bars 23 Lbs. Min. Wt. 22 Lbs. 5 Oz
Normal Wt. of Each 2nd Two Bars 6 Lbs 7 Oz. Minimum Wt 6 Lbs 4 Oz
Outside Diam. of 1st Four Coils 5 7/8" 2nd Two Coils 2 7/8"
Heights 1st Four Coils 8 1/4" Free 6 9/16" Solid: 7 1/4" 7400 Lbs. Capy 12500 Lbs.
Heights 2nd Two Coils 8 1/4" Free 6 9/16" Solid: 7 1/4" 2100 Lbs. Capy. 3500 Lbs.
Cluster of Springs
Heights Without Caps; 8 1/4" Free 6 9/16" Solid: 7 1/4" 33800 Lbs. Capy. 57000 Lbs
SPRING "D"
100000 Lbs. Cars (Arch Bar Trucks)
SECTION "A-B"
SECTION "B-C"
Eight Bars: Four Bars 1 3/16" Dia 73 3/8" Long, Tapered to 80 3/8"
Four Bars, 7/8" Dia 74 1/4" Long Tapered to 77 3/8"
Normal Wt. of Each 1st Four Bars 23 Lbs. Minimum Wt. 22 Lbs. 5 Oz
Normal Wt of Each 2nd Four Bars 6 Lbs. 7 Oz Minimum Wt. 6 Lbs 4 Oz.
Outside Diam of 1st Four Coils 5 7/8" 2nd Four 2 7/8"
Heights, 1st Four Coils 8 1/4" Free, 6 9/16" Solid, 7 1/4" 7400 Lbs. Capy 12500 Lbs.
Heights 2nd Four Coils 8 1/4" Free, 6 9/16" Solid, 7 1/4" 2100 Lbs Capy 3500 Lbs.
Cluster of Springs
Heights Without Caps 8 1/4" Free, 6 9/16" Solid, 7 1/4" 38000 Lbs Capy 64000 Lbs

FIG. 1651—STANDARD A. R. A. CLASS A, B, C, AND D SPRINGS AND SPRING CAPS FOR FREIGHT CAR TRUCKS

cooled in such a way as not to harden it. The inspector shall stamp the sample with his private mark as soon as it is cut off.

(b) The drillings for check analysis shall be made from the sample so selected; the drill to be approximately one-half the diameter of the wire. The drillings shall be mixed from the total drillings obtained by passing entirely through the section of the wire.





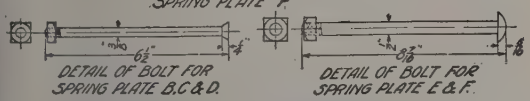


TABLE OF SPRING GROUPS

CLASS OF		Nº OF COILS		SPRING	HEIGHT INCLUDING PLATES		CAPACITY	
TRUCK	SPRING	Nº 1	Nº 2	PLATE	FREE	SOLID	SOLID	FOR H=7/8
2B	L	4	0	B	8 3/8"	6 3/8"	61900	30950
2C	M	4	2	C	8 3/8"	6 3/8"	70420	35210
2D	N	4	4	D	8 3/8"	6 3/8"	78940	39470
2E	O	5	5	E	8 3/8"	6 3/8"	98675	49338
2F	P	6	6	F	8 3/8"	6 3/8"	118410	59205

WHEN USING SPRING "O" OR "P" CLEARANCE FOR BOLT WHEN SPRING IS COMPRESSED, MUST BE PROVIDED IN SIDE FRAME OR BOLSTER.

FIG. 1652—SPRINGS AND SPRING CAPS FOR FREIGHT CARS—CLASSES L, M, N, O AND P.

III. PHYSICAL PROPERTIES AND TESTS.

5. *Physical Tests.*—(a) The properties specified in paragraphs (b), (c), (d) and (e), shall be determined in the order specified. The spring shall not be rapped or otherwise disturbed during the test.

(b) *Solid Height.*—The solid height is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load of at least one and one-quarter times that necessary to bring all coils in contact. The solid height shall not exceed that specified by more than 1/16 in.

(c) *Free Height.*—The free height is the height of the spring when the load specified in paragraph (b) has been released, and is determined by placing a straight-edge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straight-edge at the approximate center of the spring. The free height shall not exceed that specified by more than 1/8 in.

(d) *Loaded Height.*—The loaded height is the difference between the plates of the testing machine when the specified working load is applied. The loaded height shall not vary more than 1/32 in. under that specified.

(e) *Permanent Set.*—(1) The permanent set is the difference, if any, between the free height and the height after the spring has been compressed solid three times in rapid succession, with the test load specified in paragraph (b), measured at the same point and in the same manner. The permanent set shall not exceed 1/32 in.

(2) If there is any permanent set not exceeding 1/32 in. the difference between the free height and the height after the test load of 1½ times the specified working load has been applied and fully released two additional times, shall not be greater than the permanent set which was at first measured.

6. *Number of Tests.*—(a) A lot for physical test shall consist of not more than 500 individual coils, regardless of the grouping.

(b) From each lot of springs which has met the requirements of Sections 8 and 9, the purchaser or his representative may select for physical test at least 10 per cent of the total to be tested in accordance with the requirements of Section 5.

7. *Retests.*—If any of the springs representing a lot fail to meet the requirements as to physical properties specified in Section 5, but at least one-half of the springs representing a lot do meet these requirements, each spring of the lot shall be tested, and those which meet the requirements shall be accepted. If more than one-half of the springs representing a lot fail to meet the requirements specified in Section 5, the lot will be rejected.

IV. PERMISSIBLE VARIATIONS.

8. *Bars.*—The gage of the bars shall be within the limits as specified in A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

9. *Springs.*—The outside dimensions of the springs, excepting the height, shall not vary more than 1/16 in. from that specified.

V. WORKMANSHIP.

10. *Workmanship.*—(a) The springs shall be of a uniform pitch. The ends shall be tapered to present a flat bearing surface of at least two-thirds the circumference, at right angles to the axis of the springs within a tolerance of 1/8 in. to the foot.

(b) The spring bars shall be free from seams, excessive scale, roll marks or scratches which may constitute injurious defects.

VI. MARKING.

11. *Marking.*—(a) The name or brand of the manu-

FOOTNOTE: A suggested heat treatment is as follows:
(a) The coiling should be done at temperatures between 1,700° F. and 1,800° F. and the steel shall be cooled slowly in air, not quenched from the coiling heat, until black.
(b) Springs should be reheated after coiling to a temperature of 1,525° F. to 1,575° F. and quenched in oil.
(c) Springs should be removed from the oil when at a temperature of about 300° F. and either allowed to cool slowly in air or immersed immediately in the drawing bath. The springs should be drawn as soon as possible after quenching.
(d) The drawing should be done in a salt bath at a temperature of 940° F. to 960° F. and the springs should be allowed to remain in the bath and at that temperature for at least one hour.
NOTE: The unsatisfactory service of Class "D" bolster springs for trucks of cars of 100,000 capacity has been brought to the attention of the Association, and the Committee on Car Construction has prepared designs for alternate springs L, M, N and O to be substituted for present standard springs B, C, D and N. The Committee on Specifications and Tests for Materials has prepared this tentative specification for Chrome Molybdenum Alloy Helical Springs to be used for one year or until further action is recommended by the Committee.

facturer, the year and month of manufacture and, if specified, the purchaser's class number, shall be legibly stamped on each spring at a place and in such a manner as not to be detrimental to the life of the spring.

(b) Any stamping by the inspector shall be so placed as not to be detrimental to the life or service of the spring.

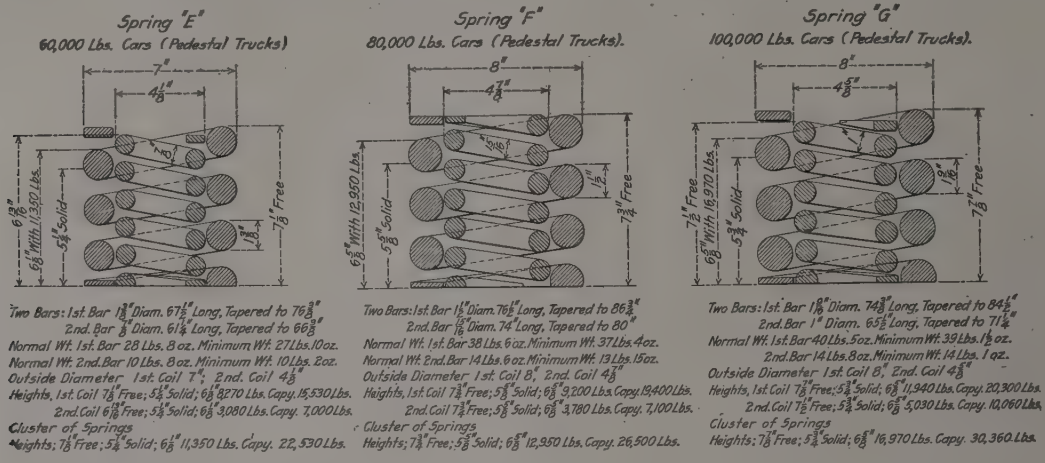

Spring "E"
60,000 Lbs. Cars (Pedestal Trucks)
Spring "F"
80,000 Lbs. Cars (Pedestal Trucks).
Spring "G"
100,000 Lbs. Cars (Pedestal Trucks).
Two Bars: 1st. Bar 1 3/8" Diam. 67 1/2" Long, Tapered to 76 3/8"
2nd. Bar 1" Diam. 61 1/4" Long, Tapered to 66 3/8"
Normal Wt. 1st. Bar 28 Lbs. 8 oz. Minimum Wt. 27 Lbs. 10 oz.
Normal Wt. 2nd. Bar 10 Lbs. 8 oz. Minimum Wt. 10 Lbs. 2 oz.
Outside Diameter 1st. Coil 7"; 2nd. Coil 4 3/8"
Heights, 1st. Coil 7 1/8" Free; 5 1/4" Solid; 6 3/8" 8270 Lbs. Capy. 15,530 Lbs.
2nd. Coil 6 1/8" Free; 5 1/4" Solid; 6 3/8" 3,080 Lbs. Capy. 7,000 Lbs.
Cluster of Springs
Heights; 7 1/8" Free; 5 1/4" Solid; 6 3/8" 11,350 Lbs. Capy. 22,530 Lbs.
Two Bars: 1st. Bar 1 1/2" Diam. 76 1/2" Long, Tapered to 86 3/4"
2nd. Bar 1 5/16" Diam. 74" Long, Tapered to 80"
Normal Wt. 1st. Bar 38 Lbs. 6 oz. Minimum Wt. 37 Lbs. 4 oz.
Normal Wt. 2nd. Bar 14 Lbs. 6 oz. Minimum Wt. 13 Lbs. 15 oz.
Outside Diameter 1st. Coil 8", 2nd. Coil 4 3/8"
Heights, 1st. Coil 7 3/4" Free; 5 3/8" Solid; 6 5/8" 9,200 Lbs. Capy. 19,400 Lbs.
2nd. Coil 7 3/4" Free; 5 3/8" Solid; 6 5/8" 3,780 Lbs. Capy. 7,100 Lbs.
Cluster of Springs
Heights; 7 3/4" Free; 5 3/8" Solid; 6 5/8" 12,950 Lbs. Capy. 26,500 Lbs.
Two Bars: 1st. Bar 1 5/8" Diam. 74 3/8" Long, Tapered to 84 1/2"
2nd. Bar 1" Diam. 65 1/2" Long, Tapered to 71 1/4"
Normal Wt. 1st. Bar 40 Lbs. 5 oz. Minimum Wt. 39 Lbs. 1 1/2 oz.
2nd. Bar 14 Lbs. 8 oz. Minimum Wt. 14 Lbs. 1 oz.
Outside Diameter 1st. Coil 8", 2nd. Coil 4 3/8"
Heights, 1st. Coil 7 5/8" Free; 5 3/4" Solid; 6 3/8" 11,940 Lbs. Capy. 20,300 Lbs.
2nd. Coil 7 5/8" Free; 5 3/4" Solid; 6 3/8" 5,030 Lbs. Capy. 10,060 Lbs.
Cluster of Springs
Heights; 7 7/8" Free; 5 3/4" Solid; 6 3/8" 16,970 Lbs. Capy. 30,360 Lbs.

FIG. 1653—A. R. A. STANDARD SPRINGS AND SPRING CAPS FOR FREIGHT CAR TRUCKS—CLASSES E, F, G.

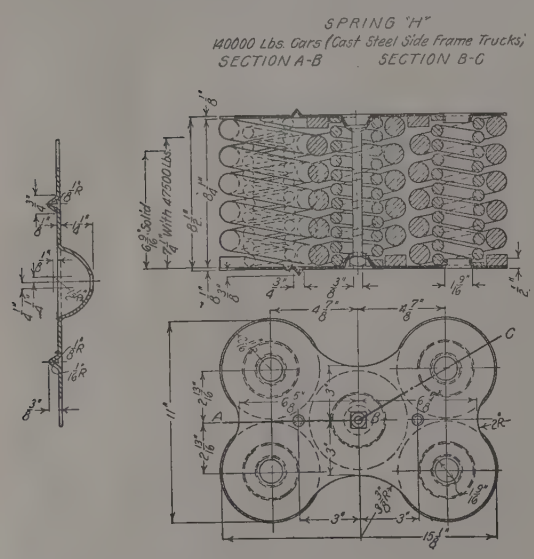

SPRING "H"
140000 Lbs. Cars (Cast Steel Side Frame Trucks)
SECTION A-B
SECTION B-C
Ten Bars. Five Bars 1 3/8" Dia., 73 3/4" Long, Tapered to 80 3/8"
Five Bars 1" Dia., 74 1/4" Long, Tapered to 77 1/4"
Normal Wt. of Each 1st Five Bars 23 Lbs. Minimum 22 Lbs. 5 Oz.
Normal Wt. of Each 2nd Five Bars 6 Lbs. 7 Oz. Minimum 6 Lbs. 4 Oz.
Outside Diam. of First Five Coils 5 7/8", Second Five 2 3/8"
Heights: First Five Coils 8 1/4" Free; 6 9/16" Solid; 7 1/4" 7400 Lbs. Capy. 12300 Lbs.
Heights: Second Five Coils 8 1/4" Free 6 9/16" Solid 7 1/4" 2100 Lbs. Capy. 3500 Lbs.
Cluster of Springs
Heights Without Caps, 8 1/4" Free; 6 9/16" Solid; 7 1/4" 47500 Lbs. Capy 80000 Lbs.

FIG. 1654—A. R. A. SPRING FOR 140,000 LB. CARS WITH CAST STEEL SIDE FRAME TRUCKS—CLASS H.

VII. INSPECTION AND REJECTION.

12. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the springs ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities and necessary assistance to satisfy him that the springs are being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

(c) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

13. *Rejection.*—(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Individual springs which, subsequent to the above tests at the mills or elsewhere and their acceptance, show defects or imperfections will be rejected and shall be replaced by the manufacturer.

14. *Rehearing.*—Samples tested in accordance with Section 3, which represent rejected material, shall be held for two weeks from the date of test report. In case of dissatisfaction with the results of tests, the manufacturer may make claim for a rehearing within that time.

15. *Reworking.*—Any springs which fail to meet the requirements of the physical tests or conform to the specified dimensions may be again submitted after being reworked.

Springs made as required in American railway service are shown in pages following.

Railway Spring Manufacture

The process of spring manufacture developed by the American Steel Foundries at its Hammond, Indiana, plant by the use of modern machinery and pyrometers, for the accurate control of furnace temperatures, enables this company to produce all kinds of railway springs of uniform quality and reliability.

Fig. 1655—Rear View, Spring Heating Furnace

The spring heating furnace shown in Figs. 1655 and 1656 is designed for quantity and continuous production. It is constructed so that double rows of spring plates may be placed in the furnace at the same time. It has six doors, front and back, each of sufficient width to receive three six-inch spring plates. Thus, as in the case

Fig. 1656—Front View, 6-Door Spring Heating Furnace

of a six-plate spring, there are six heats running at all times, two doors serving the six plates used for the one heat or one assembled spring.

The cambering machine is located adjacent to the furnace. After the spring plates have been heated to the proper temperature, the six plates which are to make up the assembled spring are taken from two doors in the front of the furnace and placed on the cambering machine; here they are assembled and formed by hydraulic pressure. During the forming operation the furnace man moves the springs at the rear of the two front doors just emptied of their charge, toward and reloads the furnace space thus left uncovered. The next heat is taken from the next two doors, the same procedure of reloading being followed. This practice continues, two doors at a time being taken in rotation.

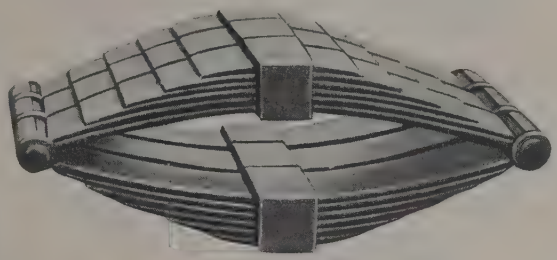


Fig. 1657—Triple Full Elliptic Spring

The springs are set on the table shown at the right of Fig. 1658 after they have been removed —from the back—of the cambering machine and are adjusted to give the proper bearing.

Fig. 1658—Elliptic Spring Fitting Press

The springs are hardened in oil—all the plates at one time—after they have been properly set. After hardening they are assembled in racks to drain and are ready for banding.

Fig. 1659—Coil Springs

By this method of manufacture, there is very little refitting or block hammering, except in very long springs. Four men are fully occupied with this unit and the output—on a piece work basis—is large.

The manufacture of coil and volute springs is in accordance with equally modern practice.

For other products and branch offices, see classified and alphabetical indexes.

Elliptic and Coil Springs for Car Equipment

The manufacture of high grade car equipment springs for railroad service, has been gradually developed from the original crude methods into a process of scientific precision, which necessitates not only spring making machinery of the most complete description but also an organization properly trained in the manipulation and heat-treatment of spring steel.

It has been fully realized by the Pittsburgh Spring and Steel Company, that the constant growth in weight and capacity of railroad cars together with the increasing tendency toward a higher speed of traffic movement, requires the use of car springs very much superior to those manufactured under the old methods. This company has, therefore, extended every possible effort toward the improvement of their facilities, by the installation of modern furnaces, special machinery and heat treating equipment of the highest class.

Fig. 1660—Single Full Elliptic

Fig. 1661—Duplicate Elliptic

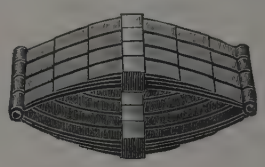


Fig. 1662—Quadruple Elliptic

Fig. 1663—Half Elliptic—Scroll ends—Suspension Spring Steel Ribbed and Grooved

In the manufacture of any spring, it is of the utmost importance that certain well established temperature ranges shall be carefully maintained during the hardening and tempering processes. When hardening springs there is a fixed temperature at which the steel should be quenched in order to obtain best results. Every degree above or below this point is detrimental to the metal structure and when it is realized that an overheat of even 300 degrees will produce a weak crystalline condition, the necessity for care in temperature determination is clearly evident.

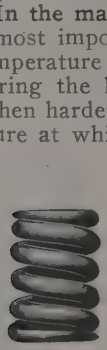


Fig. 1664—Single Coil

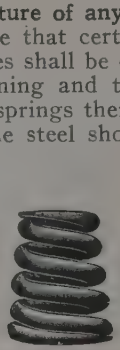


Fig. 1665—Cone Shape

Fig. 1666—Double Coil

In the plant of the Pittsburgh Spring & Steel Co. the matter of maintaining accurate temperature control receives careful and continuous study. Recording chart pyrometers and temperature regulating devices maintain the furnaces at a proper heat throughout the day, so that the steel will have a uniform hardness with a fine grain structure so desirable in car equipment springs.

In addition to the manufacture of all railroad car types of elliptic and coil springs, this company also makes a specialty of repairing old elliptic springs. Owing to their modern facilities and the scientific care with which the work is handled, it is entirely possible to re-build old elliptic springs and put them in such condition that they will have equal resiliency, and give practically the same service as when new.

A few of the various types and styles of springs manufactured by this company are shown in the accompanying illustrations. They have an engineering department of broad experience, fully capable of designing satisfactory springs for any class of rolling stock, and who will furnish every possible assistance to car builders and railway officials in providing their equipment with springs of proper design and quality.

In order to maintain a strictly high grade output of uniform excellence, the Pittsburgh Spring and Steel Company, in addition to the use of modern facilities and careful manufacturing methods, have also instituted a rigid system of test and inspection. Raw material receives an accurate examination both as regards its chemical analysis and mechanical structure. The finished product is also thoroughly tested and all springs not meeting standard requirements in workmanship or resiliency are rejected.

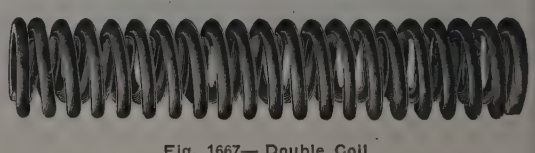


Fig. 1667— Double Coil

In view of the vital influence exerted by properly constructed springs upon the service life and riding qualities of all classes of rolling stock, it is of great importance that this item should receive intelligent consideration. This applies with special emphasis to the necessity of giving careful attention to the repair of old springs. Such repairs are very often handled with inadequate facilities and unsatisfactory results.

For other products and branch offices, see classified and alphabetical indexes.

PITTSBURGH SPRING AND STEEL COMPANY, PITTSBURGH, PA.

"Standard" Passenger and Freight Springs

With the increase in the weight and capacity of both freight and passenger cars the problem of proper spring support has become correspondingly important. To meet these needs the Standard Steel Works Company has, since the inception of its spring department, devoted a large amount of time, study, and experimentation to spring manufacture.

Full elliptic springs with malleable iron and steel end blocks or full elliptic springs with scroll ends are "Standard" products. Such springs can be made in single, double, triple, quadruple and quintuple styles.

Fig. 1668—Heavy Duplicate Full Elliptic Spring—Block End Type

The "block-end" type of spring has particular advantages. When carrying the normal load, the spring ends bear on the outer edges of the end blocks; when the load increases the carrying points shift to the inner edges of the block, thus shortening the effective length of the spring and automatically producing the additional strength required to care for the extra load. With this type of spring it is not necessary to reheat the spring after it has once been tempered and the band has been put on.

Furthermore, with the "block end" spring, any number of plates can be made full length, owing to their ability to slide freely in service. This means the strengthening of the full elliptic spring at its weakest point.

Fig. 1669—Triplicate Full Elliptic Spring

The sectional type of "block-end" spring greatly facilitates the ease of repairs and replacement. The weight of the separate sections comprising the complete spring is such that they can be easily handled by one man and readily applied or removed, section by section, by the simple method of jacking the weight of the car from the springs. It further removes the necessity of cutting and replacing retaining bolts which have become rusted in service.

All "Standard" elliptic springs are tested to one and one-half times the working load.

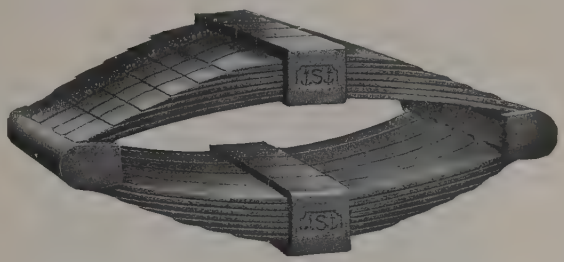


Fig. 1670—Quintuplicate Full Elliptic Spring

Plate springs may be ordered to complete dimensions or if the working load and the conditions of service are specified, the Standard Steel Works Company will design springs to meet the requirements.

Coil springs of either the single, double, or triple type can be furnished with wire diameter from ¼ in. to 1⅝ in. These springs are designed to have a torsional fibre stress of 40,000 lb. under normal working load and 80,000 lb. per sq. in. when solid. They can be furnished to specified dimensions, or if the working load and free height, or the working load and the conditions of service are specified, the company will design springs to meet the requirements.

Fig. 1671—Single Coil Spring

Fig. 1672—Nest of Coil Springs

Exhaustive laboratory tests are made throughout the process of manufacture of the springs in order to assure high quality and uniformity of product, thoroughly equipped chemical and physical laboratories being maintained for this purpose. After completion, all springs pass through the testing department where they receive repeated applications of a load in excess of the working load in order that any defects or weakness may be detected. To assure proper dimensions under working conditions a succession of loads within working limits are then applied and the heights noted for comparison with the specified heights.

The plant capacity of the Standard Steel Works Company has been increased to meet the demands, with the result that this company is in a position to insure efficient service.

For other products and branch offices, see classified and alphabetical indexes.

STANDARD STEEL WORKS COMPANY, PHILADELPHIA, PA.

Railway Car Springs

The Railway Steel-Spring Company manufactures all types of springs for use in foreign and domestic car equipment. The illustrations here shown are a few of the various types of springs used throughout the United States and many foreign countries for passenger coach and freight car equipment. There is such an infinite variety of sizes and so many variations in

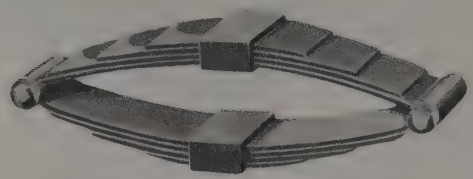


Fig. 1673—Single Full Elliptic Spring

the different classes that it is impossible, within reasonable space, to include them all, but the illustrations will serve to give a general idea of the company's standard types. The best grades of material and workmanship are employed in the manufacture of all, and several of these types embody distinctive

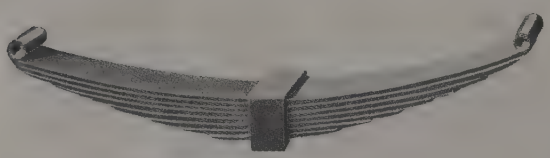


Fig. 1674—Half Elliptic Spring—Scrolled Eye

features which won for The Railway Steel Spring Company the highest award, first prize, Gold Medal, at the Louisiana Purchase Exposition at St. Louis.

The Company has four large spring plants advantageously situated, and equipped with the most modern and up-to-date appliances, together with special machinery and automatically regulated furnaces for the manufacture of springs of the highest grade and serviceability. The Railway Steel Spring Company is also fully equipped to furnish springs made of the various alloy steels, such as vanadium molybdenum, etc. Thus the Company's facilities and equipment are unsurpassed, and with the knowledge acquired by many years' experience in this particular branch of manufacture, they are in a position to satisfactorily meet every demand made upon them.

Fig. 1675—Equalizing Spring for Passenger Equipment

The single full elliptic spring shown in Fig. 1673 is adapted for use under street railway cars and the lighter forms of caboose cars.

The half elliptic type, Fig. 1674, is also intended for caboose cars and in foreign service is used under both carriages and wagons.

To prevent the excessive oscillation of four-wheel

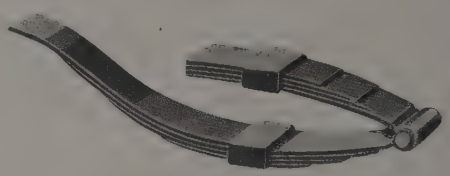


Fig. 1676—Three Quarter Elliptic Spring

trucks, a three-quarter elliptic spring, as shown in Fig. 1676, is attached to the front and rear ends

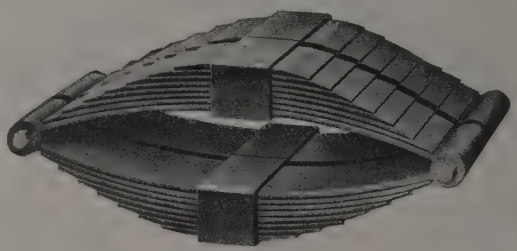


Fig. 1677—Double Elliptic Spring

of the truck frames. These are made of any required size and capacity.

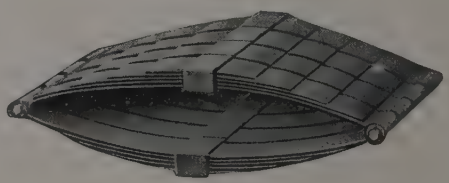


Fig. 1678—Quadruple Elliptic Spring

The double elliptic spring shown in Fig. 1677 is specially suitable for passenger equipment with six-

Fig. 1679—Freight Bolster Spring

wheel trucks. It is also well adapted for large street railway cars and for eight-wheel caboose cars and may be obtained in any capacity desired.

For other products and branch offices, see classified and alphabetical indexes.

RAILWAY STEEL-SPRING COMPANY, NEW YORK, N. Y.

Railway Car Springs *(Cont'd)*

A quadruple spring designed for passenger coaches with four-wheel trucks is shown in Fig. 1678. This spring is built in various sizes and capacities as required.

The four-coil group—Fig. 1679—is used under freight cars up to 35 tons and made with additional inside coils for 40, 50 and 55 ton cars.

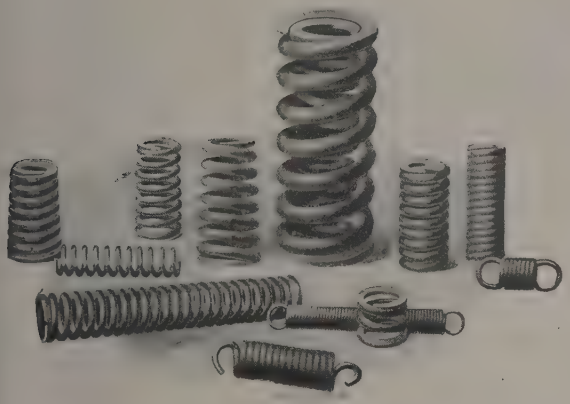


Fig. 1680—Group of Helical Springs

An equalizing spring for passenger equipment is shown in Fig. 1675. As these springs are of primary importance to the riding qualities of passenger cars they are carefully designed as to size and capacity to give the best results under service conditions.

Fig. 1681—Double Coil Draft Spring

A group of helical springs is shown in Fig. 1680. These are of various types and sizes and are intended for many diversified purposes.

A quintuple elliptic spring for passenger car service is shown in Fig. 1682. This type of spring is especially designed for heavy coaches and is adapted for four-wheel trucks. It is made in any required capacity.

The spring shown in Fig. 1683 is of the quadruple elliptic type fitted with auxiliary plates. This spring is of particular value under baggage, mail and express cars, where the loading is subjected to wide variations. It is made in any required capacity.

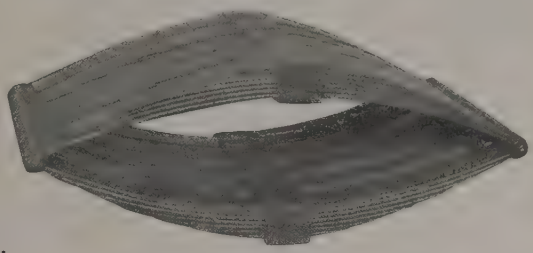


Fig. 1682—Quintuple Elliptic Spring

Fig. 1681 shows the standard A. R. A. Class G draft spring. Similar springs are made for all types and sizes of draft gears.

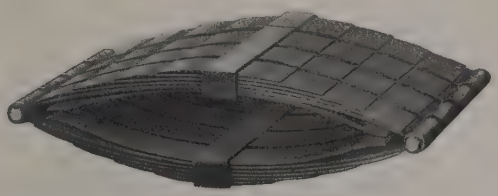


Fig. 1683—Quadruple Elliptic Spring with Auxiliary Plates

Foreign cars are usually equipped with bumper springs of the volute type—Fig. 1684—giving exceptional strength and resiliency in restricted space.

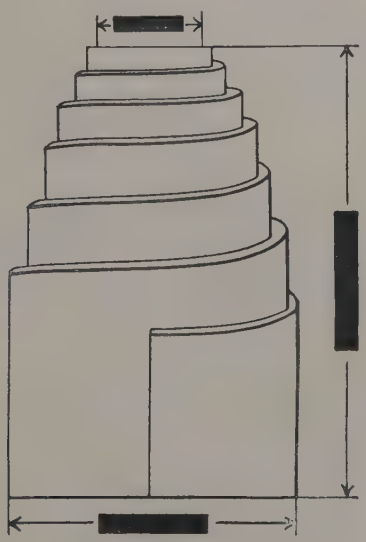


Fig. 1684—Volute Spring

Union Coil and Elliptic Springs for Railroad Cars

To absorb the shocks caused by suddenly changed direction of motion, such as the abrupt drop of a car wheel into track depressions caused by uneven roadbed, the impact when cars are moved into contact, and similar conditions met with in railroad service requires springs of great strength and resiliency.

The energy to be dissipated, when the speed of a moving mass is changed, increases with the magnitude of the mass and the rate at which it is moving. Consequently the present-day necessity for moving traffic in larger units and at a higher speed than ever before, has imposed upon the spring equipment of trains, very severe and constantly increasing loads. It therefore becomes vitally important, if the cost of maintaining springs is to be kept at a minimum, to make certain that this equipment is properly designed, fabricated from the best quality of spring steel, and carefully heat treated with scientific precision.

The Union Spring and Manufacturing Company, in the manufacture of Union Coil and Elliptic Springs make every effort to obtain perfection of design and a refined quality in the finished product. To attain this result, the raw material before being used, must pass a rigid test and inspection and only a superior type of special spring making machinery is employed, together with furnaces and heat-treating equipment of the highest grade.

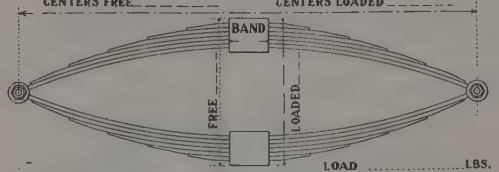
Proper heat treatment during manufacture governs, to a very great extent, resiliency, strength and useful life of steel springs. If the heat treating methods employed are not correct, the production of good springs is impossible, regardless of the quality of material used. Realizing the great importance of this fact, the Union Spring and Manufacturing Company has made a complete installation of modern spring heating furnaces, equipped with pyrometric temperature control facilities of the highest class. Quenching baths and tempering ovens of a type entirely adequate for the production of springs capable of meeting the most exacting service conditions have also been provided.

Properly constructed springs that have been carefully designed for the loads to be imposed, are more essential in the satisfactory operation and maintenance of cars than is generally realized. When springs of proper characteristics are used they often give three times the length of service obtainable from springs of inferior quality and furthermore, during this longer life their resiliency and shock absorbing ability is much superior. This is all reflected in a more continuous service secured from cars so equipped because of less frequent spring renewals, less wear and deterioration to the running gear and generally improved riding qualities.

It is therefore of considerable importance in the economical operation of a railroad to make certain that the springs used throughout the various types of equipment shall possess all the essentials of a first class product. It is the aim of the Union Spring and Manufacturing Company to meet these requirements fully in an effort to attain this end.

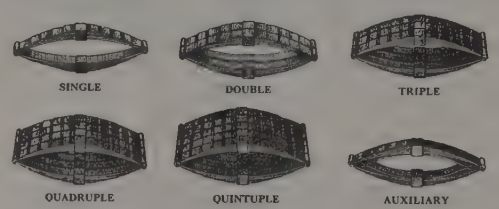
SPECIFICATION FOR FULL ELLIPTIC SPRINGS

CENTERS FREE _____ CENTERS LOADED _____



LOAD ..... LBS.

NUMBER OF LEAVES _____ BAND SIZE OF STEEL ___X____



Place a Cross (X) Over Style of Spring Wanted

With or Without Auxiliary Leaves ..... Number of Leaves, Including Auxiliary

SIGNATURE .....

NOTE: Please fill in all information called for above, as far as possible, to avoid all misunderstandings

Fig. 1685—Specimen of Elliptic Spring Specification Sheet

SPECIFICATION FOR HELICAL SPRINGS

FOR ..... QUANTITY WANTED .....

Place a Cross (X) Opposite Kind of Spring Wanted	
Single Coil Spring	
Double Coil Spring	
Triple Coil Spring	
Grouped in Plates	

NOTE:—If grouped in plates, please state the following:

Free Height over plates .....
Number of Single or Double Coils per Group .....
Enclose sketch or print of plate desired

	Outside Diameter	Free Height	Size of Bar	Solid Height	Number of Coils	Loaded Height	Load	Capacity Solid
Outer Coil								
Middle Coil								
Inner Coil								

If solid height is not known give number of coils or pitch.

SIGNED .....

NOTE:—Please fill in all information called for above, as far as possible, to avoid all misunderstandings

Fig. 1686—Specimen of Helical Spring Specification Sheet

For other products and branch offices, see classified and alphabetical indexes.

UNION SPRING AND MANUFACTURING COMPANY, PITTSBURGH, PA.

Brake Beams and Parts

THE SEVERE SERVICE to which brake beams are subjected makes it essential that they be carefully constructed. They may be either inside hung—between two pairs of wheels—or outside hung and are often of the trussed type, especially in passenger service. The American Railway Association requirements for brake beams—also brake heads and shoes—are as follows:

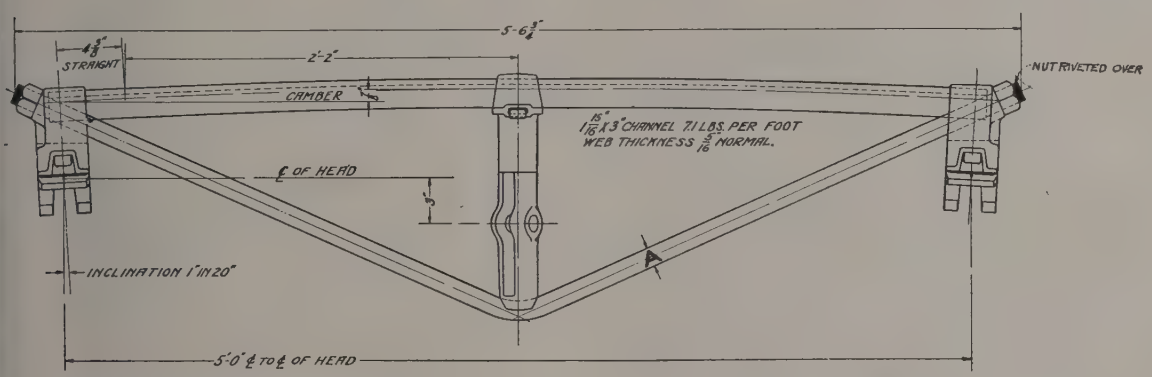
Brake Beam Specifications and Tests

Standard—ADOPTED, 1915; MODIFIED, 1917.

1. *Scope.*—This specification covers all complete brake beams for A. R. A. equipment cars.

I. MANUFACTURE.

2. *Material.*—The tension member shall conform to the A. R. A. Specifications for Mild Steel.



BEAM NUMBER	ROD DIA.	BEAM CAPACITY	THREADING OF ROD
#2	1 1/8	12000#	U.S.STD. 1 1/8"-7 THDS. 2 1/2" LONG
"2+	1 1/4	15000#	U.S.STD 1 1/4"-7 THDS. 2 1/2" LONG

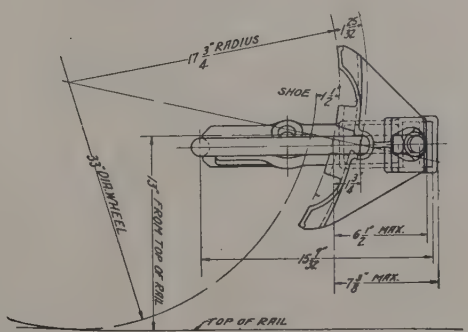


FIG. 1687—RECOMMENDED PRACTICE FOR BRAKE BEAMS COMPLETE.

3. *Heads.*—The heads and struts, where struts are of malleable iron, shall conform to A. R. A. Specifications for Malleable Iron.

II. PHYSICAL PROPERTIES AND TESTS.

4. *Proof Tests.*—The manufacturer shall give each beam a proof test load equal to the deflection load, as shown in Table No. 1, before offering them for inspection and tests.

5. *Deflection Measurement Tests.*—The test beam will be mounted in the testing machine in accordance with Section 8, and a load applied equal to deflection load as shown by Table No. 1, and then reduced to 500 lb. and the deflection instrument set at zero. The deflection load will then be reapplied and the deflection shall not be more than 0.07 in.; in event this deflection is exceeded, no further tests will be made, but the lot will be rejected and held in accordance with paragraphs 15 (b) and 17.

6. *Set Test.*—After the deflection measurements have been completed, the beam will be loaded to the set load shown in Table No. 1, and then released to 500 lb., when the beam shall not show a set greater than 0.01 in.

7. *Total Deflection Test.*—The brake beam shall stand a total movement of the head of the test machine of not less than 2 in. without failure at any point. The speed of the head of the testing machine shall be 1 in. per minute.

TABLE NO. 1

M. C. B. Beam No.	Deflection Load	Set Load	Ratio
1	6,500	14,000	47
2	12,000	24,000	50
2 plus	15,000	27,000	55
3	18,000	30,000	60
4	24,000	36,000	66.7
5	28,000	39,200	71.4
6	36,000	48,000	75

8. *Machine.*—The brake beam testing machine shall have suitable castings to represent the tread of the car wheels

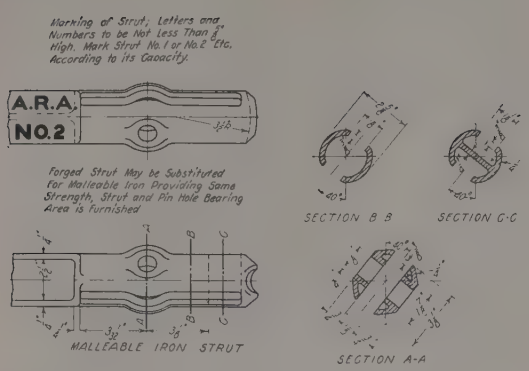

Marking of Strut, Letters and Numbers to be Not Less Than 2" High. Mark Strut No. 1 or No. 2 Etc. According to its Capacity.
A.R.A. NO. 2
Forged Strut May be Substituted For Malleable Iron Providing Same Strength, Strut and Pin Hole Bearing Area is Furnished
MALLEABLE IRON STRUT
SECTION B-B
SECTION C-C
SECTION A-A

FIG. 1688—BRAKE BEAM STRUT.

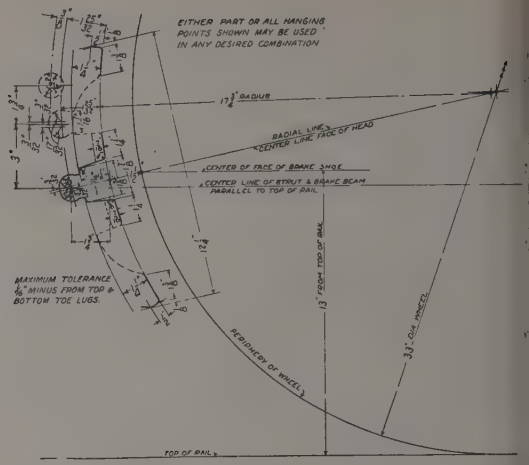

EITHER PART OR ALL HANGING POINTS SHOWN MAY BE USED IN ANY DESIRED COMBINATION
17¾" RADIUS
RADIAL LINE
CENTER LINE FACE OF HEAD
CENTER OF FACE OF BRAKE SHOE
CENTER LINE OF STRUT & BRAKE BEAM PARALLEL TO TOP OF RAIL
MAXIMUM TOLERANCE 1/16" MINUS FROM TOP & BOTTOM TOE LUGS.
13" FROM TOP OF RAIL
33" DIA. WHEEL
PERIPHERY OF WHEEL
TOP OF RAIL

FIG. 1689—PROCEDURE FOR LAYING OUT DRAWING FOR BRAI HEAD.

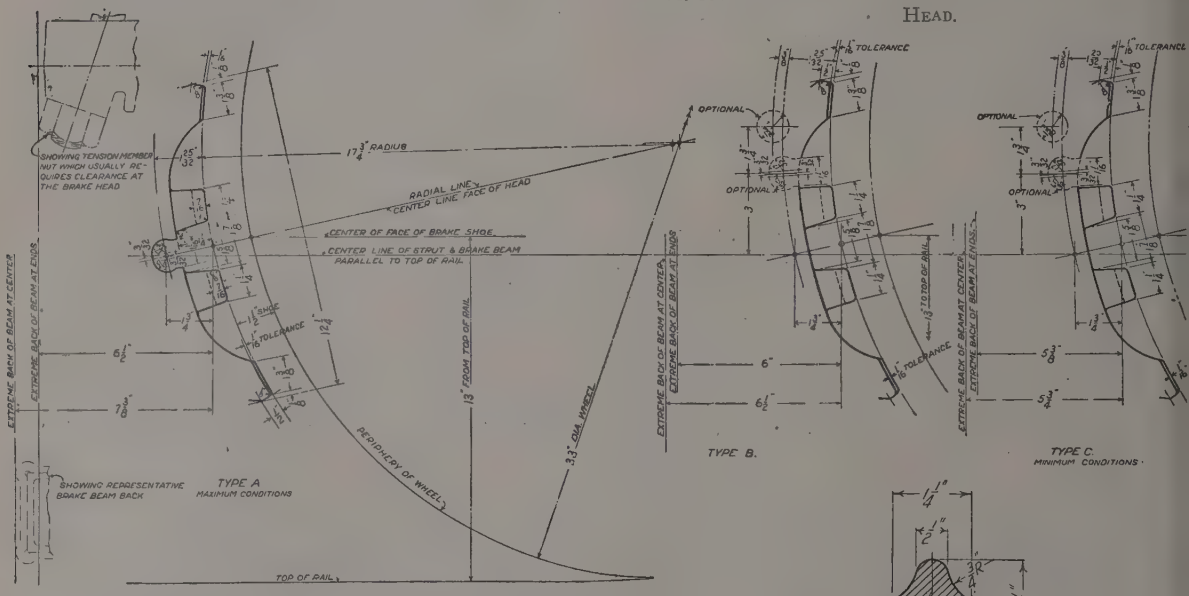
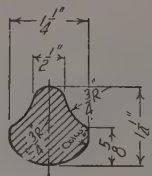

SHOWING TENSION MEMBER NUT WHICH USUALLY REQUIRES CLEARANCE AT THE BRAKE HEAD
17¾" RADIUS
RADIAL LINE
CENTER LINE FACE OF HEAD
CENTER OF FACE OF BRAKE SHOE
CENTER LINE OF STRUT & BRAKE BEAM PARALLEL TO TOP OF RAIL
EXTREME BACK OF BEAM AT ENDS
EXTREME BACK OF BEAM AT CENTER
SHOWING REPRESENTATIVE BRAKE BEAM BACK
TYPE A MAXIMUM CONDITIONS
13" FROM TOP OF RAIL
33" DIA. WHEEL
PERIPHERY OF WHEEL
TOP OF RAIL
OPTIONAL
TOLERANCE
TYPE B.
TYPE C. MINIMUM CONDITIONS.

FIG. 1690—VERTICAL CONTOUR LIMITS FOR BRAKE HEADS, TYPE "A" STANDARD, TYPE "B" AND "C" PERMISSIBLE ALTERNATE WHEN THE STANDARD CANNOT BE APPLIED.



SECTION OF METAL SURROUNDING POT-HOOK HANGER HOLE.

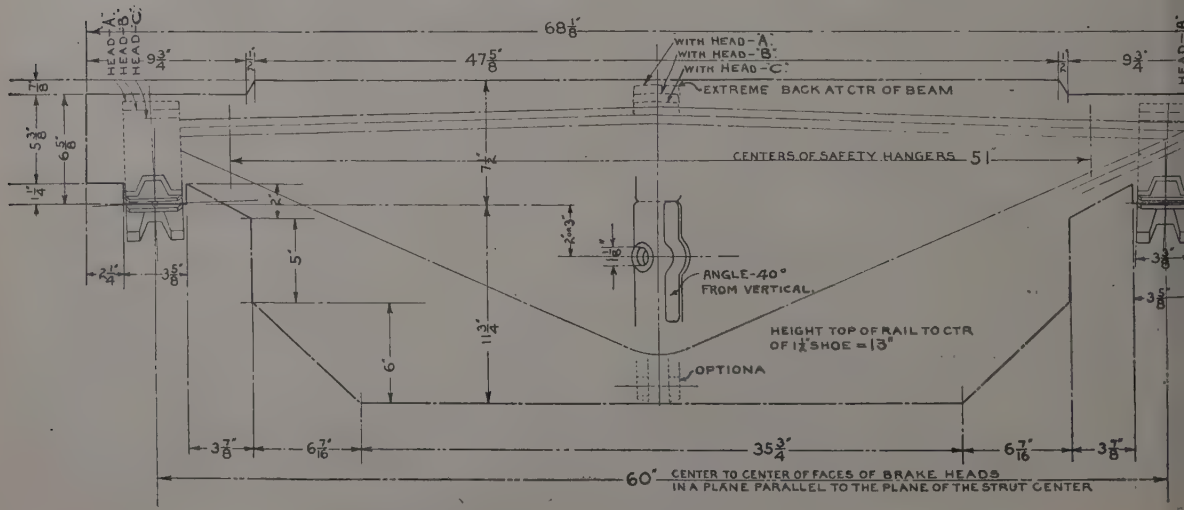

HEAD-A
HEAD-B
HEAD-C
68⅛"
47⅝"
WITH HEAD-A
WITH HEAD-B
WITH HEAD-C
EXTREME BACK AT CTR OF BEAM
CENTERS OF SAFETY HANGERS 51"
ANGLE-40° FROM VERTICAL.
HEIGHT TOP OF RAIL TO CTR OF 1½" SHOE = 13"
OPTIONA
60" CENTER TO CENTER OF FACES OF BRAKE HEADS IN A PLANE PARALLEL TO THE PLANE OF THE STRUT CENTER

FIG. 1691—STANDARD LIMITING OUTLINE FOR BRAKE BEAMS.

so that the beam can be mounted with the load applied at the pin hole in strut.

9. *Test Specimen.*—The test specimen shall consist of a complete brake beam, and may, at the option of the inspector, be either right or left hand.

10. *Number of Tests.*—The manufacturer shall have the brake beams piled according to size, regardless of requisition numbers, and sampled as follows: If the beams in a pile are either right or left hand, the lot shall consist of 501 beams or less, and if the pile consists of both right and left hand beams, the lot shall consist of 502 beams, but in either case only one beam will be selected for test. The extra beam in the lot of 502 will be returned to stock. If the pile contains more than 501 of either right or left hand beams, or 502 of both right and left hand beams, and not more than 1002 or 1004, two samples will be taken, and so on, for each additional 500 beams.

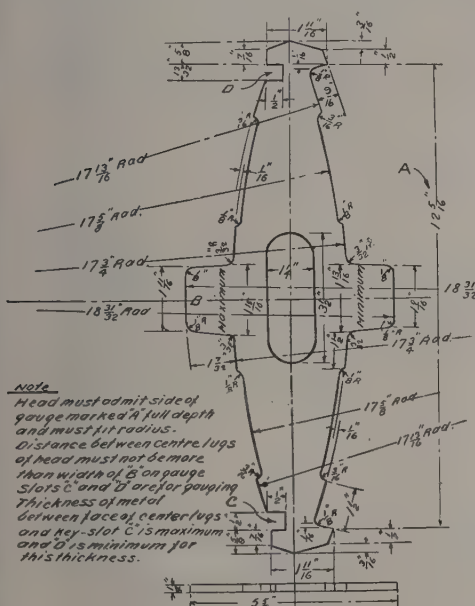

Note
Head must admit side of gauge marked "A" full depth and must fit radius.
Distance between centre lugs of head must not be more than width of "B" on gauge
Slots "C" and "D" are for gauging thickness of metal between face of center lugs and key-slot "C" is maximum and "D" is minimum for this thickness.

FIG. 1692—BRAKE HEAD GAGE.

III. PERMISSIBLE VARIATIONS.

11. *Gage.*—Brake beams shall conform to the dimensions working to drawing shown in Fig. 1691.

IV. WORKMANSHIP AND FINISH.

12. *Workmanship.*—The beam shall be made in a workmanlike manner and be free from injurious defects.

13. *Finish.*—(a) Brake beams shall be free from rust, scale, paint or any covering that will hide defects.

(b) After the beams are inspected and marked, they shall be given one coat of a quick-drying, black, protective paint.

V. MARKING.

14. *Marking.*—The A. R. A. Nos. 1, 2, 3, 4, 5 or 6, as the case may be, shall be cast on the center strut with raised letters and figures not less than 5/8 in. high and 1/8 in. in relief, as shown in Fig. 1688.

VI. INSPECTION AND REJECTION.

15. *Inspection.*—(a) The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) When the manufacturer's testing facilities are, in the judgment of the purchaser, adequate, tests shall preferably be made at the manufacturer's laboratory. The purchaser may, however, have tests made at his own or other laboratories, providing the facilities are adequate, and if the manufacturer desires, he may witness such tests.

(c) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

16. *Rejection.*—Material or completed beams which subsequently to above tests at the manufacturer's plant or elsewhere, and their acceptance, develop weak spots or imperfections, or fail to pass any one of the tests herein required, such tests to be made within 30 days of the receipt of the material by the purchaser, will be rejected and shall be replaced by the manufacturer at his own expense.

17. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be held for fourteen days from date of test report. In case of dissatisfaction with results of tests, the manufacturer may make claim for a rehearing within that time.

Laying Out Drawing for Brake Head.

Standard—ADOPTED, 1920.

The procedure for laying the brake head is as follows; working to drawing shown in Fig. 1689.

1. Scribe about a selected center, an arc representing the 33-in. wheel.

2. Draw a line parallel to and 13 in. above the rail, the intersection of which line and the periphery of the 33-in. wheel will locate the center of the face of the brake shoe.

3. Draw from the wheel center through the center of this brake shoe face, an extended radial line.

4. Locate from the intersection of this radial line and periphery of the wheel, a point 1½ in. outside the periphery of the wheel.

5. Through this point, with 17¾ in. radius, scribe an arc, which arc will represent the back of the brake shoe and the face of the brake head center lugs.

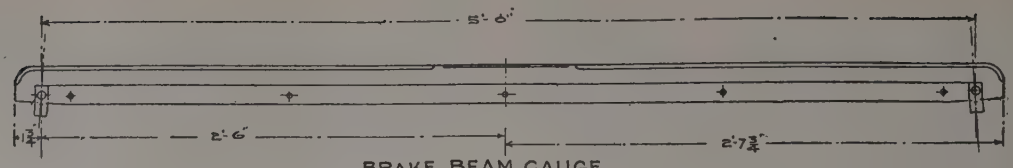
6. On the same radial line locate a point 1 25/32 in. outside the back of the brake shoe, or the face of the head, through which point draw a line parallel to the top of the rail. This horizontal line will be the center line of the strut and of the brake beam. The radial line referred to is the center line of the brake head face and the intersection of the radial line and the center line of the strut shall be the center of the center loop hanging—provided the center loop type of hanging is used.

Reports and Papers

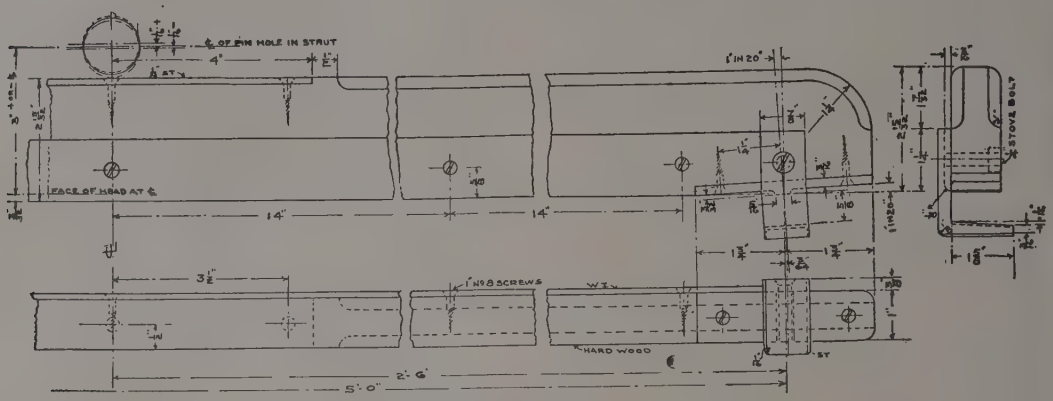
A very complete review of the brake beam situation, together with an appendix covering the tests at Purdue University, of 47 brake beams, is included in the committee report in the 1906 Proceedings, page 179.

The report of the committee in the 1910 M. C. B. Proceedings, page 222, consists largely of recommendations as to details.

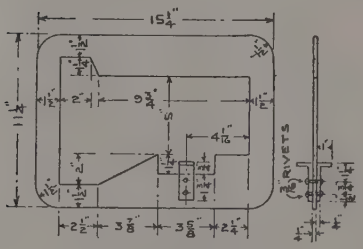
Other reports will be found in the 1912 Proceedings, page 125; 1913 Proceedings, page 95; 1914 Proceedings, page 87 (contains a report of a series of tests made by the Pennsylvania Railroad at its Altoona laboratories; 1915 Proceedings, page 74; 1916 Proceedings, page 277.



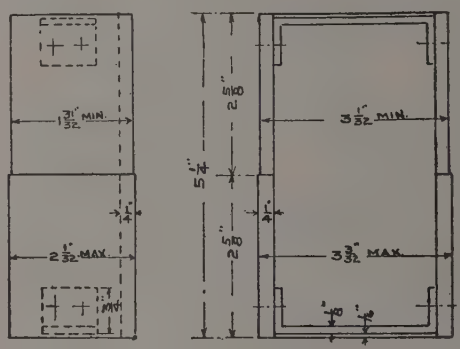
BRAKE BEAM GAUGE.

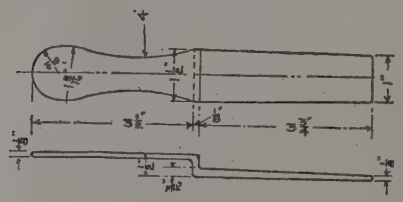


DETAILS OF GAUGE.



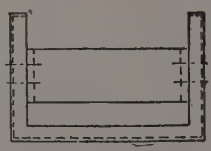
LIMITING CONTOUR GAUGE-HEAD.

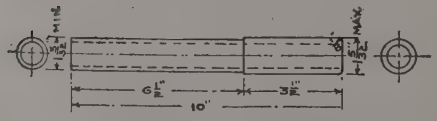




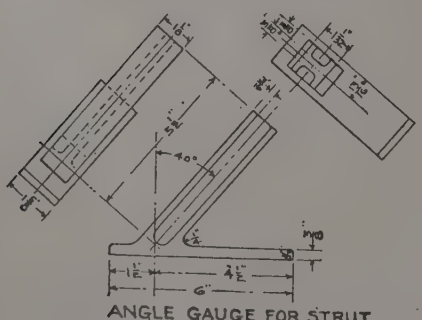
KEYWAY GAUGE.

CHANNEL OPENING GAUGE FOR HEAD AND STRUT.

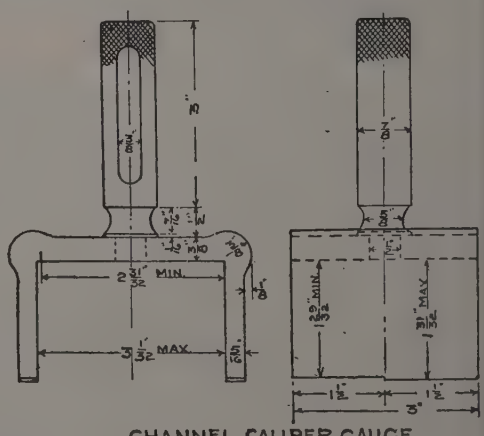




LEVER PIN HOLE GAUGE.



ANGLE GAUGE FOR STRUT.



CHANNEL CALIPER GAUGE.

FIG. 1693—GAGES FOR BRAKE BEAM, LIMITING CONTOUR GAGE HEAD, CHANNEL OPENING FOR HEAD AND STRUT, KEYWAY, LEVER PIN HOLE, ANGLE OF STRUT, AND CHANNEL CALIPER.

A topical discussion on "Brake Beams, Truss vs. Steel," will be found in the 1903 M. C. B. Proceedings, page 332.

Brake Shoes

Standard—ADOPTED, 1901; REVISED, 1910.

I. TESTS.

1. *Kinds of Test.*—Shoes shall be tested for coefficient of friction and for wear upon the American Railroad Association testing machine, or one with equivalent characteristics.

II. COEFFICIENT OF FRICTION TEST.

2. *Cast-iron Wheel.*—Shoes shall develop upon the cast-iron wheel, in effecting stops from an initial speed of 40 miles per hour, a mean coefficient of friction of not less than:

(a) 22 per cent when the brake-shoe pressure is 2,808 lb.

(b) 16 per cent when the brake-shoe pressure is 6,840 lb.

3. *Steel-tired Wheel.*—Shoes shall develop upon the steel or steel-tired wheel, in effecting stops from speed of 65 miles per hour, a mean coefficient of friction of not less than:

(a) 12½ per cent when the brake-shoe pressure is 6,840 lb.

(b) 11 per cent when the brake-shoe pressure is 12,000 lb.

(c) No limitation is placed upon the rise in coefficient of friction at the end of the stop.

III. SHOE-WEAR TEST.

4. *Cast-iron Wheel.*—Shoe wear shall be determined upon the cast-iron wheel by making not less than 100 applications of the shoe to the wheel, under pressure of 2,808 lb., and at a constant peripheral speed of the wheel of 20 miles per hour. At each application, the shoe shall remain in contact with the wheel during 190 revolutions of the latter and between applications the shoe shall remain out of contact during 610 revolutions of the wheel. Under these conditions, the shoe shall lose in weight not more than 0.8 of a pound for each 100,000,000 foot-pounds of work done.

5. *Steel-tired Wheel.*—Shoe wear shall be determined upon the steel or steel-tired wheel by making not less than ten stops from initial speed of 65 miles per hour and under pressure of 12,000 pounds. Ten minutes shall intervene between successive applications of the shoe. Under these conditions the shoes shall lose in weight not more than 4.0 lbs., from each 100,000,000 foot-pounds of work.

IV. GAGING AND DRAWING.

6. *Gaging.*—That the back of the shoe be made to conform to the gage shown in the manual of Standard and Recommended Practice and in Fig. 1694.

NOTE.—When a shoe, not entirely metallic in its composition, is tested for wear, its actual loss in weight shall be increased in the ratio which the density of the cast iron bears to the mean density of the abraded parts of the shoe, in order to determine the weight which is to be compared with the specifications.

Brake Shoe Tests

A brief report of the M. C. B. standing committee on brake shoe tests in 1900 developed an extensive discussion on the scope of the work of this committee; see Proceedings, 1900, page 72.

The report in the 1901 Proceedings, page 99, includes the results of the tests of 12 different brake shoes.

Results of tests of four different brake shoes will be found in the 1903 Proceedings, page 85. The report for 1905, see page 57 of the Proceedings for that year, included these tests. A report in 1906 included tests of a number of brake shoes taken from actual service to see whether they met with the M. C. B. requirements; Proceedings, 1906, page 137. An appendix to the report includes the description of a machine designed to determine wearing qualities

The report for 1907 includes tests, under the specifications of the Association, of brake shoes submitted by railway companies and an analytical study of the past work of the committee; also recommendations as to the design and construction of additional testing equipment in order to subject the brake shoes to an endurance or wearing test; Proceedings, 1907, page 135.

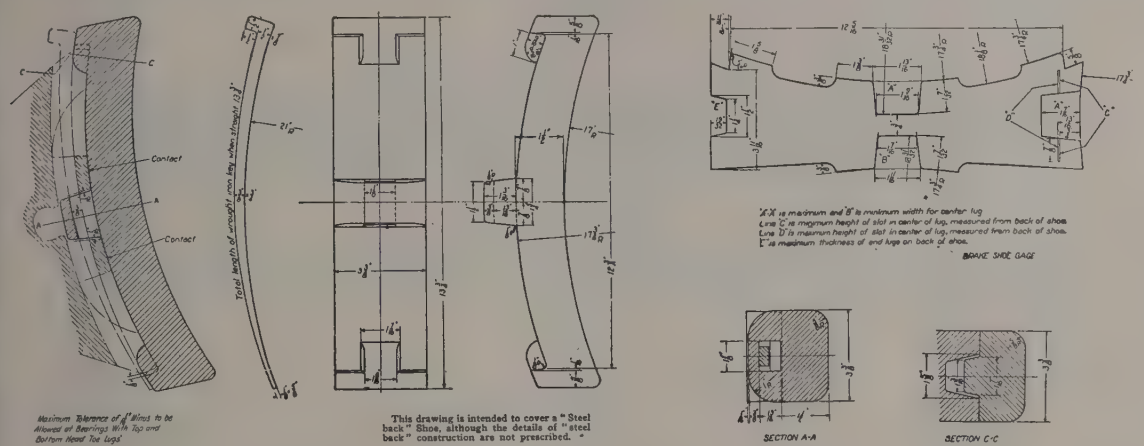

Contact
Contact
Maximum Tolerance of ⅛" Allowed at Bearings With Top and Bottom Head Toe Lugs
Total length of straight iron key when straight 13"
This drawing is intended to cover a "Steel back" Shoe, although the details of "steel back" construction are not prescribed.
"XX" is maximum and "B" is minimum width for center lug
Line "C" is maximum height of slot in center of lug, measured from back of shoe.
Line "D" is maximum height of slot in center of lug, measured from back of shoe.
"E" is maximum thickness of end lugs on back of shoe.
BRAKE SHOE GAGE
SECTION A-A
SECTION C-C

FIG. 1694—A. R. A. STANDARD BRAKE SHOE, KEY, AND GAGE.

Tests of five brake shoes were reported upon in the 1908 Proceedings, page 103, as well as special tests of nine shoes to determine the wearing qualities.

The report in the 1909 Proceedings, page 85, is a statement of progress with an outline of other work planned.

The report of the committee in the 1910 Proceedings, page 201, contains results of tests of 28 shoes to determine the coefficient of friction under the current specifications, loss in weight of the shoe under repeated applications, and loss in weight of wheel.

The report in the 1911 Proceedings, page 138, gives an account of tests made under heavy brake shoe pressures.

The report in the 1913 Proceedings, page 13, contains an appendix showing the results of a series of tests made for the New York Central Lines at the laboratory of the American Brake Shoe & Foundry Company.

The report in the 1914 Proceedings, page 74, includes the final tests of the series that the committee had been working on for a considerable period.

The report of the committee in the 1915 Proceedings, page 59, contains a comprehensive resumé of the tests made from 1906 to 1914, inclusive.

Fig. 1695—Acme I-Section Brake Beam for Short Wheel Base Freight Car Trucks.

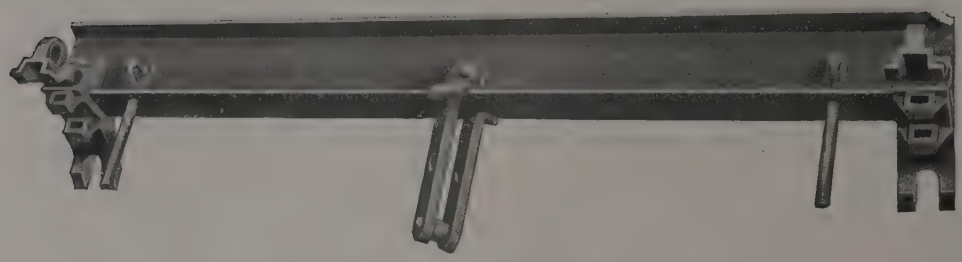


Fig. 1696—Acme I-Section Brake Beam for Freight Car Trucks.

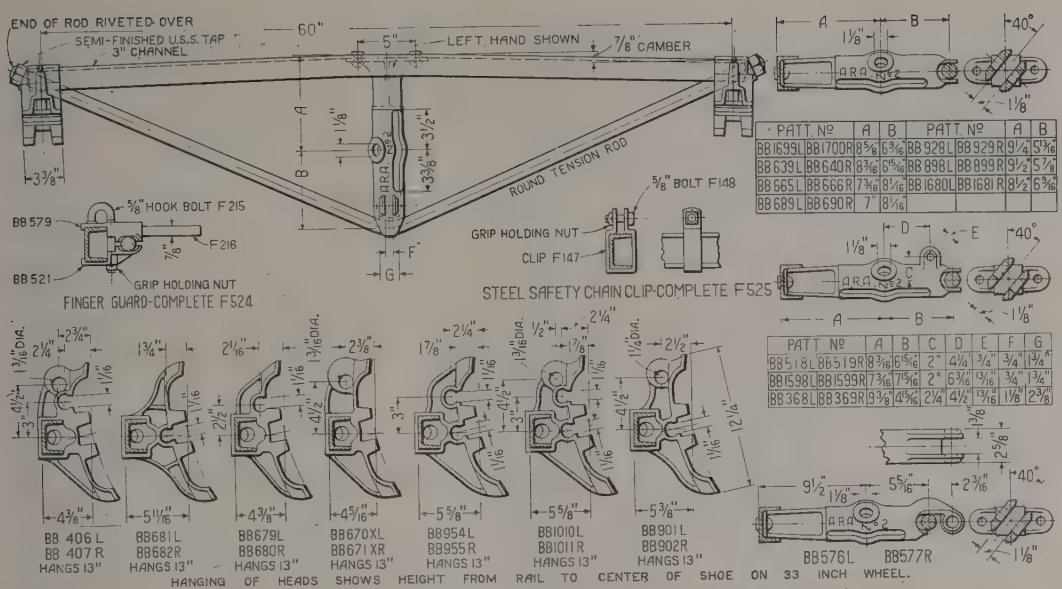
Fig. 1697—Acme I-Section Brake Beam for Freight Car Trucks.

Fig. 1698—Simplex Forged Steel Clasp Brake Beam.

Fig. 1699—Simplex Clasp Brake Beam as Applied to Pullman Standard Sleeping Cars.

American Steel Foundries.

(*See also Page 766.*)

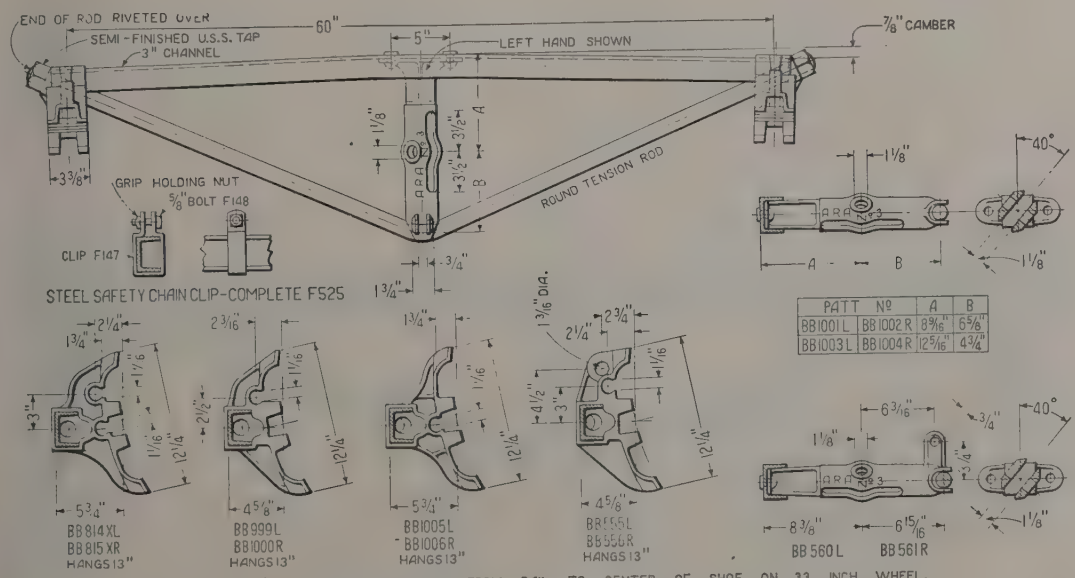


PATT. Nº	A	B	PATT. Nº	A	B
BB1699L	BB1700R	8 5/8	6 5/8	BB928L	BB929R	9 1/4	5 5/16
BB639L	BB640R	8 3/8	6 5/8	BB898L	BB899R	9 1/2	5 7/8
BB665L	BB666R	7 3/16	8 1/4	BB1680L	BB1681R	8 1/2	6 5/8
BB689L	BB690R	7"	8 1/16				

PATT Nº	A	B	C	D	E	F	G
BB518L	BB519R	8 3/16	6 5/8	2"	4 1/4	3/4"	3/4"	1 3/4"
BB1598L	BB1599R	7 3/16	7 5/16	2"	6 3/16	1 3/16	3/4"	1 3/4"
BB368L	BB369R	9 3/8	4 5/16	2 1/4	4 1/2	1 3/16	1 1/8"	2 3/8"

Fig. 1700— Ajax Freight Brake Beam for A. R. A. No. 2 Service.

Fig. 1701—Ajax Freight Brake Beam, All A. R. A. Conditions and Capacities.

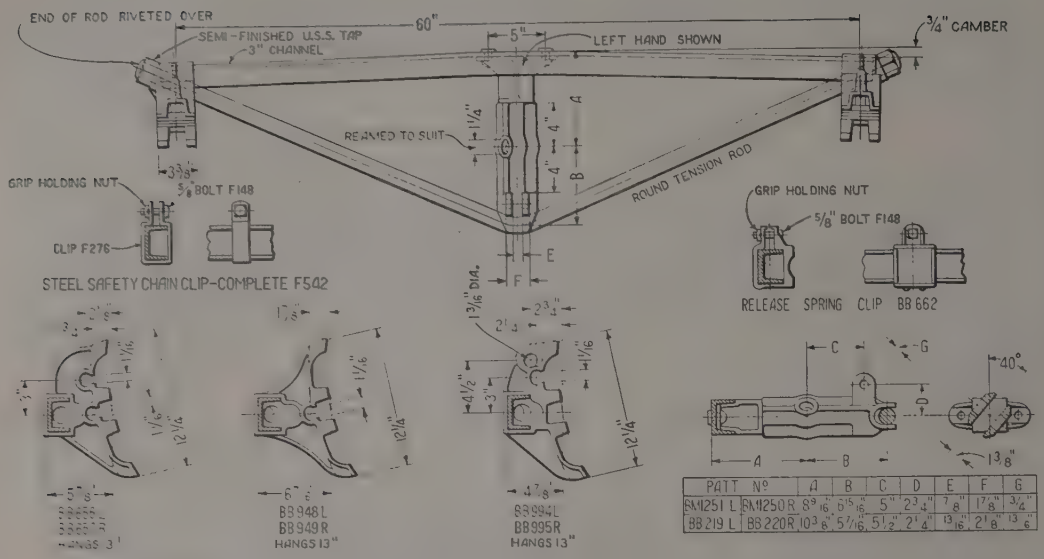


PATT Nº	A	B
BB1001L	BB1002R	8 9/16"	6 5/8"
BB1003L	BB1004R	12 5/16"	4 3/4"

Fig. 1702—Ajax Freight Brake Beam for A. R. A. No. 3 Service.

American Steel Foundries.

(See also Page 766.)



PATT Nº	A	B	C	D	E	F	G
BM1251 L	BM1250R	8 9/16"	5 15/16"	5"	2 3/4"	7/8"	1 7/8"	3/4"
BB219 L	BB220R	10 3/16"	5 7/16"	5 1/2"	2 1/4"	13/16"	2 1/8"	13/16"

Fig. 1703—Ajax Brake Beam for A. R. A. No. 4 Service.

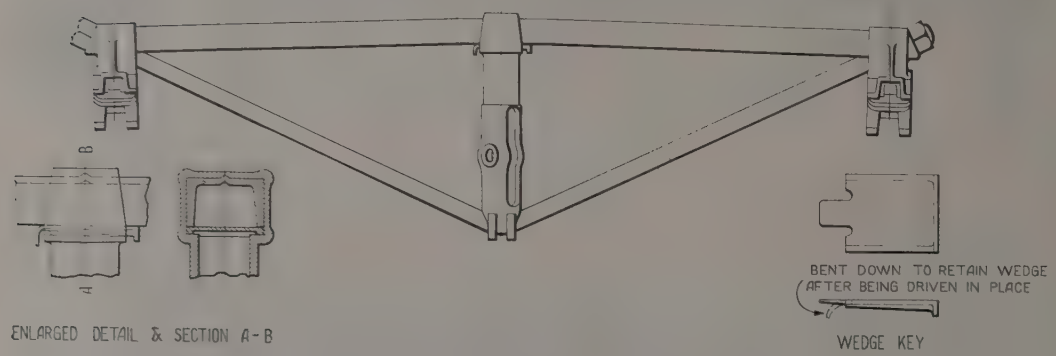


Fig. 1704—Ajax or Hercules Brake Beam with Banded Fulcrum and Wedge Key.

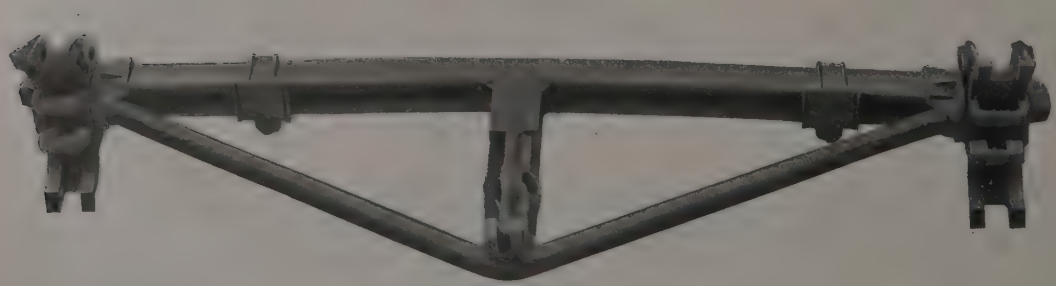


Fig. 1705—Hercules Adjustable Head Brake Beam for Four-Wheel Passenger Service. 15,000 to 40,000 Lbs. Capacities, all Conditions.

(*See also Page 766.*)

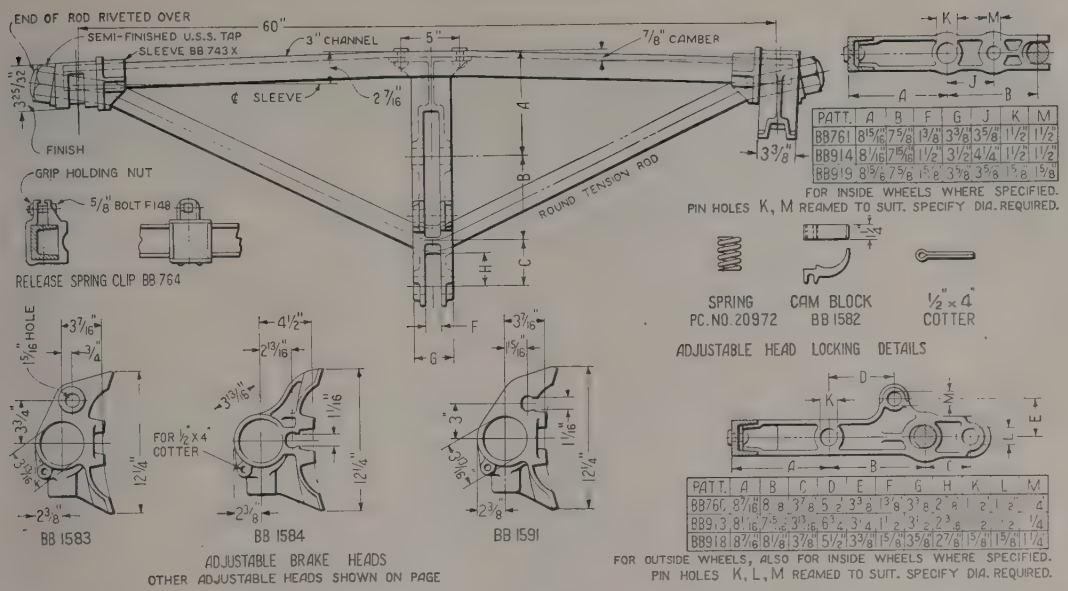

END OF ROD RIVETED OVER
SEMI-FINISHED U.S.S. TAP
SLEEVE BB 743 X
60"
3" CHANNEL
5"
7/8" CAMBER
℄ SLEEVE
2 7/16"
FINISH
GRIP HOLDING NUT
5/8" BOLT F148
RELEASE SPRING CLIP BB 764
ROUND TENSION ROD
3 3/8"
PATT. A B F G J K M
BB761 8 15/16 7 5/8 1 3/8 3 3/4 3 5/8 1 1/2 1 1/2
BB914 8 1/16 7 5/8 1 1/2 3 1/2 4 1/4 1 1/2 1 1/2
BB919 8 15/16 7 5/8 1 3/8 3 5/8 3 5/8 1 5/8 1 5/8
FOR INSIDE WHEELS WHERE SPECIFIED.
PIN HOLES K, M REAMED TO SUIT. SPECIFY DIA. REQUIRED.
SPRING PC. NO. 20972
CAM BLOCK BB 1582
1/2" x 4" COTTER
ADJUSTABLE HEAD LOCKING DETAILS
PATT. A B C D E F G H K L M
BB760 8 7/16 8 3/8 5 2 3 3/8 1 3/8 3 3/8 2 1/8 2 1/8 4
BB913 8 1/16 7 5/8 3 1/16 6 3/4 3 1/4 1 1/2 3 1/2 2 3/8 2 1/2 1 1/4
BB918 8 7/16 8 1/8 3 7/8 5 1/2 3 3/8 1 5/8 3 5/8 2 7/8 1 5/8 1 5/8 1 1/4
FOR OUTSIDE WHEELS, ALSO FOR INSIDE WHEELS WHERE SPECIFIED.
PIN HOLES K, L, M REAMED TO SUIT. SPECIFY DIA. REQUIRED.
BB 1583
BB 1584
BB 1591
FOR 1/2 x 4" COTTER
ADJUSTABLE BRAKE HEADS
OTHER ADJUSTABLE HEADS SHOWN ON PAGE

Fig. 1706—Hercules Passenger Brake Beam, for Six-Wheel Trucks, 40,000 lbs. Capacity with 1/16" Deflection

Fig. 1707—Hercules Adjustable Head Brake Beam for Six-Wheel Trucks in High Speed Passenger Service.

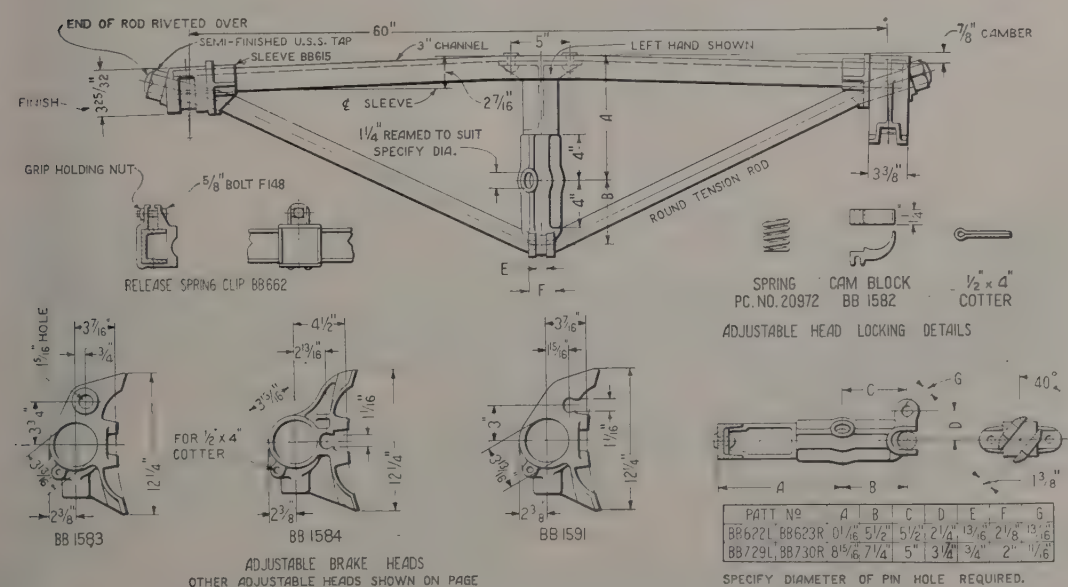


Fig. 1708—Hercules Passenger Brake Beam for Four-Wheel Truck, 28,000 lbs. capacity with 1/16" Deflection.

American Steel Foundries.

(*See also Page 766.*)

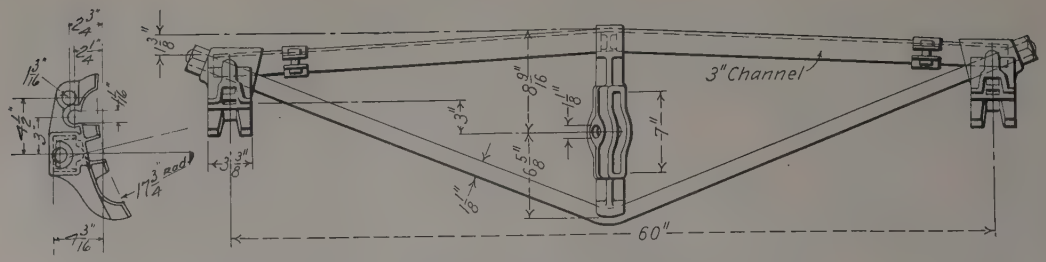


Fig. 1709—No. 2, 12,000 lb. Capacity Buffalo Brake Beam.

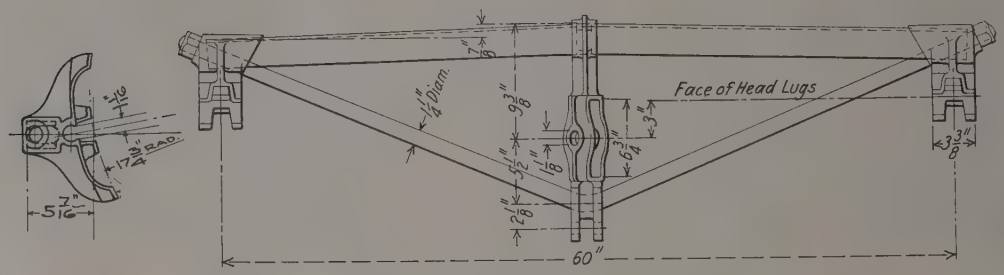


Fig. 1710—No. 2+, 15,000 lb. Capacity Truss Brake Beam.

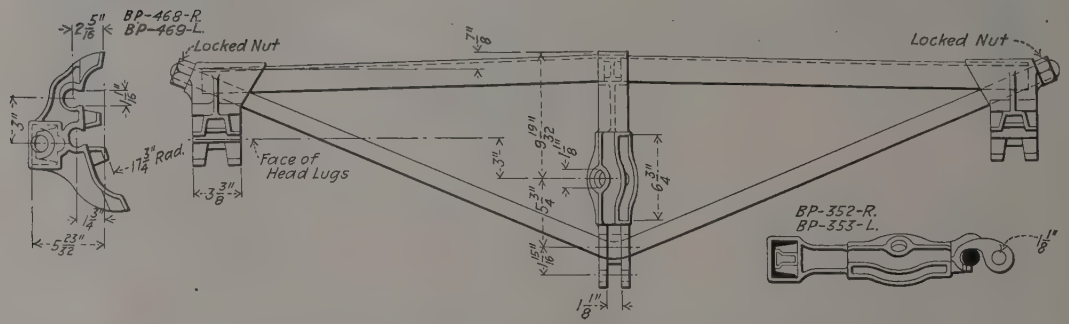


Fig. 1711—No. 3, 18,000 lb. Capacity Buffalo Truss Brake Beam.

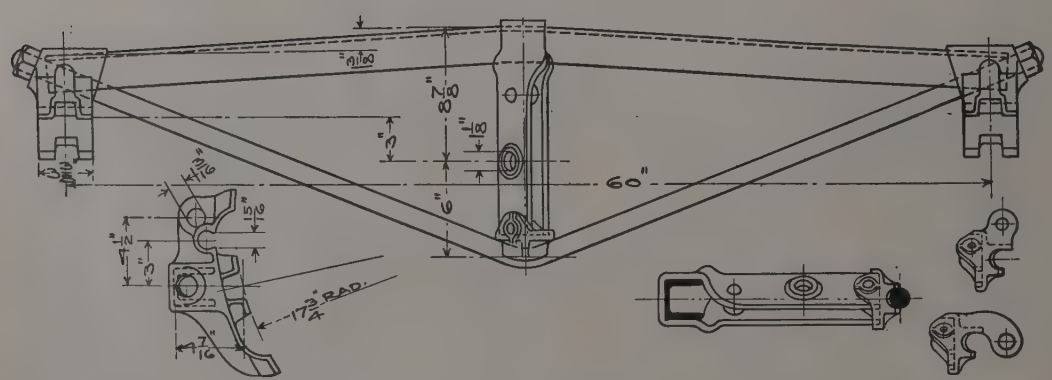


Fig. 1712—No. 3, 18,000 lb. Capacity Buffalo Trussed Brake Beam.

Buffalo Brake Beam Company.

(*See also Page 747.*)

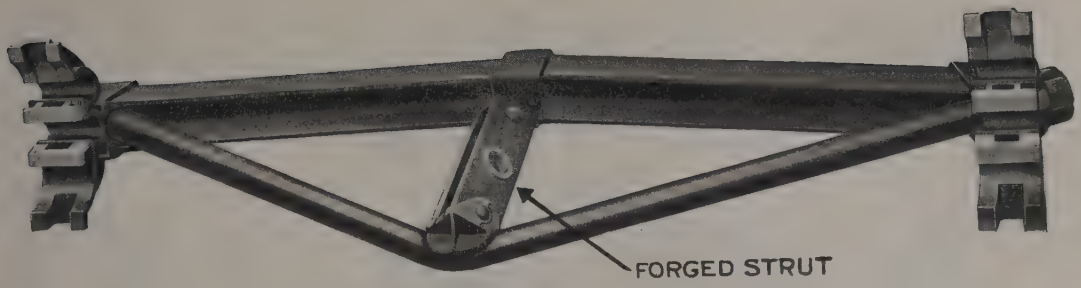


Fig. 1713—Buffalo Freight Truss Brake Beam.

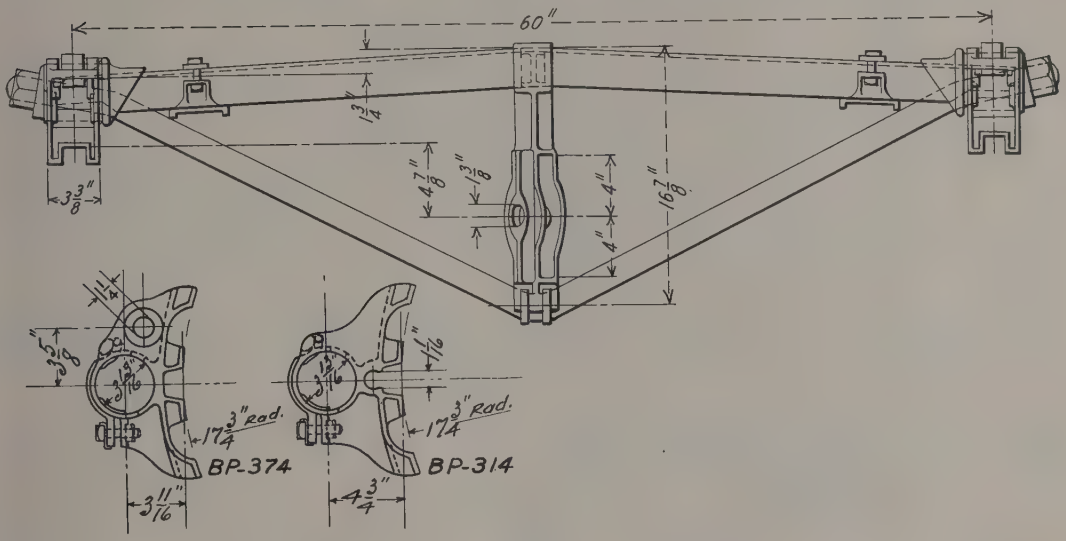


Fig. 1714—No. 5, Buffalo Truss Brake Beam.

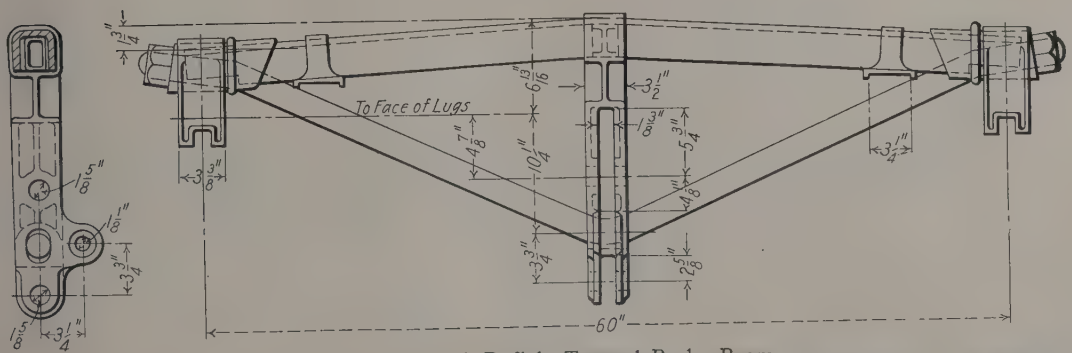


Fig. 1715—No. 6, Buffalo Trussed Brake Beam.

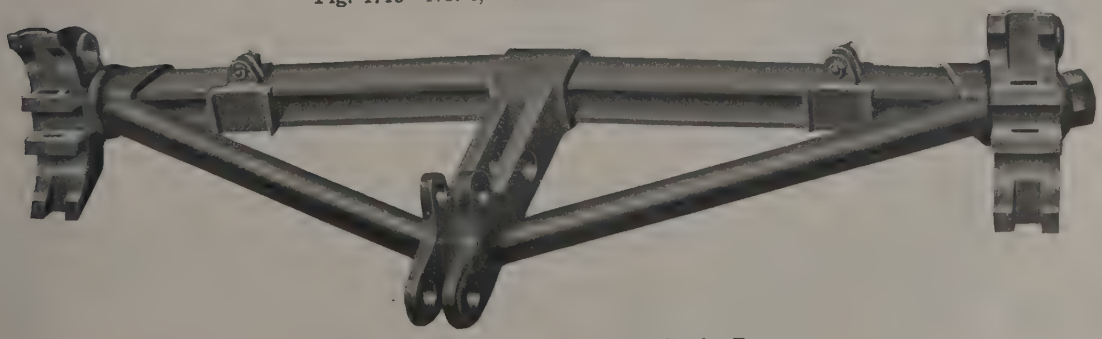


Fig. 1716—No. 7, Buffalo Trussed Brake Beam.

Buffalo Brake Beam Company.

(See also Page 747.)

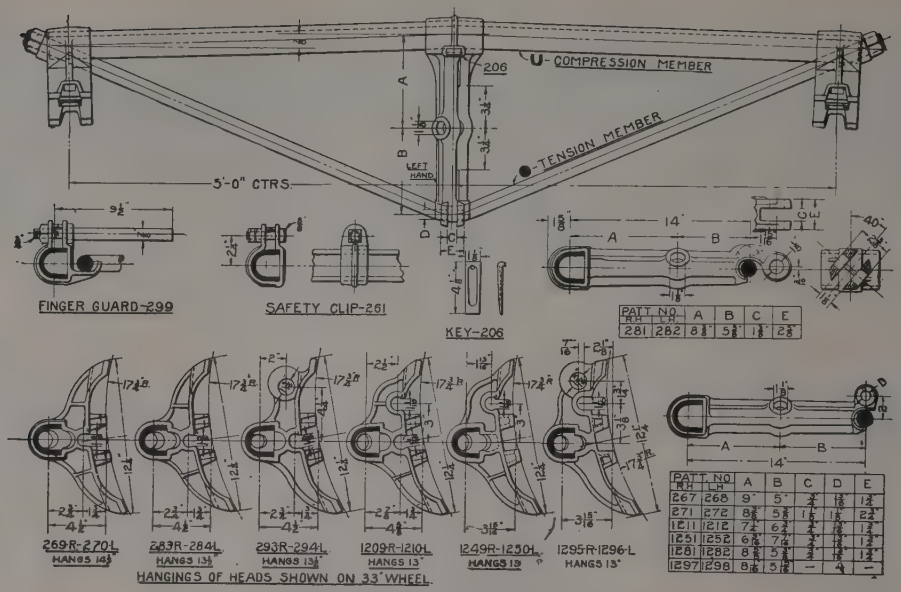

U COMPRESSION MEMBER
TENSION MEMBER
206
5'-0" CTRS.
FINGER GUARD-299
SAFETY CLIP-261
KEY-206
269R-270L HANGS 14½
283R-284L HANGS 13½
293R-294L HANGS 13½
1209R-1210L HANGS 13"
1249R-1250L HANGS 13"
1295R-1296-L HANGS 13"
HANGINGS OF HEADS SHOWN ON 33" WHEEL.
PATT NO A B C E
281 282 8½ 5½ 1⅛ 2⅜
PATT NO A B C D E
267 268 9" 5" 2¾ 1⅜ 1½
271 272 8⅜ 5⅜ 1⅝ 1⅜ 2¼
1211 1212 7½ 6¼ 2¼ 1⅜ 1½
1251 1252 6⅜ 7¼ 2¾ 1⅜ 1½
1281 1282 8⅜ 5⅜ 2¾ 1⅜ 1½
1297 1298 8⅜ 5⅛ 2¾ 1⅜ 1½

Fig. 1717—Creco Brake Beam for Heavy Freight Service.

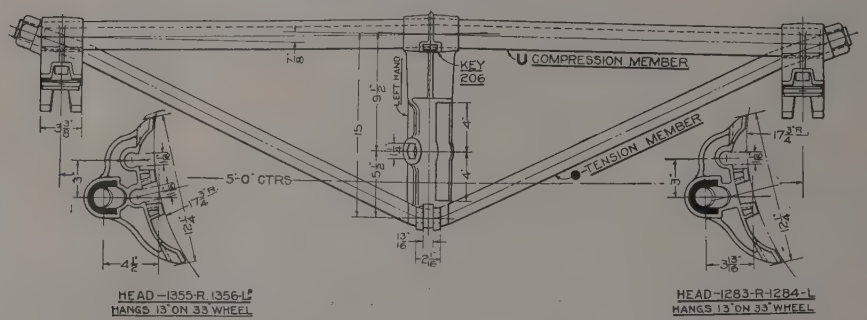


Fig. 1718—E L Creco Brake Beam for Use with Westinghouse Empty and Load Brake for Heavy Freight Service.

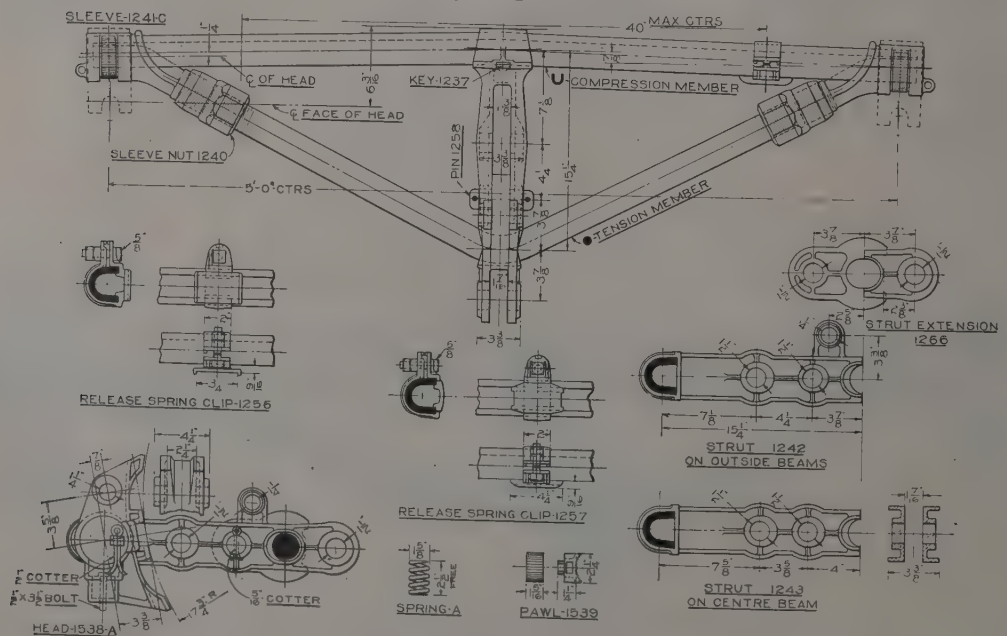


Fig. 1719—P C Creco Brake Beam for Heavy Service with Six-Wheel Trucks.
Chicago Railway Equipment Company.

(*See also Page* 731.)

Creco Brake Beams

The CRECo Brake Beam—a product of the Chicago Railway Equipment Company—is built with a U-shaped compression member and rod tension member, with the strut keyed to the compression member. The strut can be arranged with third support ears for use with the CRECo Third-Point Support and Safety Device or the tension member can be equipped with CRECo Four-Point Chairs for use with the CRECo Four-Point Support and Safety Device. This type of beam is built for both light and heavy freight equipment—

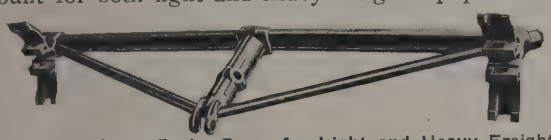


Fig. 1721—Creco Brake Beam for Light and Heavy Freight Equipment

A. R. A. capacities Nos. 1, 2, 3, 4 and 5; is furnished with or without safety chain or finger guard clips; with brake heads of either the rigid or adjustable type.

The P. C. CRECo brake beam is built to take a load of 40,000 lb. at 1/16 in. deflection for use on heaviest type of passenger equipment. It is made to interchange with the Diamond Special brake beam—a CRECo product—and to occupy an equally limited space. The compression member is U-shaped and the tension member round, with

Fig. 1722—Drexel Brake Beam for Freight Equipment

sleeve nut take-up. The beam is equipped with CRECo standard automatically adjustable brake heads, the same as used on the "Diamond Special." The "P. C. CRECo" brake beam is made for both four and six wheel trucks. Fig. 1724 illustrates "Pullman Standard" beam of six wheel type.

The Drexel brake beam is built for Nos. 1, 2 and 3 A. R. A. capacities, with or without safety chain or finger guard clips. This beam has a channel shaped compression member and rod tension member, with either riveted or keyed strut. The strut as shown in Fig. 1722 has support ears for use with CRECo Third-Point Support as applied to United States Railroad Administration cars.

The Diamond Special brake beam is built for A. R. A. No. 4 and for 28,000 lbs. capacity at 1/16 in. deflection. This beam has a solid rectangular compression member and rod tension member and is furnished with either rigid or automatically adjustable brake heads. The strut is keyed to the compression member. This beam is designed for use under four and six wheel heavy passenger

Fig. 1720—Diamond Special Brake Beam

equipment. It was "Pullman Standard" equipment until the advent of all steel cars in 1910 and there are over 380,000 of them in service.

The National Hollow brake beam—Fig. 1723—is built for Nos. 1, 2, 3 and 4 A. R. A. capacities. This beam has a tubular compression member and rod tension member, with either rigid or adjustable brake heads. The National Hollow was the old "Pullman Standard" from 1892 to 1901 and is built for use on freight or four and six wheeled passenger equipment.

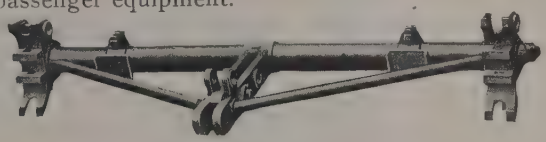


Fig. 1723—National Hollow Brake Beam

In addition to the above types, the Chicago Railway Equipment Company manufactures the Monarch, Sterlingworth and Ninety-Six solid freight brake beams for both inside and outside hung brakes. This company also makes the Kewanee brake beam with hollow rectangular pipe compression member and strap tension member. This type of beam has interchangeable right-or-left-hand brake heads and either rigid or reversible strut.

The Reliance beam is made with a channel shaped compression member and a strap tension member; brake heads are interchangeable, right or left hand.

Fig. 1724—"P. C. Creco" Triple Brake Beam

The CRECo reversible strut is made by the Chicago Railway Equipment Company for use where it is desired to have brake beams available as either right or left hand—by simply turning the lever slot.

This company has furnished over 9,000,000 brake beams for cars and locomotives used in both freight and passenger service.

For other products and branch offices, see classified and alphabetical indexes.

CHICAGO RAILWAY EQUIPMENT COMPANY, CHICAGO, ILL.

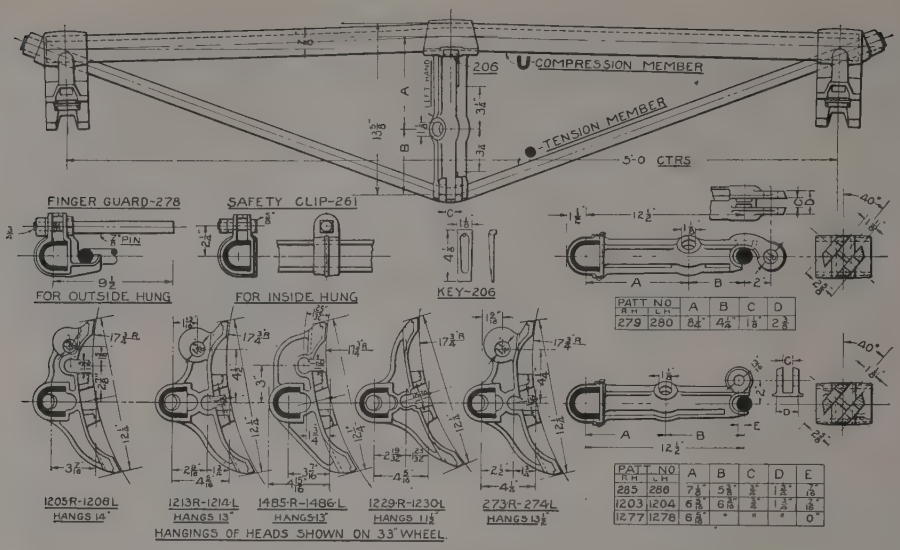

206 U COMPRESSION MEMBER
TENSION MEMBER
5'-0 CTRS
FINGER GUARD-278
PIN
FOR OUTSIDE HUNG
SAFETY CLIP-261
FOR INSIDE HUNG
KEY-206
PATT NO | A | B | C | D
279 280 | 8½ | 4½ | 1⅛ | 2⅜
1205R-1208L HANGS 14"
1213R-1214-L HANGS 13"
1485-R-1486-L HANGS 13"
1229-R-1230L HANGS 11½"
273R-274L HANGS 13½"
PATT NO | A | B | C | D | E
285 286 | 7⅞ | 5⅜ | ⅜ | 1⅜ | ⅞
1203 1204 | 6⅜ | 6⅜ | ⅜ | 1⅜ | ⅞
1277 1278 | 6⅜ | " | " | " | 0"
HANGINGS OF HEADS SHOWN ON 33" WHEEL.

Fig. 1725—Creco A. R. A. No. 1 and No. 2 Freight Brake Beam.

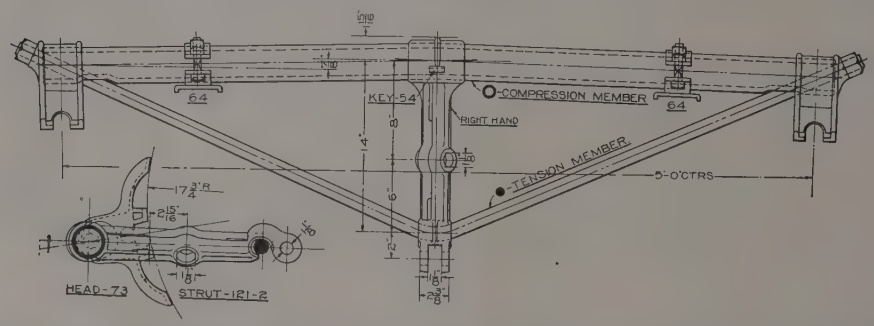


Fig. 1726—National Hollow 2½-in. Brake Beam with Rigid Heads for Heavy Freight Service.

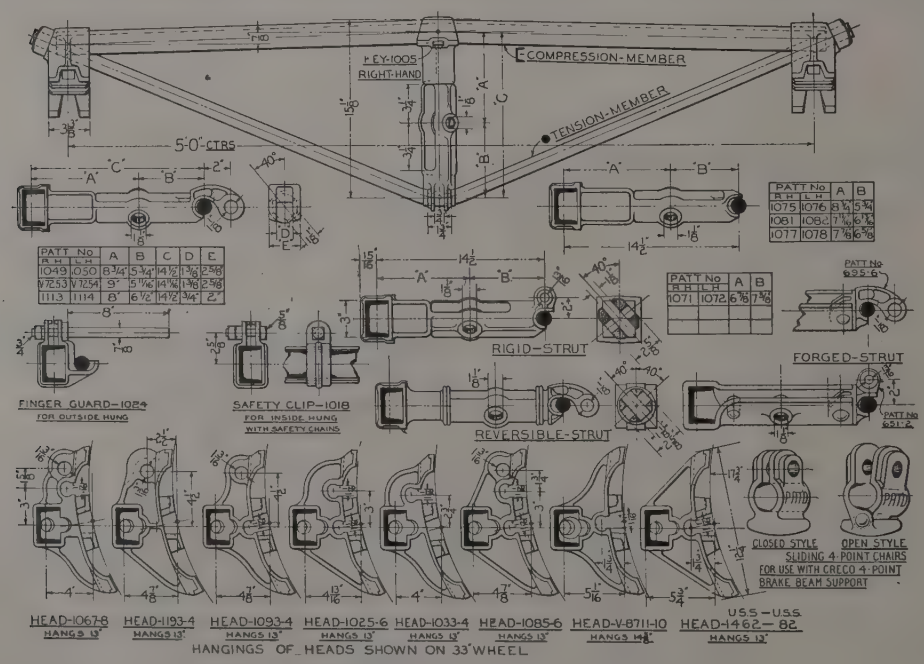

KEY-1005 RIGHT-HAND
COMPRESSION-MEMBER
TENSION-MEMBER
5'-0"CTRS
PATT No | A | B
1075 1076 | 8¼ | 5¾
1081 1082 | 7⅞ | 6⅛
1077 1078 | 7⅞ | 6⅛
PATT No | A | B | C | D | E
1049 1050 | 8¾ | 5¾ | 14½ | 1⅜ | 2⅝
V 7253 V 7254 | 9" | 5 11/16 | 14½ | 1⅜ | 2⅝
1113 1114 | 8" | 6½ | 14½ | ¾ | 2"
PATT No | A | B
1071 1072 | 6⅜ | 7⅛
RIGID-STRUT
FORGED-STRUT
PATT No 925-6
PATT No 921-A
REVERSIBLE-STRUT
FINGER GUARD-1024 FOR OUTSIDE HUNG
SAFETY CLIP-1018 FOR INSIDE HUNG WITH SAFETY CHAINS
CLOSED STYLE SLIDING 4-POINT CHAIRS FOR USE WITH CRECO 4-POINT BRAKE BEAM SUPPORT
OPEN STYLE
HEAD-1067-8 HANGS 13"
HEAD-1193-4 HANGS 13"
HEAD-1093-4 HANGS 13"
HEAD-1025-6 HANGS 13"
HEAD-1033-4 HANGS 13"
HEAD-1085-6 HANGS 13"
HEAD-V-8711-10 HANGS 14½"
HEAD-1462—82 HANGS 13"
U.S.S.-U.S.S.
HANGINGS OF HEADS SHOWN ON 33"WHEEL

Fig. 1727—Drexel A. R. A. No. 2 and No. 3 Brake Beams.

Chicago Railway Equipment Company.

(*See also Page 731.*)

Fig. 1728—Drexel Brake Beam with Riveted Strut.

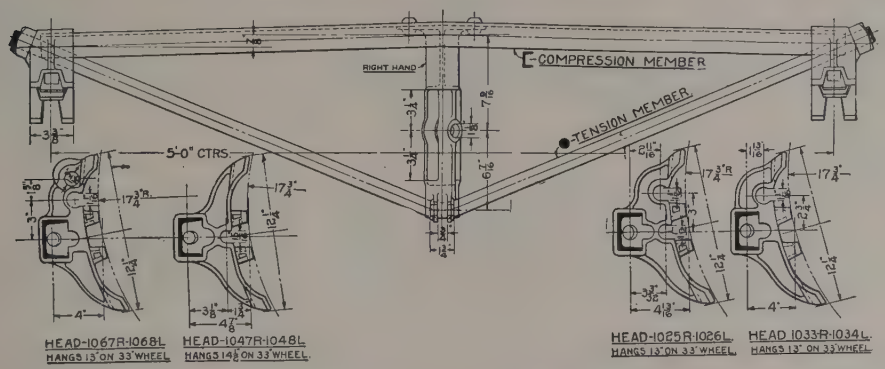


Fig. 1729—Drexel A. R. A. No. 2 and No. 3 Freight Brake Beam with Riveted Strut.

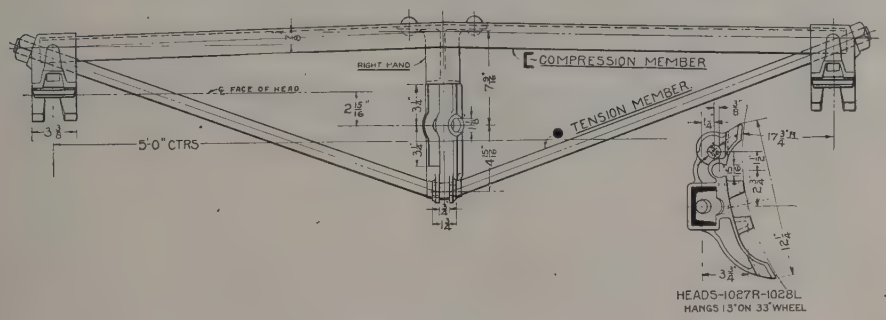


Fig. 1730—Drexel A. R. A. No. 1 Freight Brake Beam with Riveted Strut.

Fig. 1731—Drexel Brake Beam with Keyed Strut.

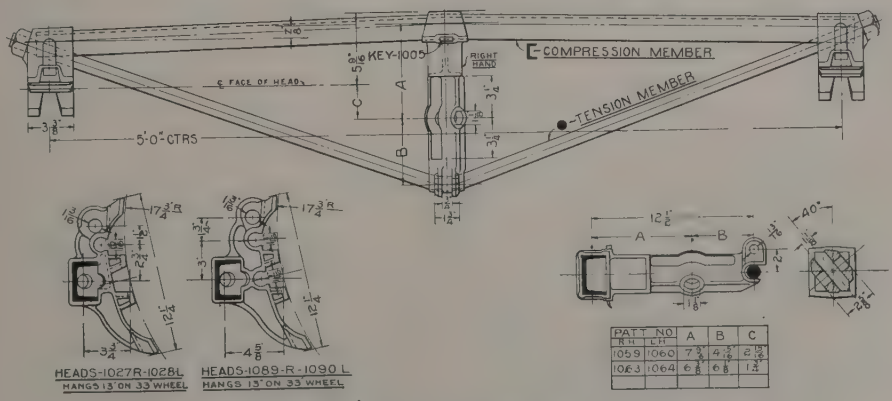


Fig. 1732—Drexel No. 1 A. R. A. Brake Beam with Keyed Strut.

Chicago Railway Equipment Company.

(*See also Page* 731.)

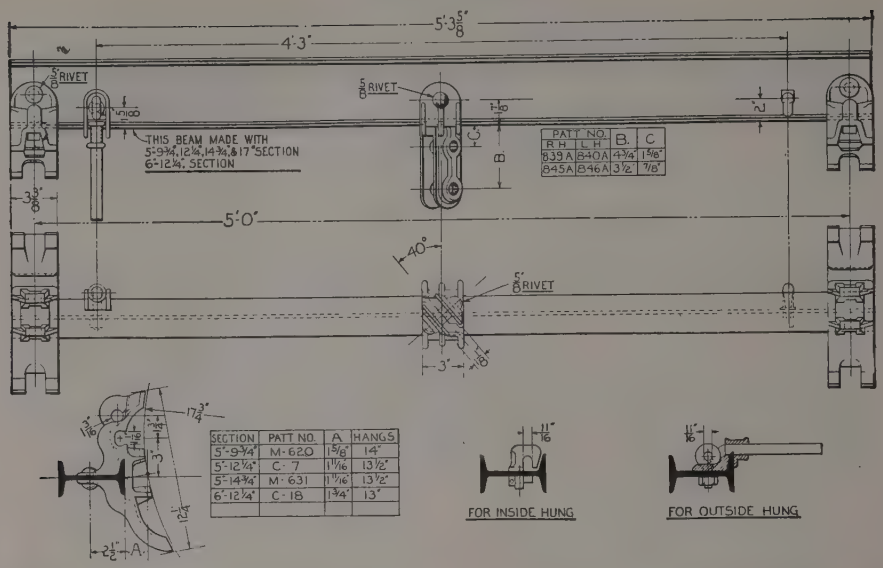


Fig. 1733—Monarch Solid Brake Beam.

Fig. 1734—Kewanee Brake Beam.

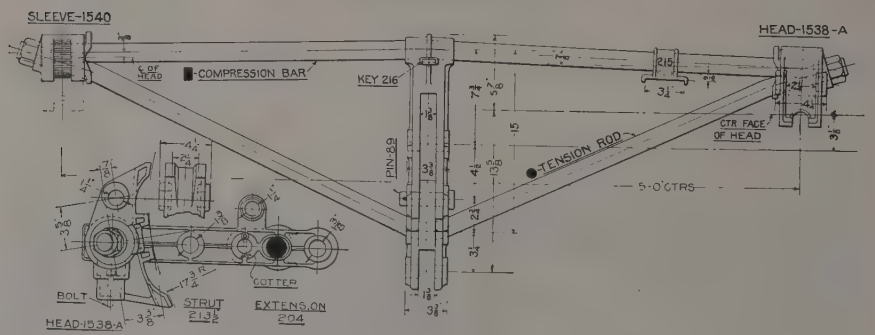


Fig. 1735—Diamond Special Triple Brake Beam for High Speed Six-Wheel Trucks.

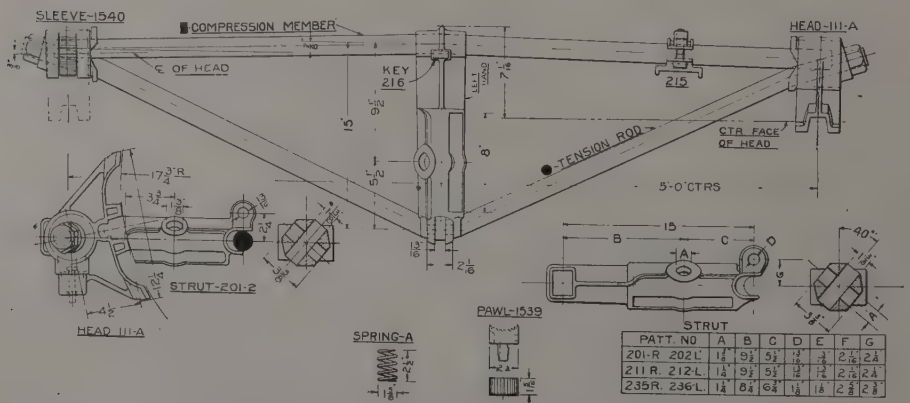


Fig. 1736—Diamond Special Double Brake Beam for High Speed Four-Wheel Trucks.

Chicago Railway Equipment Company.

(*See also Page* 731.)

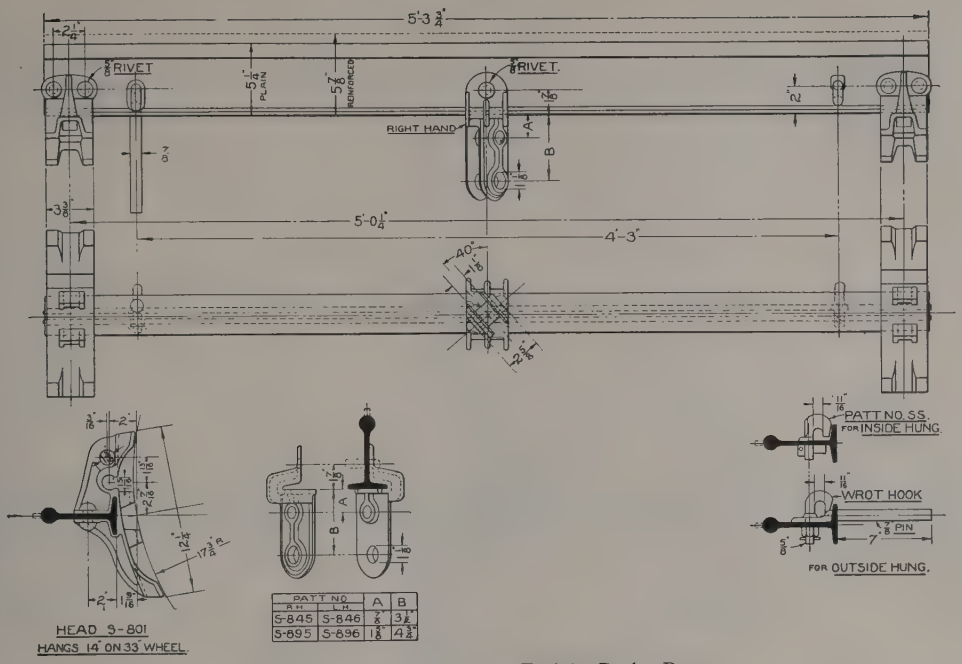


Fig. 1737—Sterlingworth Freight Brake Beam.

Fig. 1738—Sterlingworth Freight Brake Beam.

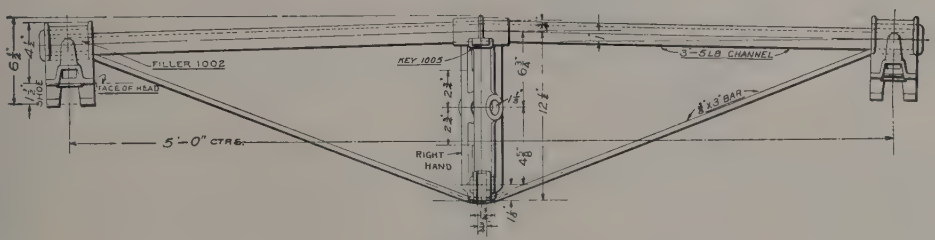


Fig. 1739—Reliance Freight Brake Beam.

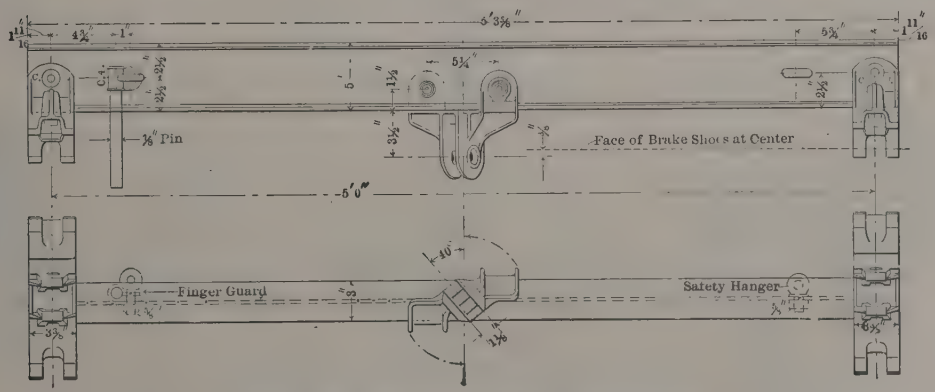


Fig. 1740—Ninety-Six Freight Brake Beam.

Chicago Railway Equipment Company.

(See also Page 731.)

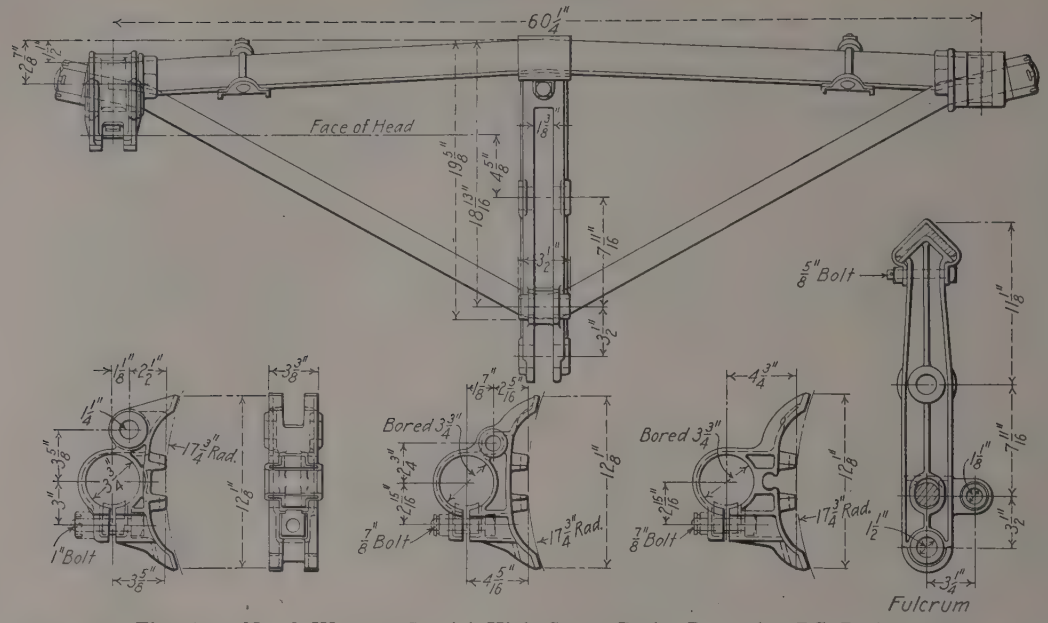


Fig. 1741—No. 2 Waycott Special High Speed Brake Beam for PC Brakes.

Fig. 1742—No. 2 Waycott Special High Speed Brake Beam.

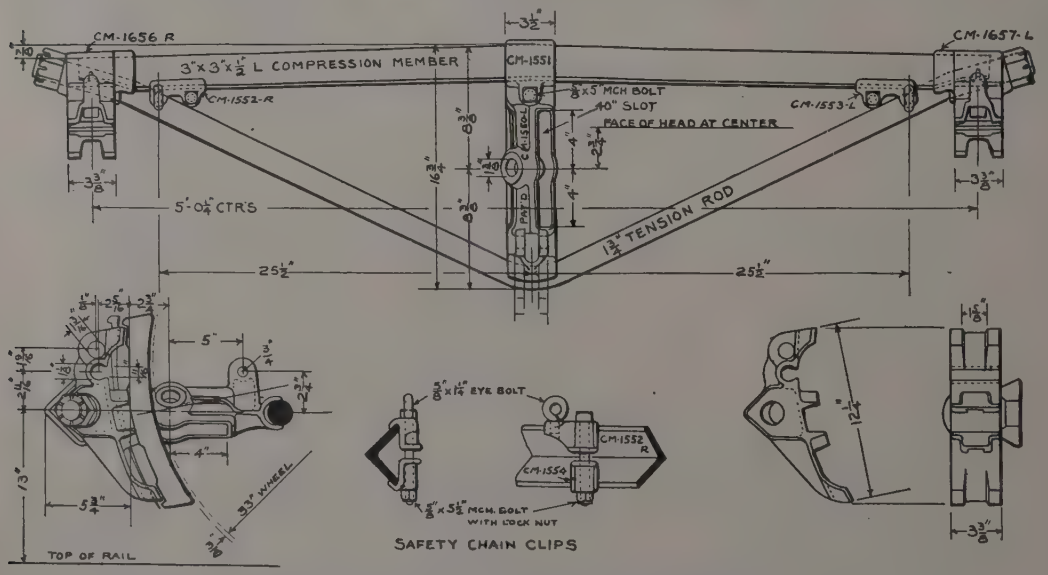


Fig. 1743—Waycott Brake Beam with Rigid Heads for High Speed Four-Wheel Trucks.

The Damascus Brake Beam Company.

(*See also Page 748.*)

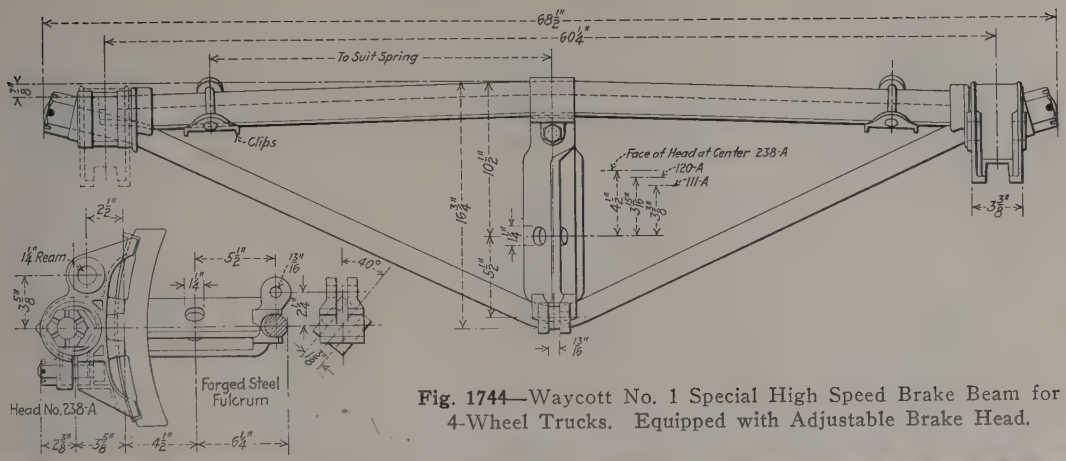


Fig. 1744—Waycott No. 1 Special High Speed Brake Beam for 4-Wheel Trucks. Equipped with Adjustable Brake Head.

Fig. 1745—No. 1 Waycott Special High Speed Brake Beam.

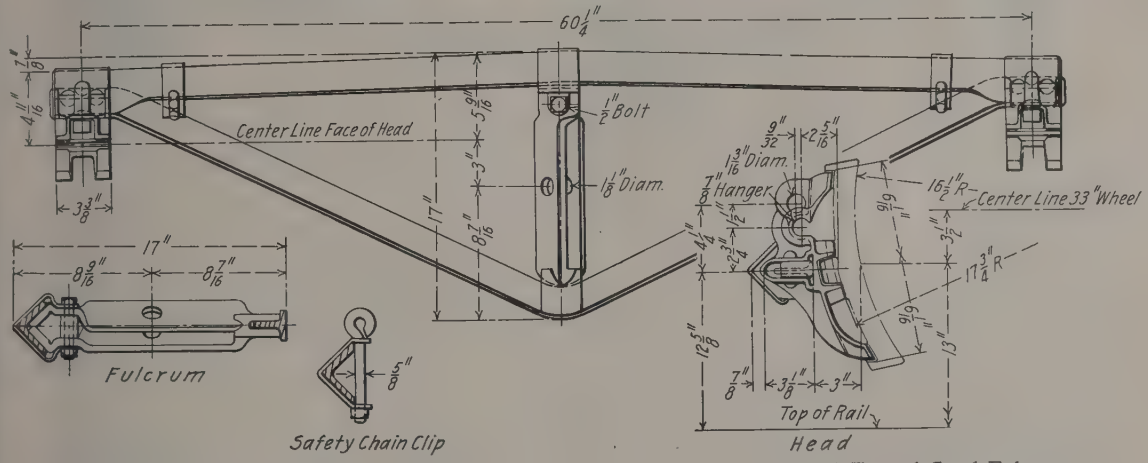


Fig. 1746—No. 2 Waycott Freight Brake Beam with Reversible Head and Forged Steel Fulcrum.

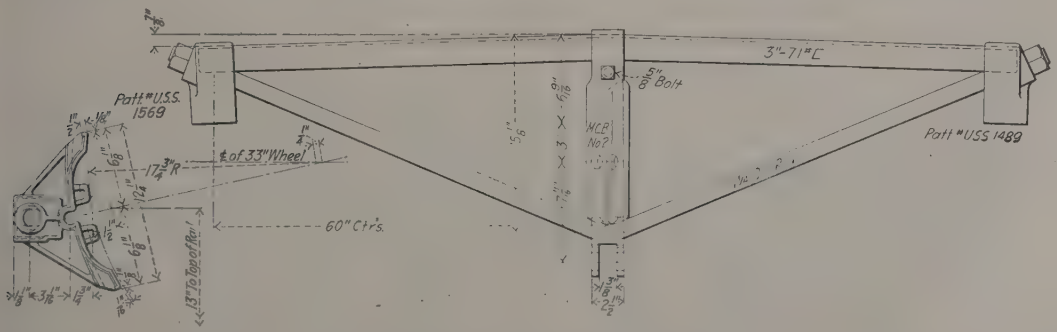


Fig. 1747—No. 2 Channel Brake Beam for U. S. Government Standard Cars.

The Damascus Brake Beam Company.

(See also Page 748.)

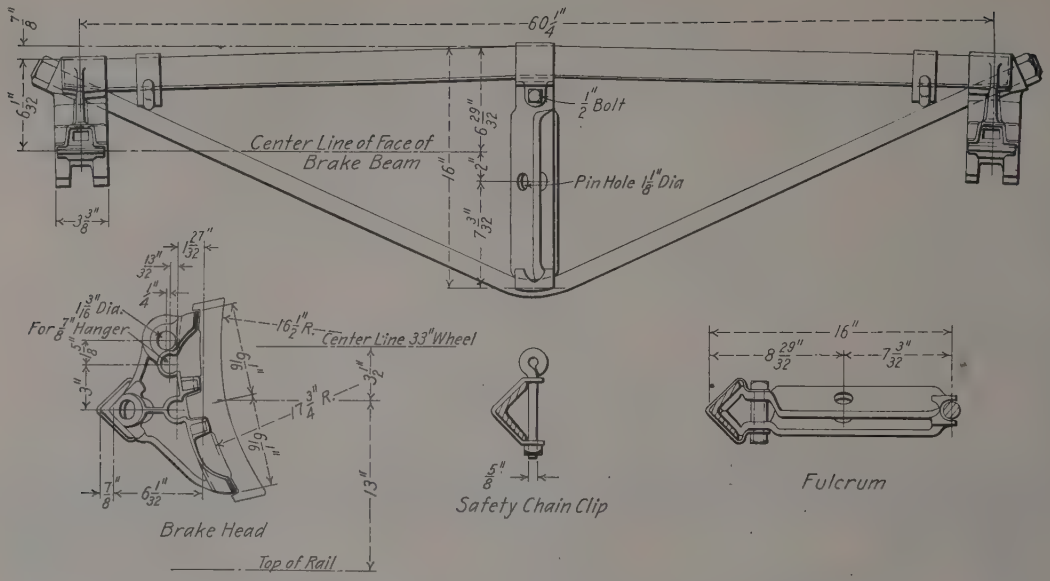
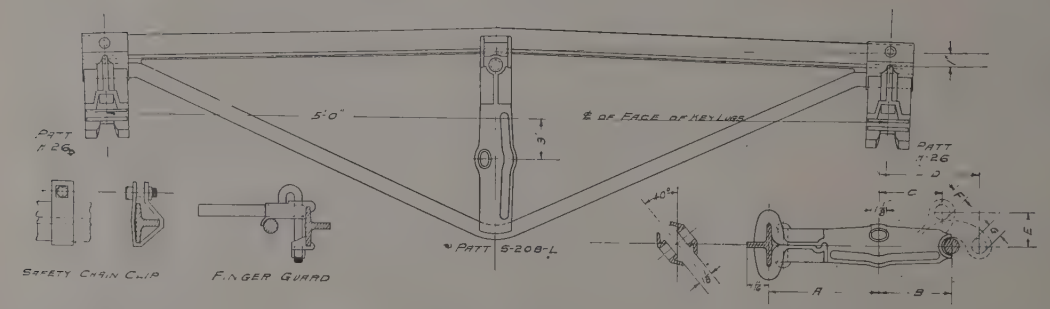
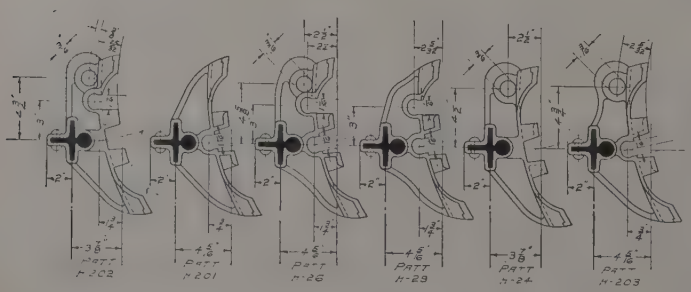


Fig. 1748—Anglrod A. R. A. No. 2 Freight Brake Beam. Damascus Brake Beam Company.

Fig. 1749—Davis Rod and Channel Brake Beam. Davis Brake Beam Company.

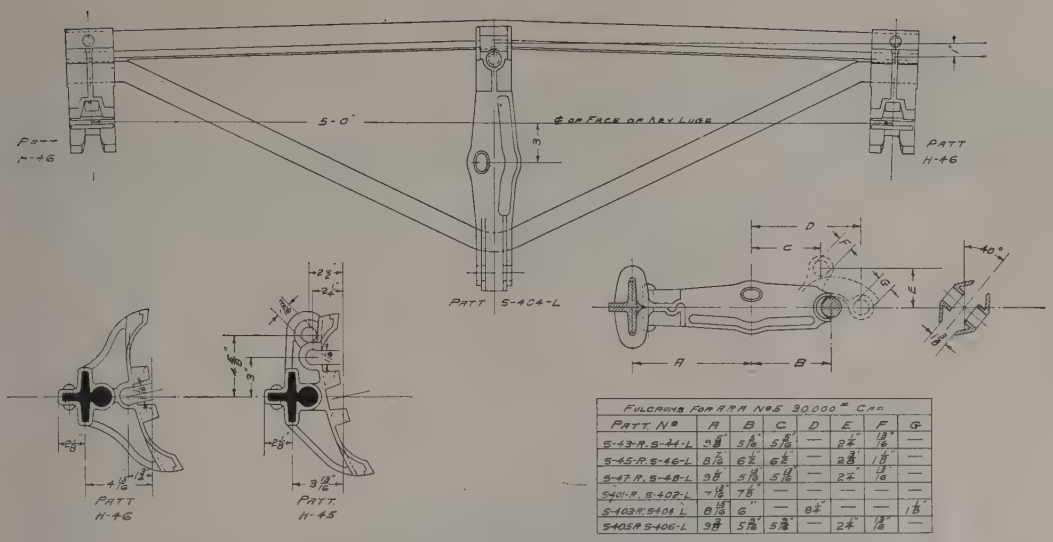




FULCRUMS FOR A.R.A. No. 2 12,000# CAP							
PATT No.	A	B	C	D	E	F	G
S-21-R S-22-L	7 3/8	5 1/16	—	7 3/8	—	—	1 1/8
S-23-R; S-24-L	8 7/16	4 1/16	—	6 7/8	—	—	1 1/8
S-27-R, S-28-L	7 1/8	4 7/16	—	—	—	—	—
S-203-R; S-204-L	8 1/16	4 1/16	—	—	—	—	—
S-205-R S-206-L	7 1/8	5 1/4	—	—	—	—	—
S-211-R; S-212-L	6 1/4	5 3/8	—	—	—	—	—
S-217-R; S-218-L	7 7/16	5 1/16	—	—	—	—	—
S-219-R S-220-L	6 3/8	5 1/2	6 7/16	—	2	1 3/4	—
S-221-R S-222-L	6 7/16	5 7/16	—	—	—	—	—

FULCRUMS FOR 15,000 CAP							
PATT No.	A	B	C	D	E	F	G
S-207-R S-208-L	8 1/16	5 3/16	—	—	—	—	—
S-209-R S-210-L	8 1/2	5 3/8	4 1/4	—	2 1/2	1 3/4	—
S-223-R S-224-L	7 1/16	6 7/16	—	—	—	—	—
S-225-R S-226-L	7 3/8	6	—	—	—	—	—
S-227-R S-228-L	6 3/8	7	—	—	—	—	—

Fig. 1750—Davis Solid Truss Brake Beam for Freight Service. Davis Brake Beam Company.



FULCRUMS FOR A.R.A. No 5 30,000 LB CAP.							
PATT. No	A	B	C	D	E	F	G
S-43-R. S-44-L	9 3/8	5 1/16	5 1/16	—	2 1/4	13/16	—
S-45-R. S-46-L	8 1/16	6 1/2	6 1/2	—	2 3/8	1 1/8	—
S-47-R. S-48-L	9 3/8	5 1/16	5 1/16	—	2 1/4	13/16	—
S401-R. S-402-L	7 13/16	7 1/8	—	—	—	—	—
S-403-R. S-404-L	8 1/16	6	—	8 1/4	—	—	1 1/8
S-405-R. S-406-L	9 3/8	5 1/16	5 1/16	—	2 1/4	13/16	—

Fig. 1751—Davis Solid Truss Brake Beam for Heavy Passenger and Tender Service.

Fig. 1752—Davis Solid Truss Brake Beam No. 4 for High Speed Passenger and Tender Service.

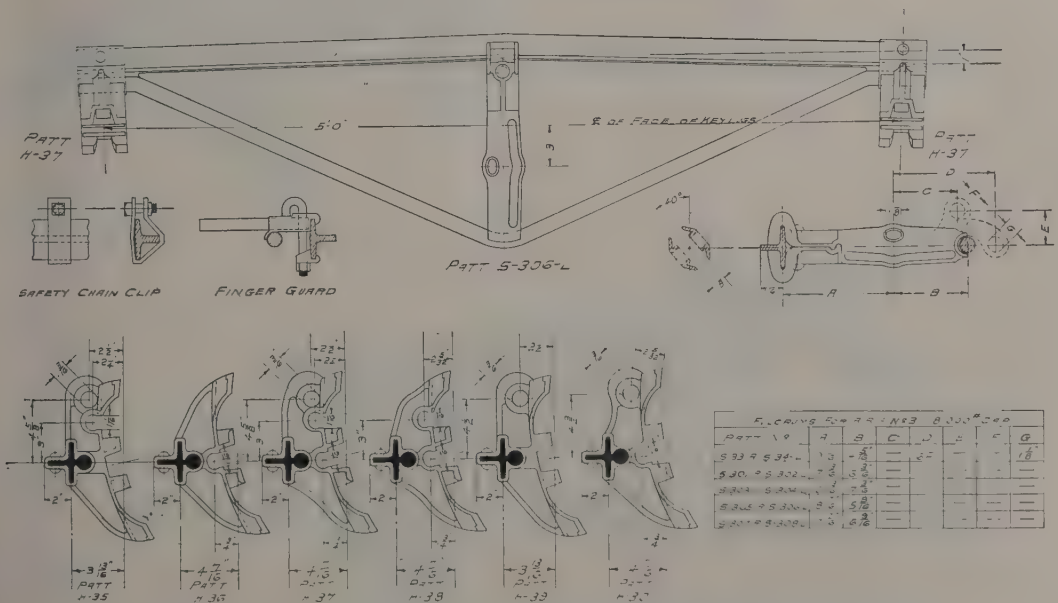


Fig. 1753—Davis Solid Truss Brake Beam for Heavy Freight and Tender Service.

Davis Brake Beam Company.

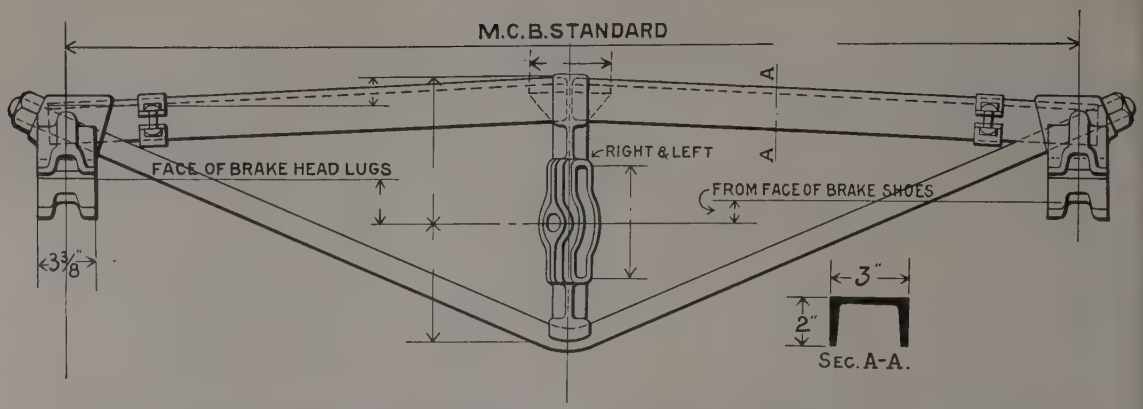


Fig. 1754—Pennsylvania Trussed Brake Beam, No. 1 and No. 2. Pennsylvania Brake Beam Company.

Fig. 1755—Standard I-Beam Brake Beam with Drop Forged Fulcrum.

Fig. 1756—Standard Deck Beam Brake Beam with Drop Forged Fulcrum.

Fig. 1757—Special Combination Deck and I-Beam Section Brake Beam with Drop Forged Fulcrum.

Pennsylvania Brake Beam Company.

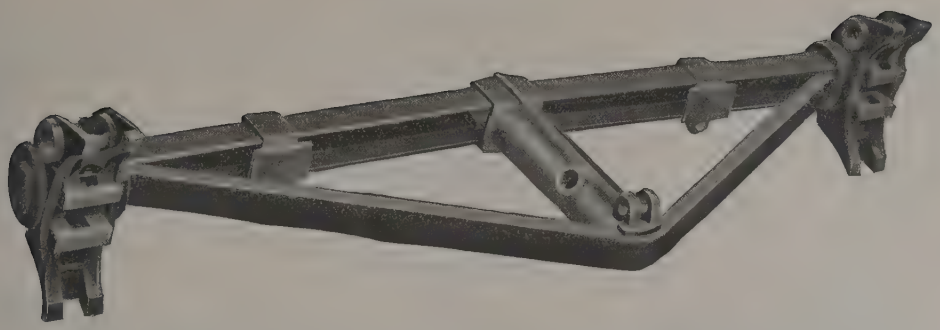


Fig. 1758—Huntoon Standard Brake Beam for Four-Wheel Passenger Car Trucks.

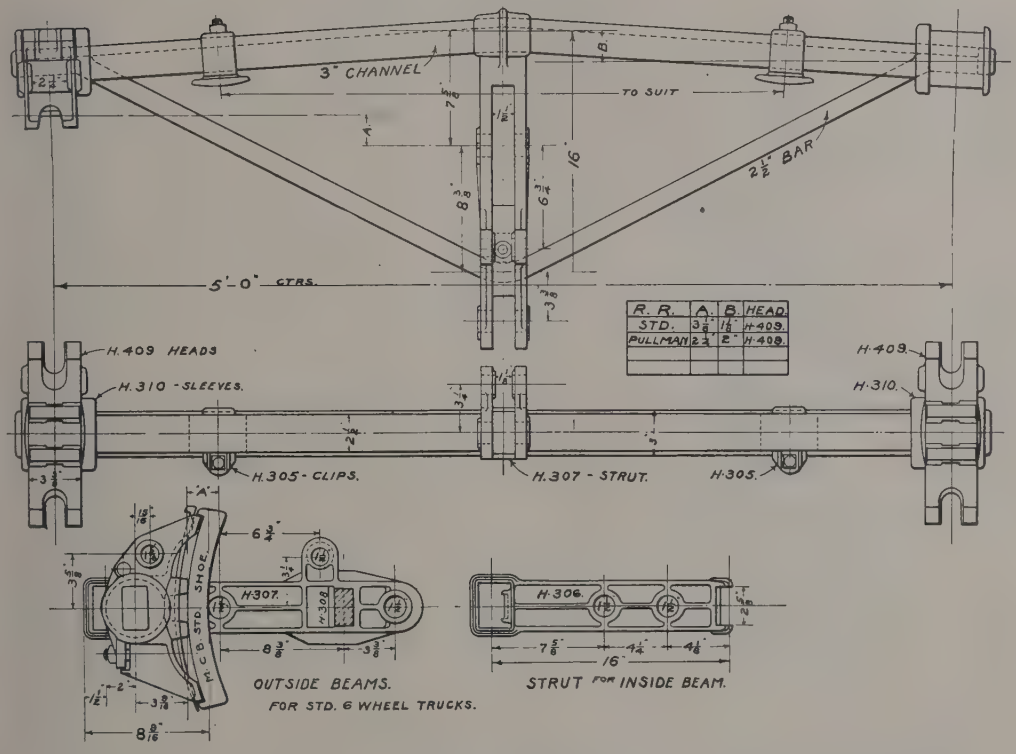


Fig. 1759—Huntoon Adjustable Head Brake Beam for Six-Wheel Passenger Car Trucks. Capacity, 40,000 lb.

Fig. 1760—Huntoon Adjustable Head Passenger Brake Beam Details.

Republic Railway Equipment Company, Inc.

(See also Pages 743, 745)

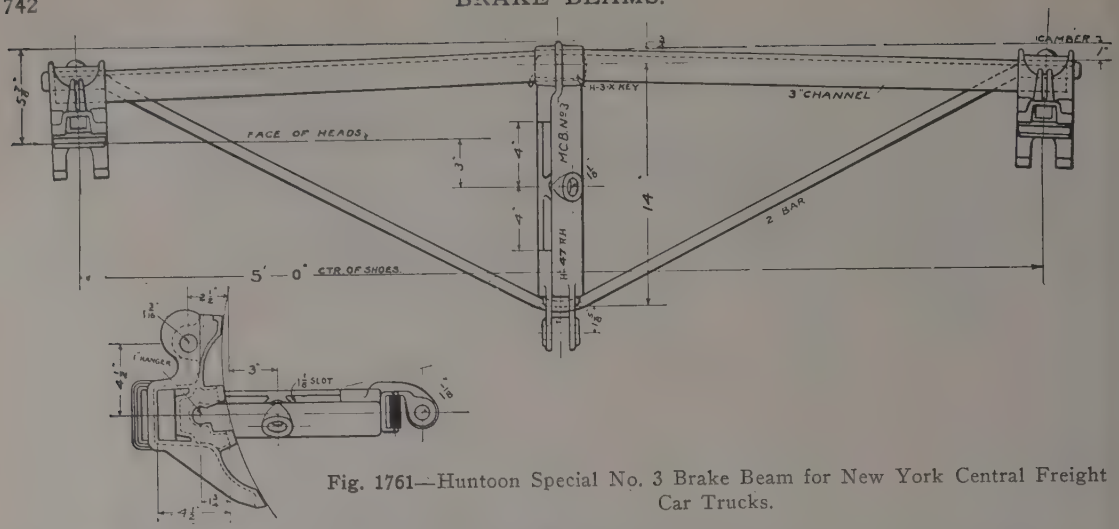


Fig. 1761—Huntoon Special No. 3 Brake Beam for New York Central Freight Car Trucks.

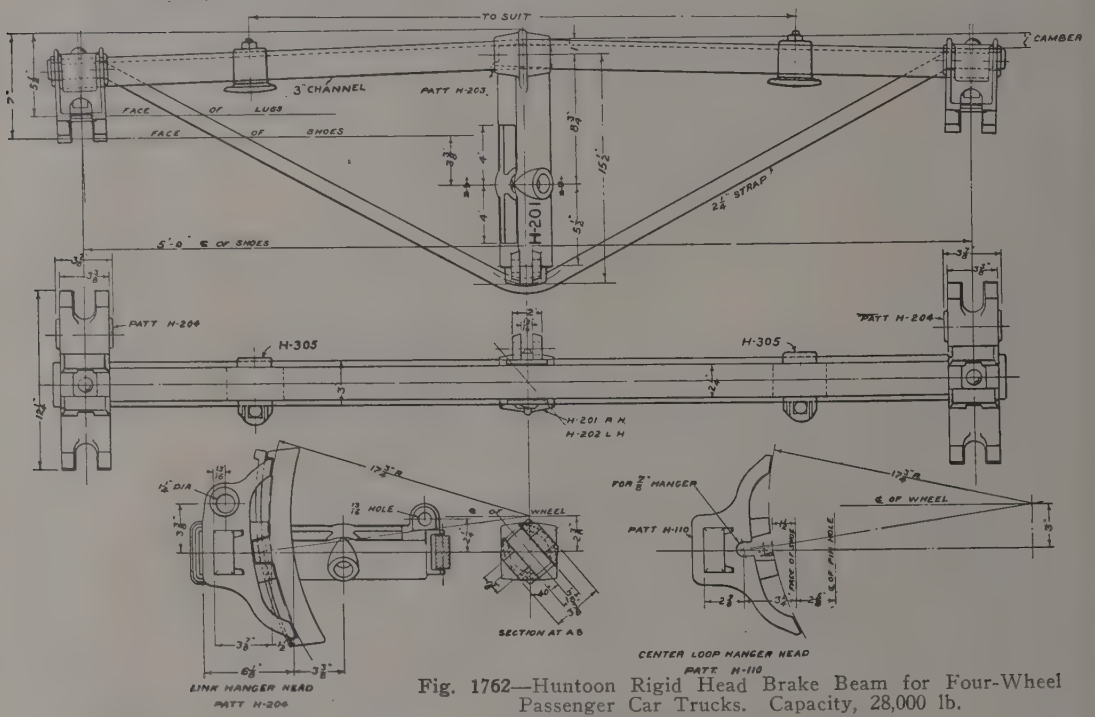


Fig. 1762—Huntoon Rigid Head Brake Beam for Four-Wheel Passenger Car Trucks. Capacity, 28,000 lb.

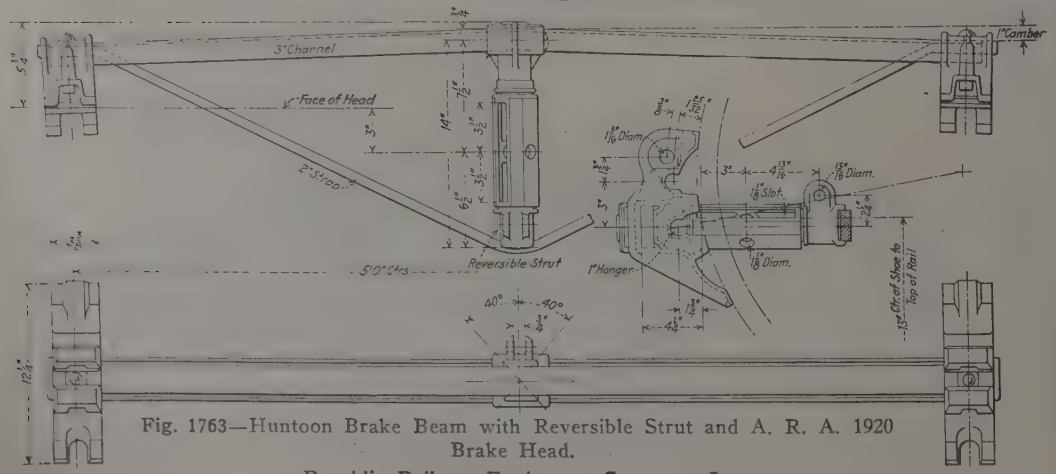


Fig. 1763—Huntoon Brake Beam with Reversible Strut and A. R. A. 1920 Brake Head.

Republic Railway Equipment Company, Inc.

(*See also Pages* 743, 745)

Adjustable Brake Beams and Brake Heads

The Huntoon Reversible Brake Beam—as shown in Fig. 1764—has a reversible strut, making the brake beam either right or left hand as desired. By simply inserting the brake lever, the strut can be turned to the desired angle; lugs or stops placed in the proper position insure correct alignment of levers.

Fig. 1764—Huntoon Brake Beam with Reversible Strut

The two parts of this strut are telescoped one into the other and riveted together, making it the equivalent of, but stronger than, an integral strut. They are furnished as a complete strut or unit—no loose parts to be secured or adjusted by the workmen.

The great advantages of this type of strut is that the necessary stock of beams and repair parts is reduced to a minimum, thus often preventing delays in replacements particularly at isolated repair points.

Huntoon Brake Beams with the Reversible Struts are now in use on over fifty railroads and are giving satisfactory service and effecting economies in maintenance. The cost is the same as a brake beam having an integral strut, with the advantage of the reversible feature.

The Huntoon Adjustable Brake Heads—as shown in Fig. 1766—are furnished on high capacity passenger and locomotive tender beams, to insure maximum braking power and even brake shoe wear. Upon the first application of the air-brake the brake heads are automatically adjusted to the proper position and are maintained in this position by the spring-actuated clamp. The heads are secured between collars on the journal ends of the brake beam and are free from any endwise movement or possibility of misplacement. The large area of contact between the heads and the beam prevents wear and the consequent lost motion.

The Joliet Journal Box is a one-piece, high-grade malleable iron journal box made to the A. R. A. specifications and having an improved patented lid which protects the journal and bearings against ice, snow and dust. Both the box and the lid, being malleable iron, are exceedingly strong and have great rust resisting properties.

The box is interchangeable with any A. R. A. journal box now in use and is as readily applied.

Fig. 1766—Adjustable Brake Head

A heavy coil spring and shoe on the lid gives maximum pressure in closed position, preventing rattling and protecting the bearings perfectly.

Fig. 1765—Huntoon Brake Beam with Adjustable Heads

Should the lid accidentally be torn off, it can be quickly replaced with an A. R. A. standard flat spring lid until a new Joliet lid is available.

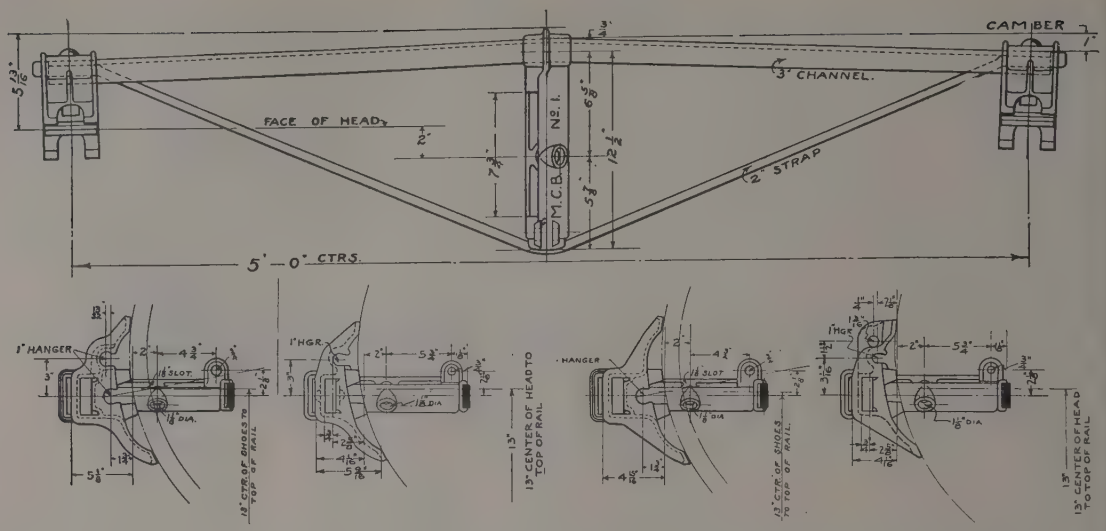


Fig. 1767—Huntoon A. R. A. No. 1 Brake Beam for Freight Service.

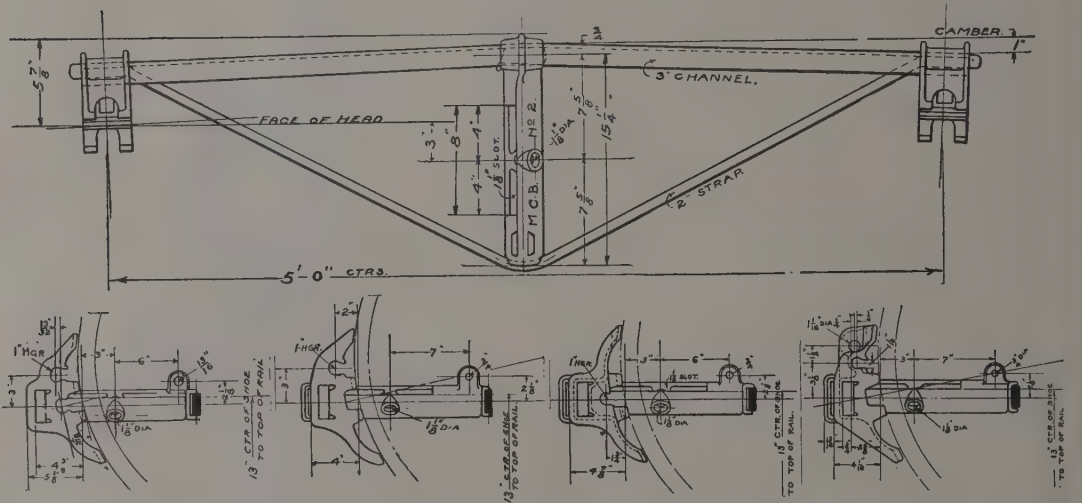


Fig. 1768—Huntoon Heavy A. R. A. No. 2 Brake Beam for Freight Service.

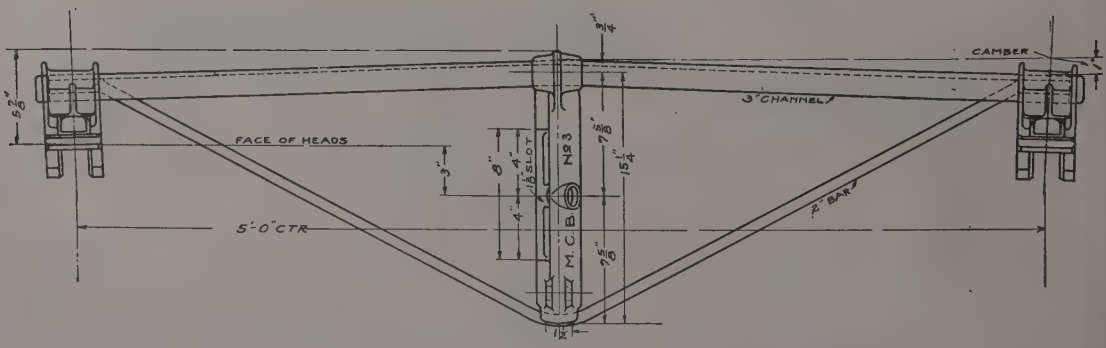


Fig. 1769—Huntoon A. R. A. No. 3 Brake Beam for Freight Service.

Republic Railway Equipment Company, Inc.

(*See also Pages* 743, 745)

Huntoon Brake Beam

The Huntoon Brake Beam is built to withstand the unusually hard service incident to modern traffic requirements. The beam — as shown in Figs. 1770 and 1772—is built-up and of truss form; for a tension member, it has a flat bar upset at its ends to give added strength at points of greatest stress, these ends being interlocked into and bearing directly against the ends of the compression member, which is made of a channel iron. The ends of the truss member are held in place by the brake heads, the latter being riveted on to prevent endwise displacement—as shown in Fig. 1771.

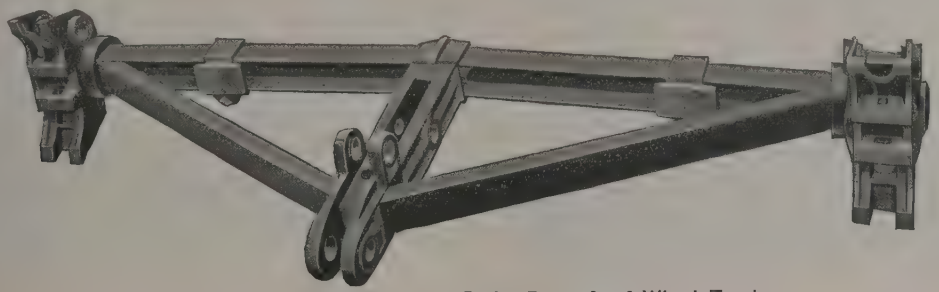


Fig. 1770—Huntoon Passenger Brake Beam for 6-Wheel Trucks

The Huntoon Beam has no nuts to loosen, no threads to strip or rust off, no key slot in the strut to cause breakages or rivets to weaken the compression member. There is no danger of the tension member being cut by the wheel flanges—the cause of many brake beam failures, as the inspection of any scrap pile will confirm.

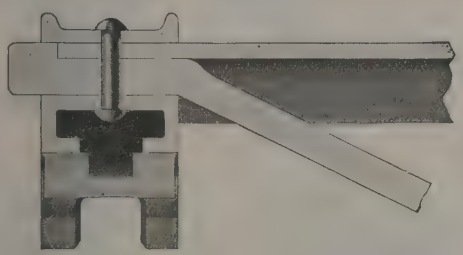


Fig. 1771—Section at End of Freight Brake Beam

The dominant feature of construction of the Huntoon beam is the manner in which the two main truss members are interlocked and secured at their ends—as shown in Fig. 1771. The upset tension bar corresponding to the contour of the inner face of the channel compression member, lies flat along the inside web of the channel terminating in shoulders at the brake heads which fit squarely against the ends of the compression member, without any interposed blocks or parts, thus giving a direct bearing in a direct plane with the compression channel, and filling the brake head beam seat snugly and preventing lost motion.

To assemble the beam the compression member is slightly flexed beyond the normal camber and the heads of the tension bar are slipped into place, interlocking with the channel. This holds the two members against displacement and gives the truss the desired resiliency. The brake heads are then pressed on and riveted in place, the only function of the rivets being to prevent any endwise movement of heads on the beam.

After assembling, all beams are subjected to a test load slightly under the elastic limit of the beam to disclose against any possible defects or flaws in the material. They are then carefully inspected and gaged to see that they fully meet all A. R. A. specifications as to dimensions and interchange. After undergoing these tests one beam from each lot is tested in the laboratory of the company on a specially designed Riehle testing machine to see that it fully meets all A. R. A. requirements as to capacity, minimum deflection and set under the required loads.

All Huntoon Beams are constructed to exceed their rated capacities, and on account of this excess strength, they will stand great abuse in service, insuring durability and efficiency under all conditions. Beams removed after eight years of service showed the same deflections under test as when first built, there being no depreciation in the capacity or strength of the beams.

Fig. 1772—Huntoon Freight Brake Beam

Huntoon Beams are furnished for all classes of equipment, being made in all sizes from 12,000 lb. to 40,000 lb. capacity.

For other products and branch offices, see classified and alphabetical indexes.

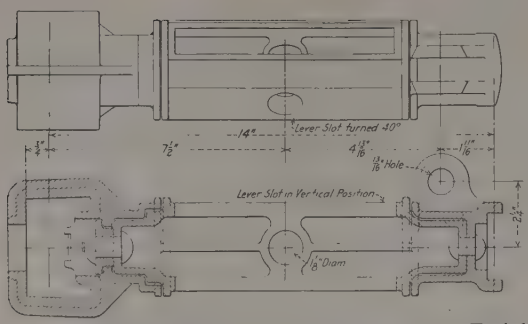


Fig. 1773—Huntoon Reversible Strut for Heavy Freight and Tender Brake Beams. Republic Railway Equipment Company.

(See also Page 745.)

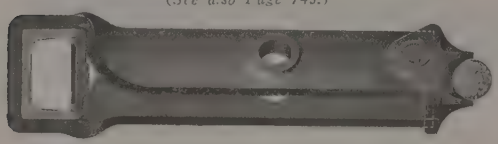


Fig. 1775—Forged Steel Strut. Buffalo Brake Beam Company.

(See also Page 747.)

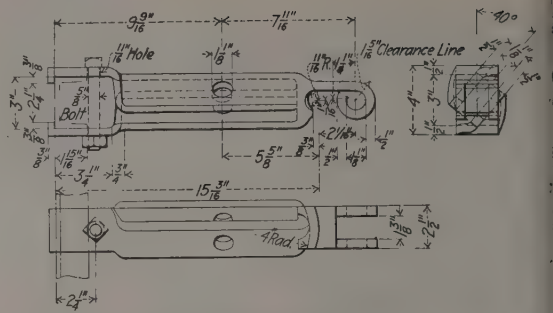


Fig. 1774—Forged Steel Fulcrum for U. S. Standard No. 2 Channel Brake Beam. Damascus Brake Beam Company.

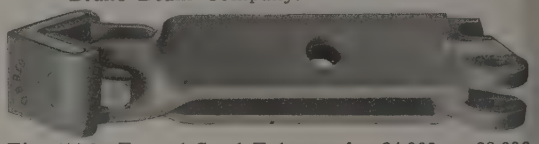


Fig. 1776—Forged Steel Fulcrum for 24,000 to 28,000 lb. Capacity Angle Brake Beam for Passenger Car Trucks. Damascus Brake Beam Company.

(See also Page 748.)

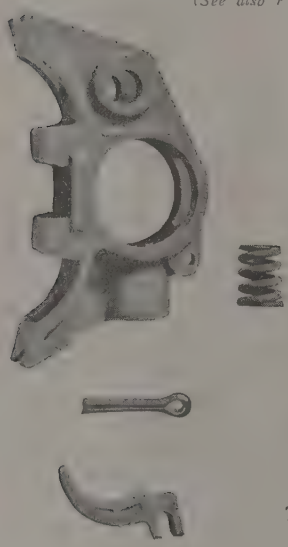


Fig. 1777 — Automatically Adjustable Brake Head, Cam Block and Spring for Hercules Brake Beam. American Steel Foundries.

Top Hanger, Bottom Adjustment.

Center Hanger, Bottom Adjustment.

Fig. 1778—Buffalo Adjustable Brake Heads. Buffalo Brake Beam Company.

Fig. 1779—"Waycott" Adjustable Brake Head. The Damascus Brake Beam Company.

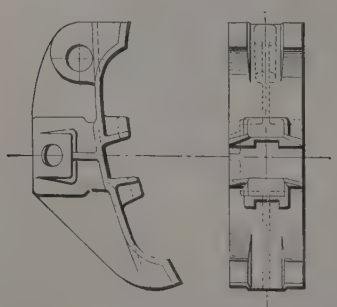
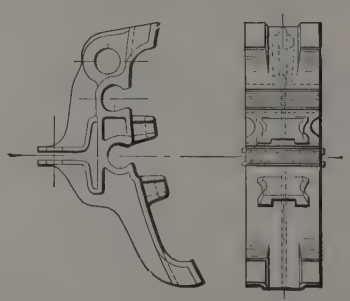


Fig. 1780—Brake Head for Ajax Brake Beams.



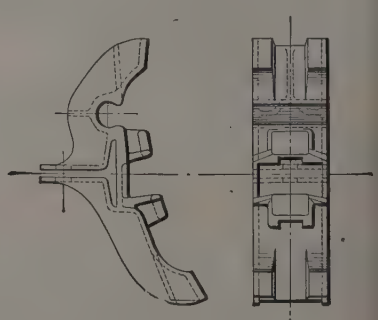


Fig. 1780A—Brake Heads for Acme Brake Beams. American Steel Foundries.

Brake Beam Struts
Buffalo Safety
Brake Shoe Key

The constantly increasing weight of freight cars and the high speed of modern traffic movement, have resulted in an urgent demand for more efficient braking facilities and particularly for more reliable brake rigging, to contend with the greater stresses imposed under these conditions.

The question of more efficient brake beam construction has been thoroughly studied by the Buffalo Brake Beam Company and they are now producing several devices pertaining to brake beams, which involve a number of improvements.

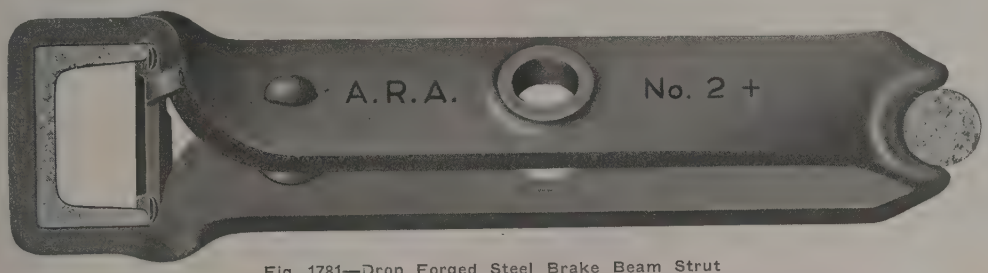


Fig. 1781—Drop Forged Steel Brake Beam Strut

The one-piece drop forged steel strut shown in Fig. 1781 is manufactured from a single piece of 7/16 in. by 2½ in. steel and can be applied to any style of brake beam. The design of this strut has received careful attention in order to eliminate unnecessary weight and to produce a member of maximum strength. The channel box, brake level slot and rod saddle are formed by the drop forging process, and as the entire strut consists of solid steel it is practically unbreakable; consequently it may be considered as a safety device of great value in brake beam construction.

A further advantage of this strut arises from the fact that it is entirely free from castings and rod saddle welds. Railroads doing reclamation work will find an advantage in this device because in case it becomes distorted, as the result of an accident or other abnormal condition, it can be easily straightened and restored to service at very low expense.

The Buffalo Safety Brake Shoe Key shown in Fig. 1782 is also manufactured by this company. It is forged to A. R. A. standards in all essential dimensions and can be applied or removed as easily and quickly as an ordinary key.

Under existing conditions, brake shoe keys often work out of position, resulting in the loss of both key and shoe with the constant possibility of further serious trouble. The Buffalo Safety Brake Shoe Key is designed to lock automatically by engaging the bottom side of the lower lugs on the brake head, thus eliminating any possibility of loss or damage caused by missing keys and brake shoes.

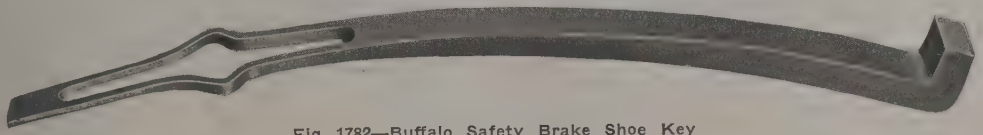


Fig. 1782—Buffalo Safety Brake Shoe Key

In addition to the one piece drop forged steel strut described above, this company also manufactures the drop forged steel reversible strut shown in Fig. 1783. This construction embodies all valuable features of the one-piece type and has a further advantage in that it can be used in either a right or left hand position. It can be applied to any style of brake beam and may be reversed without disturbing the nuts or tension adjustment. The component parts of this strut cannot shake loose and the entire assembly may be easily repaired in case of accident or excessive abuse. Where brake beams embodying this device are used it is possible to effect a considerable reduction in the stock of extra beams and repair parts usually kept in stock.

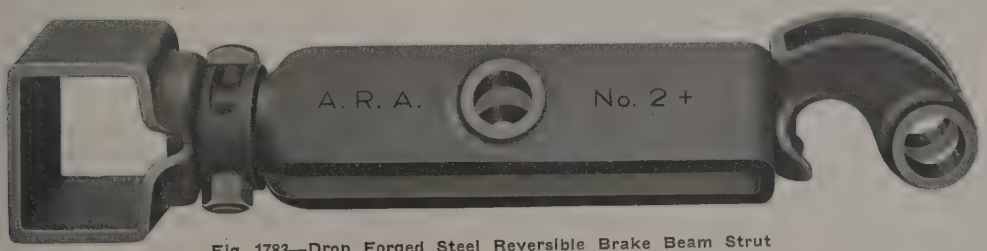


Fig. 1783—Drop Forged Steel Reversible Brake Beam Strut

For other products and branch offices, see classified and alphabetical indexes.

BUFFALO BRAKE BEAM COMPANY, NEW YORK, N. Y.

Damascus Indestructible Fulcrums

The brake beam fulcrum is undoubtedly the most important member among those parts of the brake equipment known as the foundation brake gear. Functioning at a point of great stress in the operation of the brakes the fulcrum is subjected to enormous pressure and shock strain. It therefore is of the highest importance that only durable and dependable fulcrums be used in all classes of equipment—locomotive tenders, and passenger and freight cars.

The Indestructible One-Piece Forged Steel

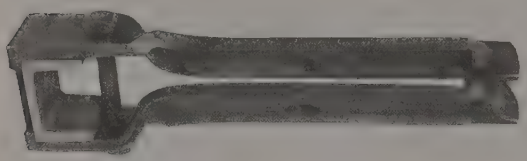


Fig. 1784—Indestructible One-Piece Forged Steel Strut for Outside Application to a Channel Brake Beam

Fulcrum has been developed by the Damascus Brake Beam Company. As its name indicates, the fulcrum is made in one piece of high quality forged steel that has successfully met severe metallurgical and mechanical tests to which all metal designed for this service is subjected. In comparison with malleable iron castings showing a tensile strength of 37,000 lb. per square inch, Indestructible Forgings show a tensile strength of 70,000 lb. per square inch. This difference in tensile strength enables a light fulcrum of relatively small cross sectional area to replace the old cast type.

The single forging combining all functions of a fulcrum gives the maximum strength where necessary and insures perfect ease of operation. If bent or distorted by accident the fulcrum is easily straightened and restored to its original state, ready for further use.

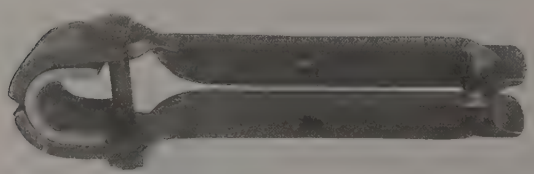


Fig. 1785—Indestructible One-Piece Forged Steel Fulcrum for Application to a U-Section Brake Beam

One highly important feature of the Indestructible One-Piece Forged Steel Fulcrum is that it is removable by simply removing one bolt and it can be replaced in a few minutes. It is also possible and practical to replace a right hand with a left hand fulcrum without the least difficulty if necessity should arise.

The fulcrums illustrated on this page show a rounded concave seat for round tensile rod in all cases except Fig. 1786 showing the Waycott fulcrum. Fulcrums can also be furnished with a seat to take care of any other type of tension rod. The fulcrums for channel compression members are made for both outside and inside application—see Figs. 1784 and 1787.

The economy of the use of the Indestructible One-Piece Forged Steel Fulcrum is effected by a low average replacement cost, a minimum of time lost by the car when the foundation brake gear is being re-

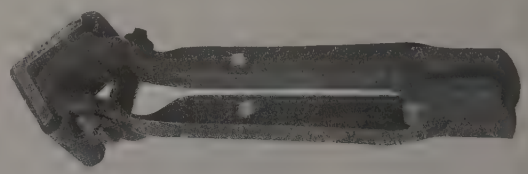


Fig. 1786—Indestructible One-Piece Forged Steel Fulcrum for Application to a Waycott Brake Beam

paired and an increase in length of service of the brake rigging.

All Damascus Brake Beams are equipped with the Indestructible Fulcrum and many years of continuous services of these brake beams have demonstrated its value.

The reduction in maintenance costs, the interchangeability and the increase in service and

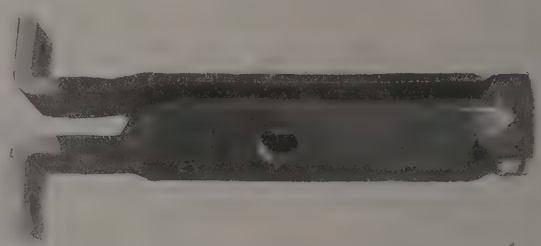


Fig. 1787—Indestructible One-Piece Forged Steel Fulcrum for Inside Application to a Channel Brake Beam

mileage of cars are distinctive features of all brake beams equipped with the Indestructible One-Piece Forged Steel Fulcrum and demonstrate its efficiency and economy.

The Damascus Brake Beam Company manufactures the Indestructible One-Piece Forged Steel Fulcrum for all types of passenger, freight

Fig. 1788—Indestructible One-Piece Forged Steel Fulcrum for Application to An Anglrod Brake Beam

and locomotive tender brake beams; whether of the Anglrod or channel rod construction regardless of whether the third point suspension is used or not.

For other products and branch offices, see classified and alphabetical indexes.

Car Brake Shoes

The requirements for brake shoes used on American railway equipment are: safety, friction, and durability, with no harmful action on the wheel. As a result of long experience in the manufacture of brake shoes, together with many tests in the laboratory and in actual service, the American Brake Shoe Foundry Company have been able to meet these requirements. Careful selection of special body metals and inserts; special reinforcing features; and the methods employed in manufacturing produce brake shoes combining high braking efficiency, durability, and safety.

Three types of brake shoes used extensively on railway cars are: Plain Gray Iron Steel Back Type;

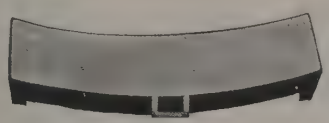


Fig. 1789—Plain Gray Iron Shoe

Special Chilled Steel Back Type, and Diamond "S" Steel Back Type.

The Plain Gray Iron, steel back and steel lug brake shoe has—as its name implies—a body composed of gray iron of a composition which combines the highest friction with the greatest durability that can be obtained from a gray iron wearing face. This type of shoe is particularly adapted for use in general freight service on moderately heavy equipment operated at comparatively slow speeds.

The Special Chilled, steel back and steel lug brake shoe is very similar to the Plain Gray Iron

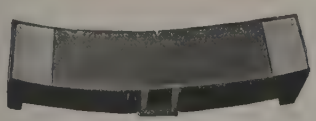


Fig. 1790—Special Chilled Type

type except that the body metal is of considerably harder composition and additional durability is obtained by hardening the ends of the shoe—by chilling—during the casting process. This produces a brake shoe which will fill the requirements of general freight service and also will give adequate friction and the durability for economical use in fast and heavy freight service.

The Diamond "S" steel back and steel lug brake shoe combines great durability with the high frictional qualities of the Plain Gray Iron Shoe. In its construction an insert composed of expanded mild steel plate is embedded in the body metal during the casting process. This, together with the steel plate back and lug reinforcement, produces a brake shoe which is practically indestructible except by actual wear. This type of brake shoe is universally used in passenger service. It is recommended for use on freight equipment and

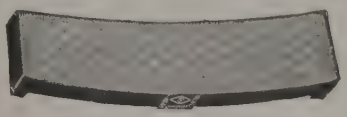


Fig. 1794—Diamond "S" Type

is especially desirable for heavy freight service on severe grades where brake applications are frequent and of long duration.

The Flanged Diamond "S" steel back and steel lug brake shoe is suitable for use on motor cars and other equipment for electric interurban service. On this class of equipment the trucks usually are not equipped with brake beams and the unflanged style of brake shoe will not properly maintain its position on the wheel. The Diamond "S" flanged type will overcome this difficulty and, due to its

Fig. 1795—Flanged Diamond "S" Type

composition and construction, will render efficient, economical service.

All of these types of brake shoes are reinforced with steel plate backs and lugs which are securely anchored in the castings and permit the use of the shoes until they are worn to a thickness of less than one-half inch. The steel plate back also will permits the use of a cracked shoe which would be unfit for use and dangerous if not provided with such a reinforcement.

In the manufacture of these shoes the steel plates, lugs, and inserts are set in the mold and the molten body metal then poured in, thus forming a solid casting which will withstand the most severe service.

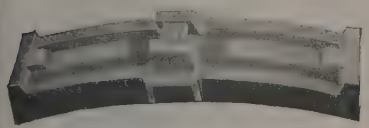


Fig. 1791—Steel Back Shoe—New

Fig. 1792—Steel Back Shoe—Cracked, but Good for Service

Fig. 1793—Steel Back Shoe—Worn to the Limit

These several types of brake shoes conform to the recognized standards of American practice and fully meet the A. R. A. requirements for friction and wear. They are in general use on chilled cast iron wheels and the various types of steel wheels used in all classes of railway service.

For other products and branch offices, see classified and alphabetical indexes.

AMERICAN BRAKE SHOE & FOUNDRY COMPANY, NEW YORK, N. Y.

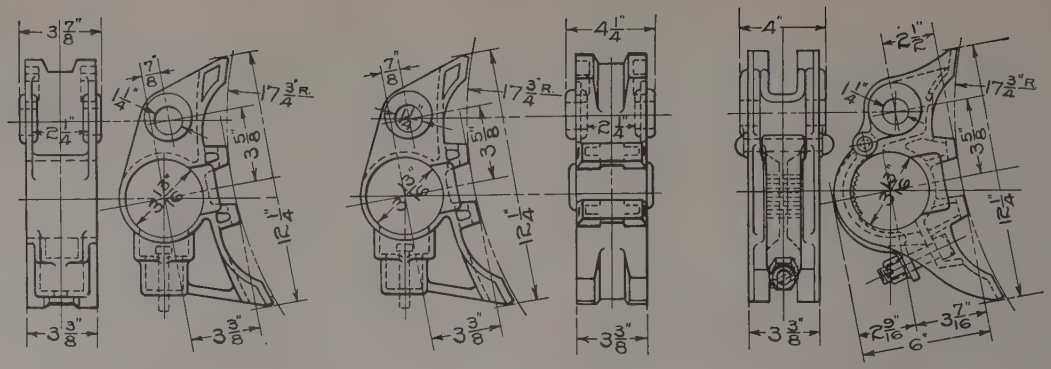


Fig. 1796—Creco Standard Adjustable Brake Heads. Chicago Railway Equipment Company.

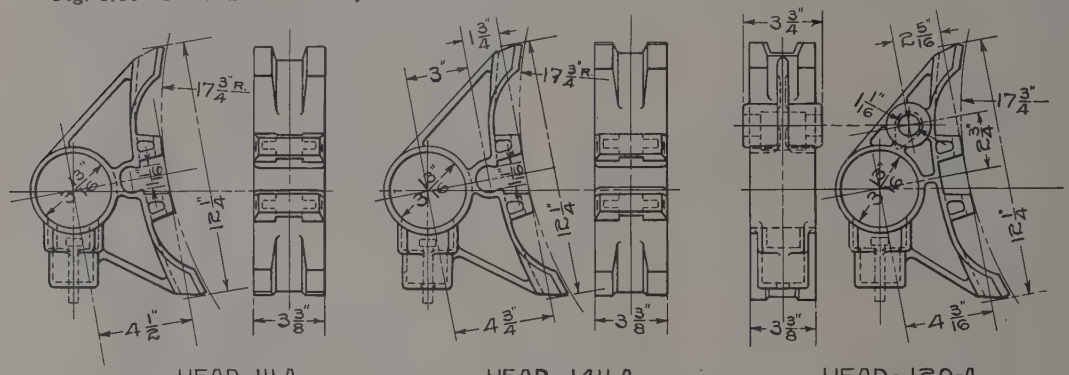


Fig. 1797—Creco Standard Adjustable Brake Heads. Chicago Railway Equipment Company.

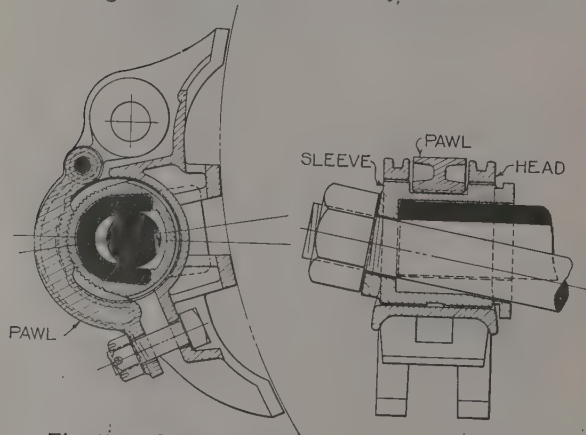


Fig. 1798—Semi-Adjustable Head for Creco Brake Beam. Chicago Railway Equipment Company.

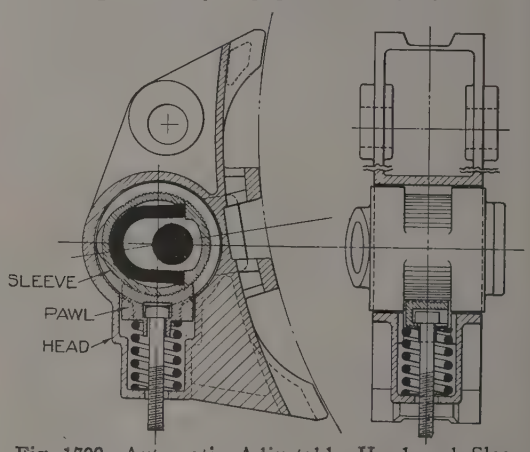


Fig. 1799—Automatic Adjustable Head and Sleeve for Creco Brake Beams. Chicago Railway Equipment Company.

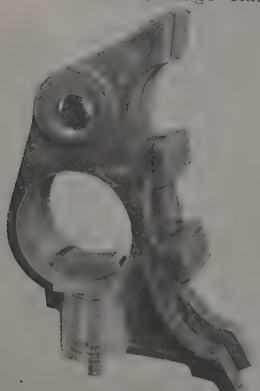


Fig. 1800—Adjustable Brake Head. Chicago Railway Equipment Company.

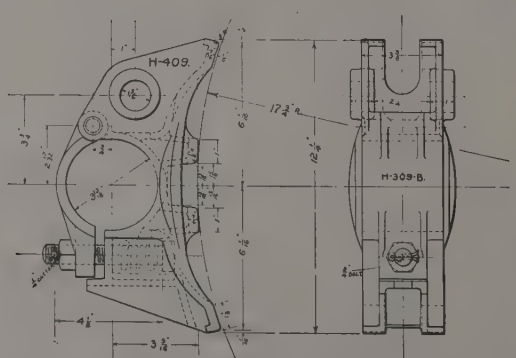


Fig. 1801—Huntoon Adjustable Brake Head. Republic Railway Equipment Company.

(See also Page 743.)

The Weierbach Improved Brake Shoe

Although a comparatively simple piece of equipment, the variety of conditions which they must meet in service, make the obtaining of satisfactory brake shoes one of the most complex of the problems relating to the design of railway rolling stock. The safe and satisfactory functioning of the entire air brake equipment of the modern freight or passenger train depends in no small measure upon the action of the brake shoes.

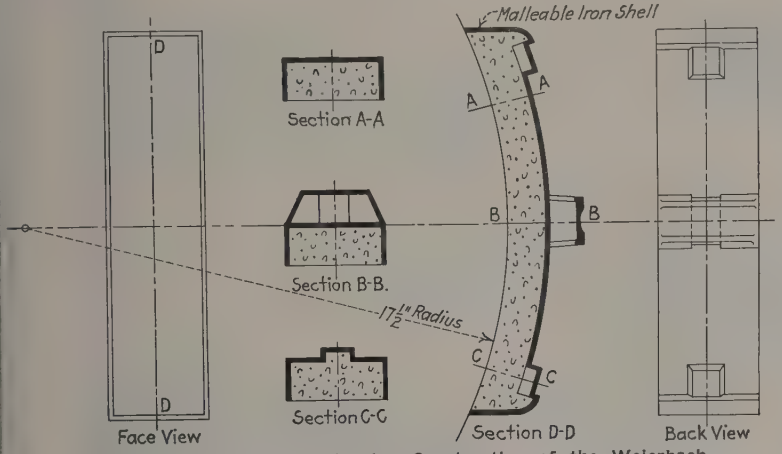


Fig. 1802—Section Views Showing Construction of the Weierbach Improved Brake Shoe

A good brake shoe should have a maximum coefficient of friction which should be available immediately upon the application of the brakes, should remain constant throughout the life of the shoe, and "warming-up" should not be required in order for the shoe to take proper action. All clinging action, as the train slows down or comes to a stop, is undesirable, as are any tendencies toward locking or sliding of wheels, cutting, scoring, or roughening the tread of rolled steel or steel tired wheels. Brake burns must be avoided and screeching or other noises accompanying an application of the brakes, are decidedly objectionable. While meeting the above-mentioned conditions, the structure of the shoe must be such that it will not break or disintegrate and that undue wear does not take place, so that economy from the standpoint of cost will be obtained.

The Weierbach Improved Brake Shoe is unique in that the friction element consists of an entirely different material than is used for supporting the shoe in its place against the tread of the wheel. The shell or back of the shoe is a malleable iron casting, of which the dimensions and other qualities meet fully the American Railway Association standards governing this section of a brake shoe. The filling material is a mixture which is plastic when applied and is carefully pressed into the shell, and baked to a uniform hardness. This mixture is a combination of substances which in laboratory tests and in actual road service have demonstrated their fitness for meeting the requirements enumerated for a good brake shoe. The use of malleable iron for the back provides amply for both strength and ability to stand the severe service to which this part of a car is subject.

The weight of a Weierbach brake shoe for use on passenger coaches, baggage, mail or express cars is 12 lb., and freight car shoes weigh 10 lb.

The manner in which these shoes wear is illustrated in Fig. 1803. The malleable shell effectively supports the filling material, and full braking efficiency is obtained until the shoe is worn to the point where it is no longer fit for service. The view at the right shows the appearance of the shoe when new and the other two, how service is obtained until shell and filling are worn to a very low scrap weight.

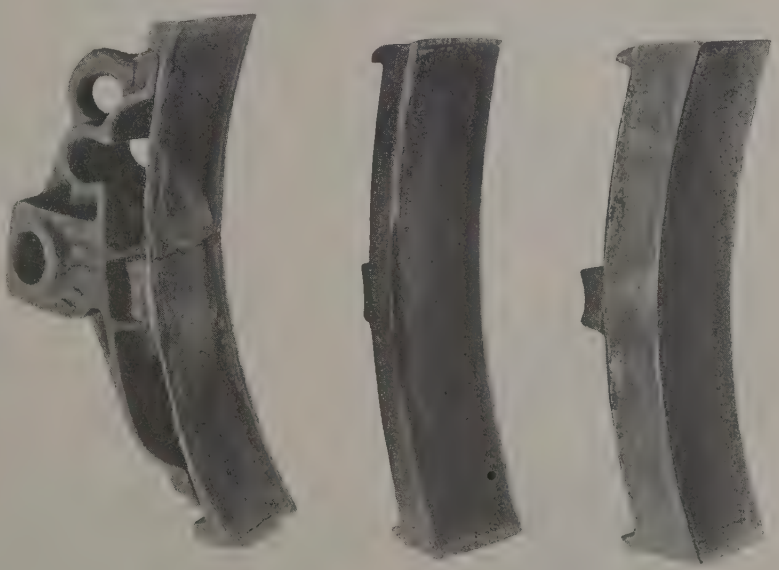


Fig. 1803—Weierbach Brake Shoe When New, Also When Partly Worn, and When Ready to Scrap

The range of service in which Weierbach brake shoes can be applied includes all types of cars on steam railways, in addition to subway, street and interurban electric railway equipment.

For other products and branch offices, see classified and alphabetical indexes.

WEIERBACH BRAKE SHOE COMPANY, SCRANTON, PA.

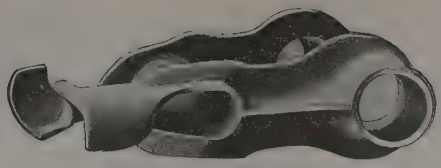


Fig. 1804—Western One-Hole Brake Jaw.

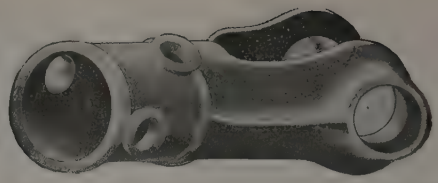


Fig. 1805—One-Hole Malleable Iron Brake Jaw.

Fig. 1806—Western Three-Hole Brake Jaw.

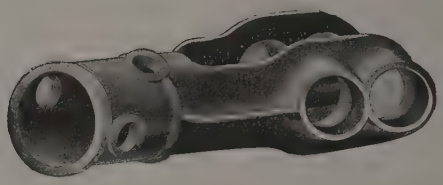


Fig. 1807—Two-Hole Malleable Iron Brake Jaw.

Fig. 1808—Western Dead Lever Guide.

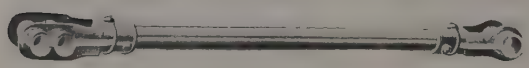


Fig. 1809—Western Bottom Connecting Rod with Center of Extra Heavy Pipe.

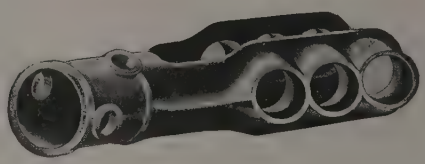


Fig. 1810—Three-Hole Malleable Iron Brake Jaw.

Western Railway Equipment Company.

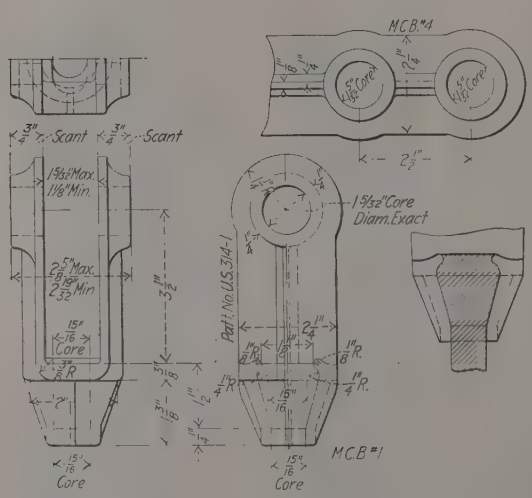


Fig. 1811—Kelly Malleable Iron Brake Jaw.
National Railway Appliance Company.

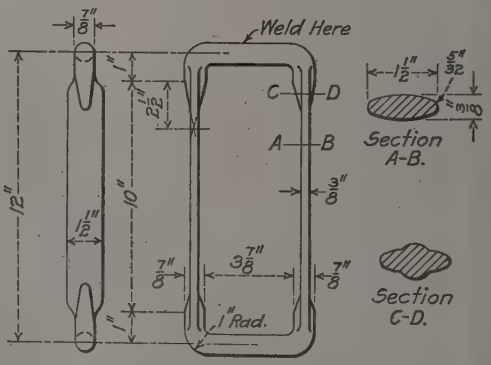
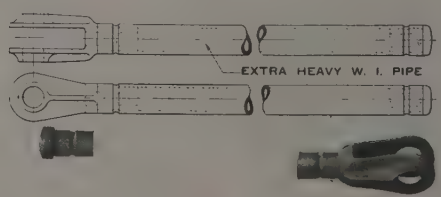


Fig. 1812—Brake Beam Hanger Designed for Lateral Flexibility. Q. & C. Company.



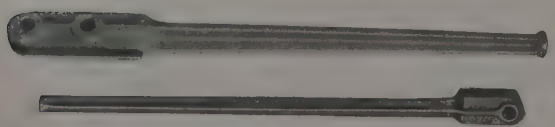
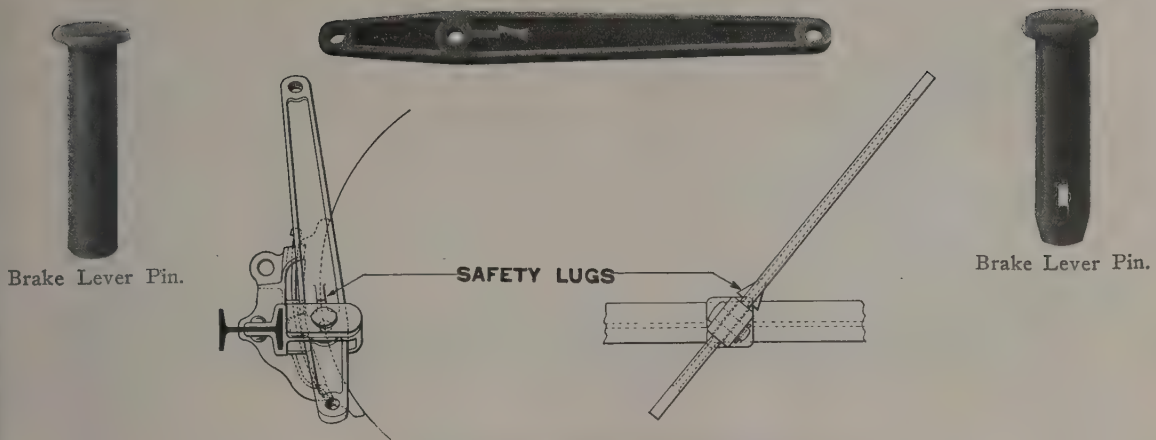


Fig. 1813—Cylinder Push Rods.
National Malleable Castings Company.

Fig. 1814—National Cylinder Push Rod Jaw and Tip.
National Malleable Castings Company.



Brake Lever Pin.

Brake Lever Pin.

Fig. 1815—National Safety Brake Lever.

Fig. 1816—Cylinder Lever.

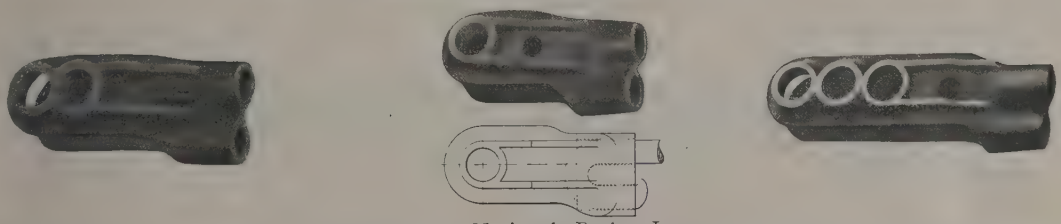


Fig. 1817—National Brake Jaws.

Fig. 1818—Truck Lever Connections.

Fig. 1819—The "National" Dead Lever Guide.

Fig. 1820—Dead Lever Guide or Brake Lever Stop.

Fig. 1821—"National" Sheave Jaw.

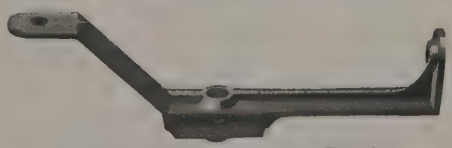


Fig. 1822—Floating Lever Bracket.

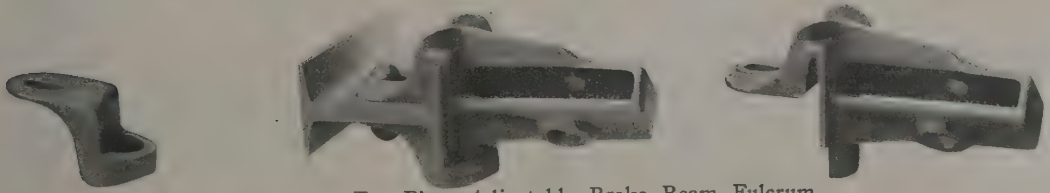


Fig. 1823—Two-Piece Adjustable Brake Beam Fulcrum.

Fig. 1824—Brake Shoe Key, M. C. B. Standard.

Fig. 1825—Finger Guard

National Malleable Castings Company.

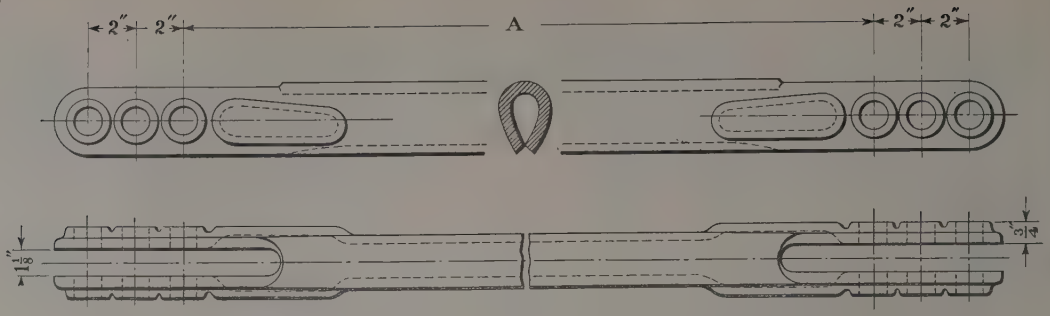


Fig. 1826—Diagram of Schaefer Truck Lever Connections.

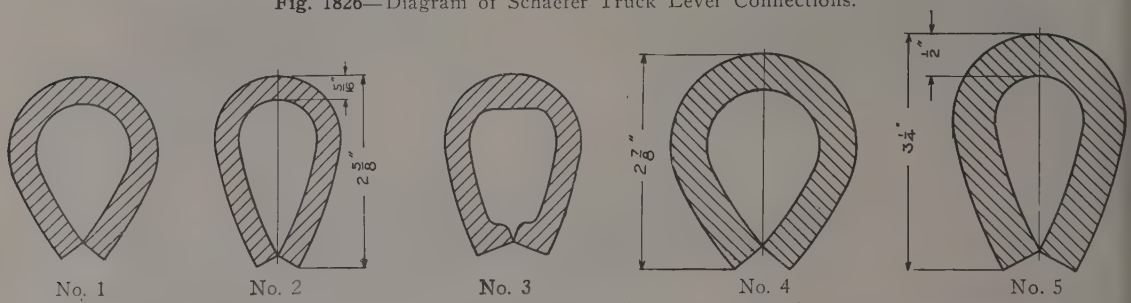


Fig. 1827—Sections Through Truck Lever Connections.

Fig. 1828—Schaefer Drop Forged Brake Rod and Brake Rod Jaw.

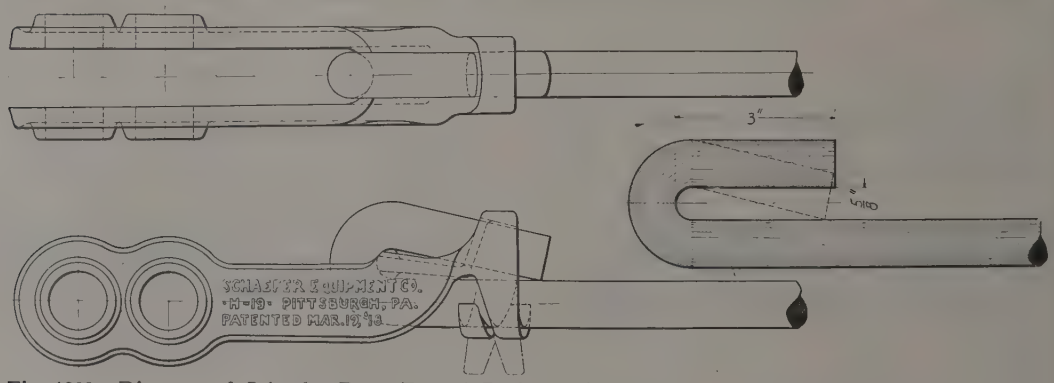


Fig. 1829—Diagram of Schaefer Drop Forged Brake Rod Jaw.

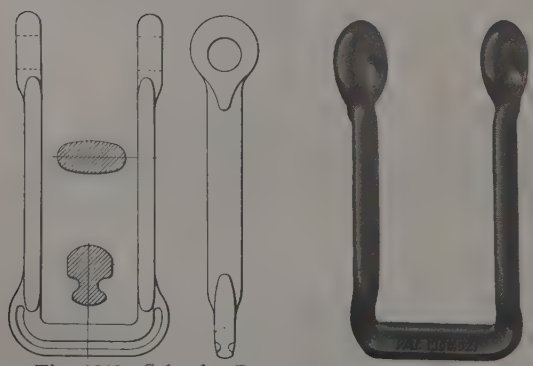


Fig. 1830—Schaefer Drop Forged Brake Hanger.

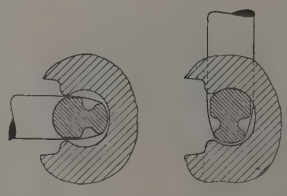


Fig. 1831—Sections Through Brake Hanger.

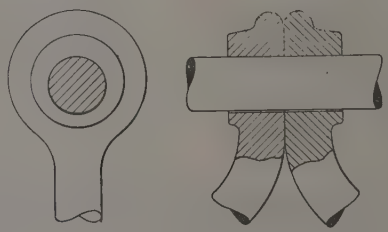


Fig. 1832—Sections of Brake Hanger.

Schaefer Equipment Company.

(See also Pages 755-757.)

Schaefer Truck Lever Connections

Schaefer Truck Lever Connections were brought out a few years ago to replace the heavy cast or the welded-up forged connections then in general use. The Schaefer type of connection was a departure in design, with inherent features of increased strength and material decrease in weight, which in a short time was approved by the mechanical officers of American railways and has now been adopted as standard by a large number of the leading railway systems in this country.

Fig. 1833—Schaefer Offset Truck Lever Connection, Two-Hole Type

The connection, which is primarily designed for a compression member, was originally applied to freight cars only, but the peculiarly inverted "U"-shape structure adapted itself admirably to any condition where stresses had been increased over those required by the ordinary 50-ton or 70-ton freight car. As a result of this the connection was readily produced in the much heavier designs required on such equipment as the Westinghouse "empty and load" brake, heavy locomotive tenders, and 4-wheel passenger trucks, where a dependable compression member is a prime requisite. The cross-sections illustrated in Fig. 1827 give a clear idea of the adaptability of the various Schaefer designs. The section shown as No. 1 is that used in the straight type connection; No. 2 is the common offset type. Both designs are intended for freight cars and the two views indicate how the structure is modified to meet these two conditions. The relative sizes of the sections used in the heavier types of connections are shown as No. 3, No. 4 and No. 5. These are required for engine tenders and passenger cars.

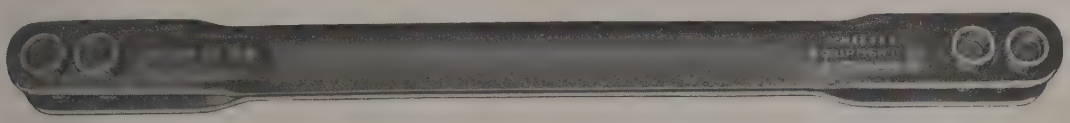


Fig. 1834—Schaefer Straight Truck Lever Connection, Two-Hole Type

Reduced weight as compared with ordinary solid types of forged connections of the same strength and stiffness is a feature of Schaefer designs. It has been clearly established that these various designs represent an actual reduction in weight of 40 per cent and an increased strength as high as 100 per cent in excess of that developed in the welded-up solid structure.

One of the reasons for constant vigilance on the part of the mechanical department and its inspectors is the necessity for renewals in the foundation brake gear details. This is due to the constant wear in brake-pin holes, brake heads, hangers, etc., and many failures may be traced to excessive wear on these parts.

Careful investigation over a period of time on all types of freight equipment has disclosed the fact that the destructive wear on all foundation brake gear parts is due not so much to the actual application and release of the brakes as to the constant vibration of these parts when in free suspension during the road operation of the car. This wear is not always discernible by casual running inspection, and can only be ascertained by dismantling but the time required and the cost make this procedure prohibitive. Recently, the acetylene and electric welding processes have been resorted to in building up oblong brake-pin holes in brake details and their supporting brackets, but this method has proved expensive, and in such parts as column castings, etc. useless.

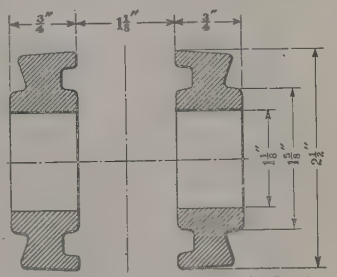


Fig. 1836—Section Through Center of Pin Holes

The problem of excessive wear has been solved satisfactorily, however, by the Schaefer Equipment Company through the use of steel of considerably greater hardness and correspondingly increased strength. The results of recent inspections of Schaefer designs. It has been clearly established that these various designs represent an actual reduction in weight of 40 per cent and an increased strength as high as 100 per cent in excess of that developed in the welded-up solid structure.

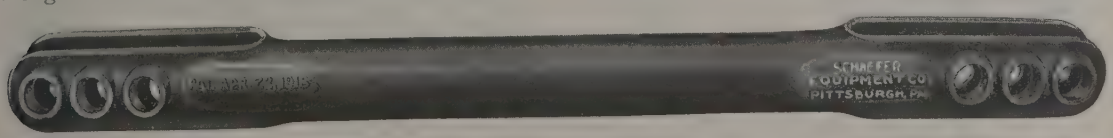


Fig. 1835—Schaefer Straight Truck Lever Connection, Three-Hole Type. (U. S. R. A. Standard)

tails, which have been in service over a period of years, indicate that the wear in the brake-pin holes is so slight as to insure full car life with

Schaefer Drop-Forged Brake Lever

the corresponding absence of increased piston travel due to such wear.

The Schaefer Drop-Forged Brake Lever—Fig. 1837—had its origin in the demand for lighter foundation brake details. The lever is so constructed that a uniform stress conditions is produced throughout practically the entire length of the structure, which in turn, means a corresponding reduction in weight over the old common solid lever. This weight reduction is approximately 35 percent, or stated in another way, with a weight of 24 lb. for the 8-in.—16-in. solid lever, the Schaefer type of the same length weighs 15½ lb.

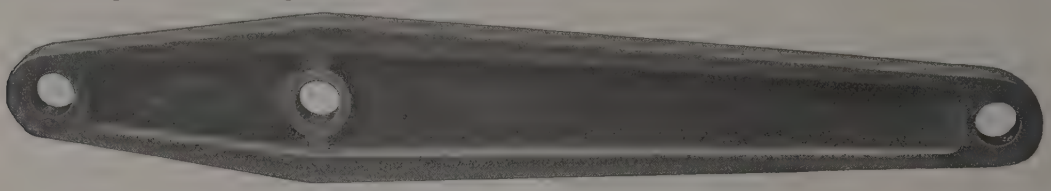


Fig. 1837—Schaefer Drop-Forged Brake Lever

The results of comparative tests—Fig. 1838—

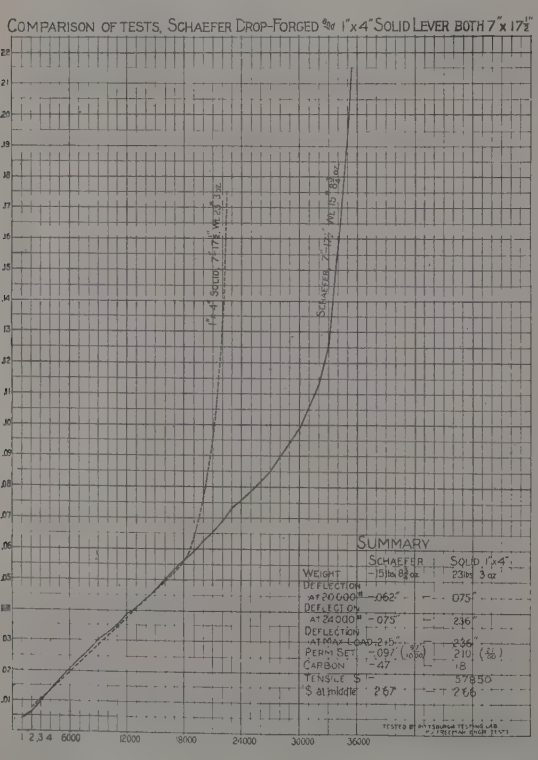


Fig. 1838

indicate clearly the superior strength of the Schaefer design over the ordinary type of lever having uniform thickness. Particular attention is drawn to the ultimate load of only 22,000 lb. sustained by the old type as compared with 35,000 lb. for the Schaefer design, with permanent sets of approximately ¼ in. for the former, as against 1/10 in. for the latter.

Equally good results from all Schaefer Levers are assured by the uniformity of product effected through careful selection of raw material and the manufacturing processes which are employed. Carbon steel, having 0.35 to 0.50 percent carbon, is used and after experience covering six years, a definite saving in wear at the pin holes has been shown. Steam drop-hammers of 10,000 lb. capacity are used to forge the levers to shape, and insure homogeneity of the metal structure.

Levers of any dimensions can be manufactured on short notice and levers designated as 6-in.—18-in. (U. S. R. A. Standard), 8-in.—16-in., 7-in.—17½-in., and 7-in.—21-in. are carried in stock.

The Schaefer Drop-Forged Brake Rod Jaws shown in Figs. 1839-1840 are designed to meet the general requirements outlined in the A. R. A. Specifications.

Many efforts have been made in the past to produce a brake rod jaw which would embody within it the feature of being readily attached to the required size of brake rod, and at the same time develop as nearly as possible the full strength of such a rod while also having within it the dependable features of the steel or iron rod itself. That these objects have been achieved in Schaefer Brake Rod Jaws is evident in the illustrations.

Manufactured from open hearth steel by the drop-forging method, these jaws are of homogeneous structure with uniform strength throughout while the method of connecting the jaw to the rod does not detract in any way from the strength of either and thus is formed a joint of practically 100 percent efficiency. In addition, ample brake-pin wearing surface is provided at the pin holes, and, being of simple design, the jaws may be applied with economy and ease and may be removed and re-applied at will.

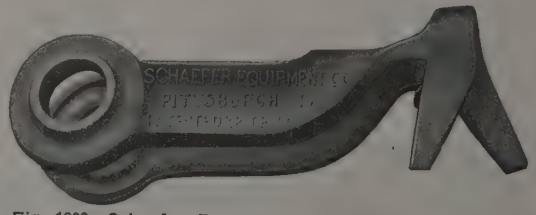


Fig. 1839—Schaefer Drop-Forged Brake Rod Jaw Before Attaching to the Brake Rod

The method of suspending the brake beam and the parts attached thereto is a subject to which much attention has been devoted by railway me-

Schaefer Brake Rod Jaws and Brake Hangers

chanical men. The brake beam hanger is probably subjected to a greater variety of stress conditions than any other member in the foundation brake gear. In addition to the reversal of stress due to compression and tension load on the opposite hangers in inside hung brakes, it is necessary to consider and contend with the lateral motion between the hangers and the truck wheels.

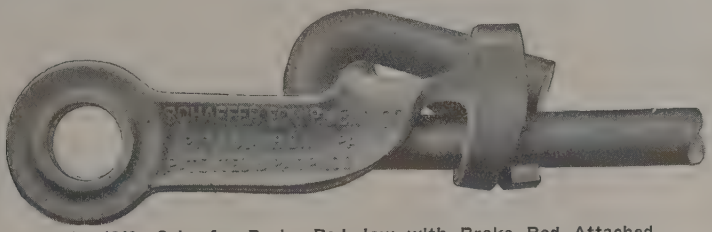


Fig. 1840—Schaefer Brake Rod Jaw with Brake Rod Attached

The A.R.A. opening in a brake head with a 1-in. round cross-member representing the hanger is shown in Fig. 1842. A similar structure but with the Schaefer Brake Beam Hanger having the deepened cross-member and the self-locking feature of this special section is illustrated in Fig. 1831 which also shows the method of inserting this hanger into the brake head. The eyes of these hangers are drop-forged, integral with the round side member, and the hanger pin holes are drilled. A comparison of the nominal surface available to resist the constant wear in these parts of the ordinary hanger made from round material with formed eye is shown at "B" and "C" in Fig. 1842, as contrasted with a similar condition—Fig. 1832, where the pin holes are drilled through forged eyes.

Other Schaefer Brake Beam Hangers are shown in Figs. 1841 and 1830. The latter is designed to provide lateral flexibility. This feature is particularly applicable to locomotive tenders, and its use in this service has been characterized by entire absence of the breakage so prevalent with the ordinary designs of hanger. This type also embodies the valuable advantage of being self-locking.

To summarize the advantages of Schaefer equipment, it is emphasized that the use of Schaefer Truck Lever Connections and Schaefer Drop-Forged Brake Levers will effect a reduction in weight, of 35 percent. This reduction in weight and the almost entire elimination of back lash, combine to produce an extremely efficient foundation brake gear for freight and passenger service.

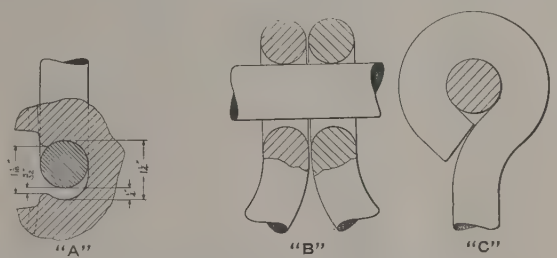


Fig. 1842—Methods of Suspending Brake Gear with Ordinary Hangers of 1-in. Rod Section

Fig. 1841—Different Types of Schaefer Drop-Forged Self-Locking Brake Hangers

For other products and branch offices, see classified and alphabetical indexes.

SCHAEFER EQUIPMENT COMPANY, PITTSBURGH, PA.

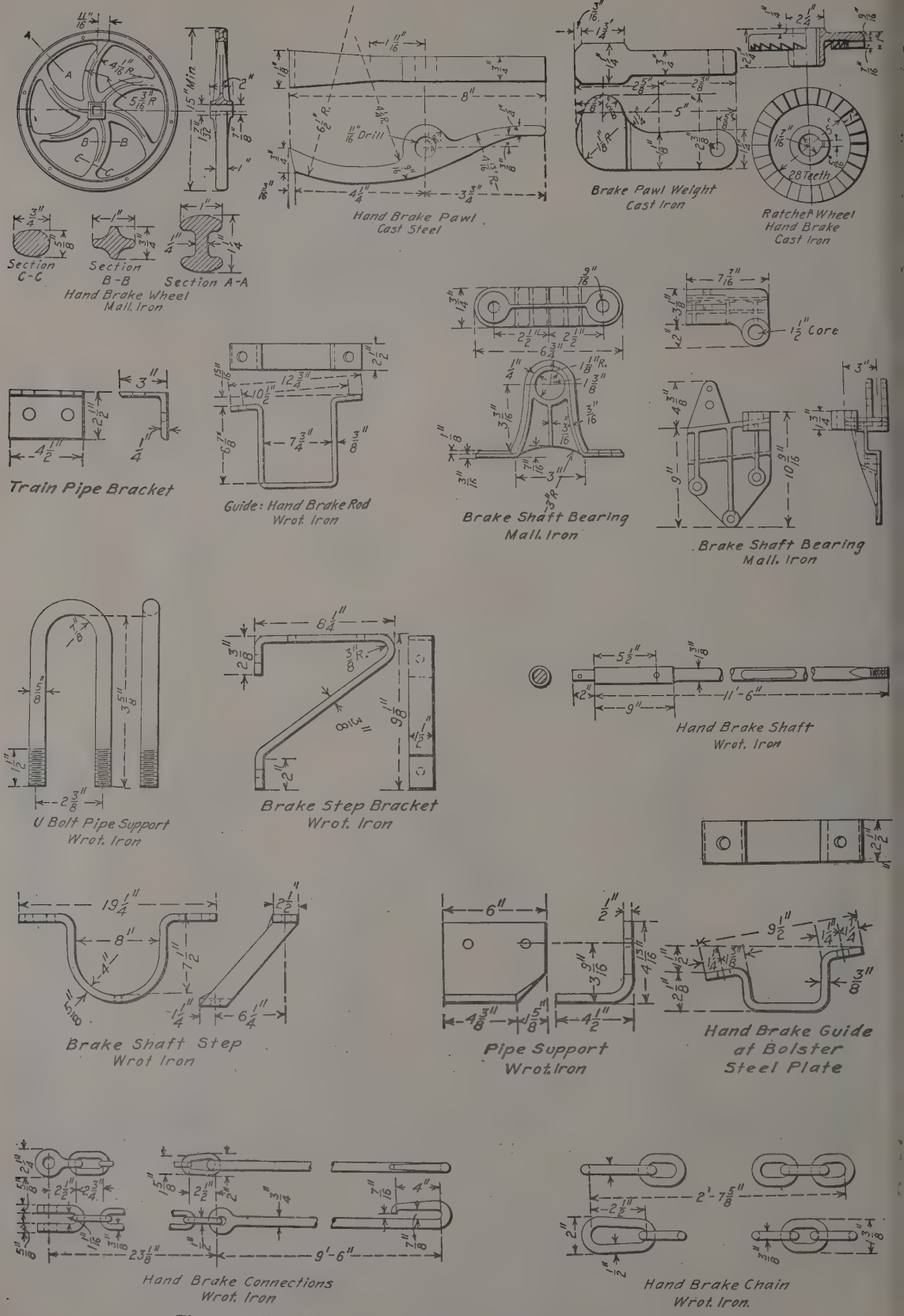


Fig. 1843—Details of Brake Gear for New York Central Freight Cars.

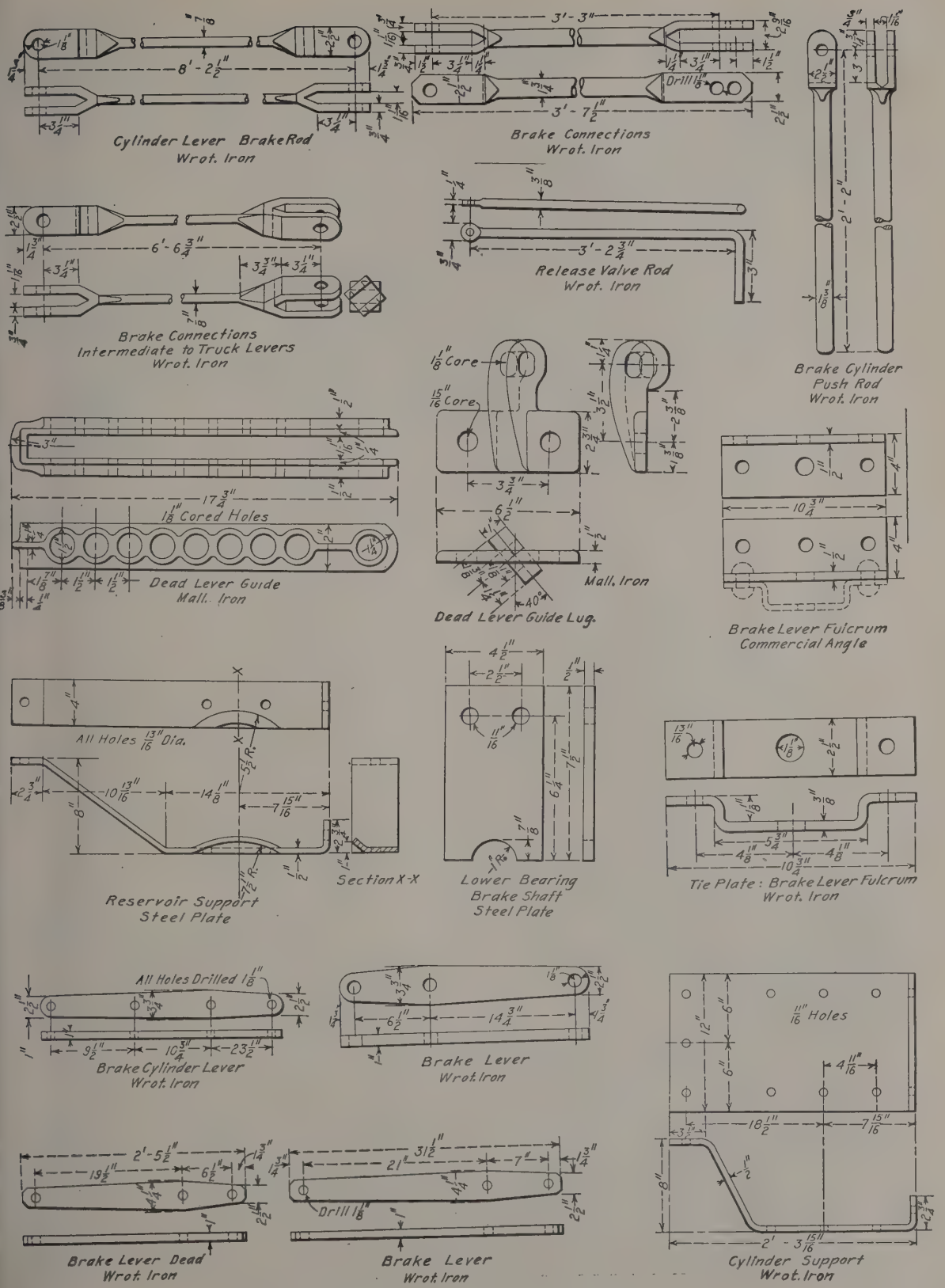


Fig. 1844—Details of Brake Gear for New York Central Freight Cars.

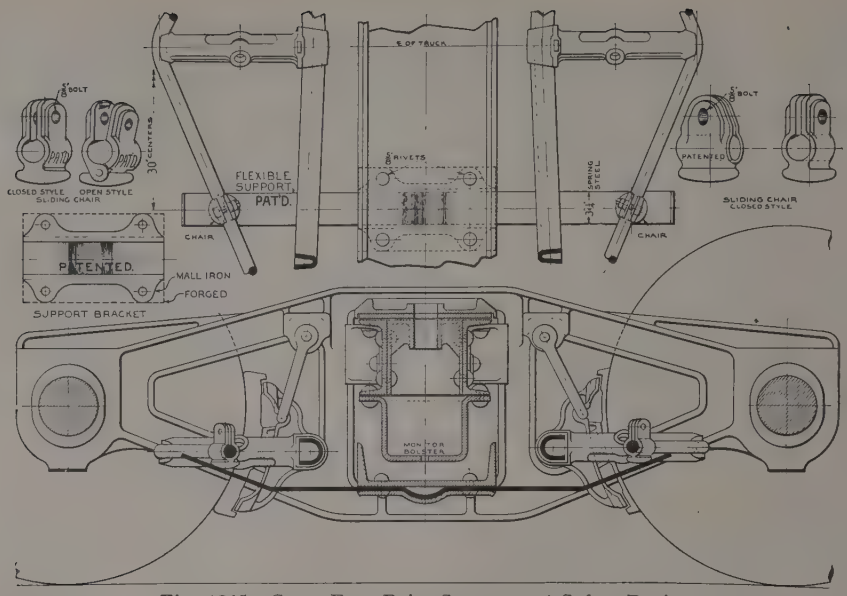


Fig. 1845—Creco Four-Point Support and Safety Device.

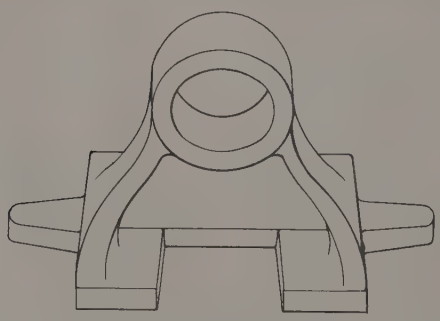


Fig. 1846—Sliding Chair for Creco Third-Point Support.

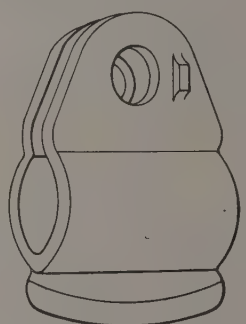


Fig. 1847—Sliding Chair for Creco Four-Point Support.

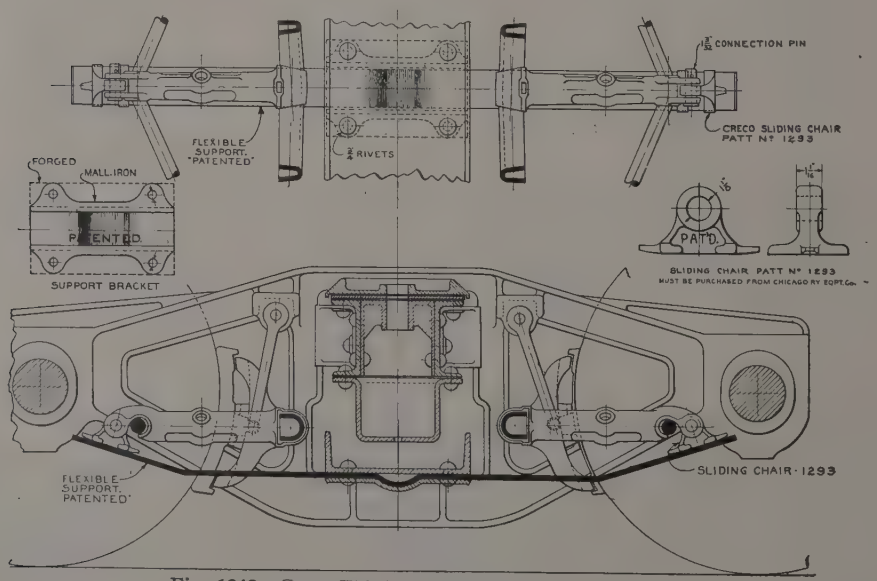


Fig. 1848—Creco Third-Point Support and Safety Device.

Chicago Railway Equipment Company.

(*See also Page* 761.)

Creco Brake Beam Supports and Safety Devices

The CRECo Brake Beam Support and Safety Device was developed to meet the need of an appliance which, without inherent defects would function to secure proper action of the brake beam at all times—incidentally embodying all the essentials of an ideal safety device. Faults in some old methods of brake beam suspension often cause the beam to

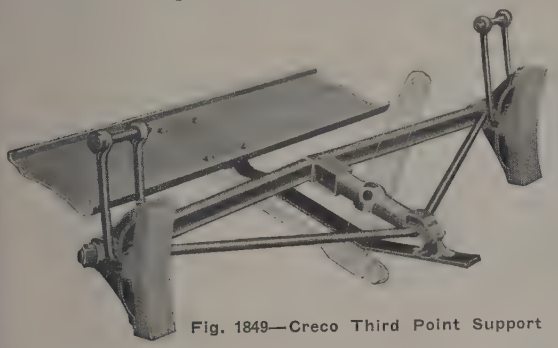


Fig. 1849—Creco Third Point Support

be pulled or pushed downward when the spring gets out of position; they also wear very rapidly and thus increase the cost of brake beam renewals.

The CRECo Support and Safety Device does not interfere with the forward movement of the beam when brakes are applied with badly worn shoes; does not prevent the beam from having such lateral movement as the brake hangers allow; does not throw the beam out of alignment in case a supporting spring is bent and does not get twisted out of shape by beam action. It maintains a proper relation to the brake beam hangers at all times; is operative with beams of different strut depths on the same truck; has the essential flexibility and broad bearing areas; permits quick application or removal of beams; and takes care of brake shoe wear and the reduction in diameter of rolled steel wheels. It absolutely

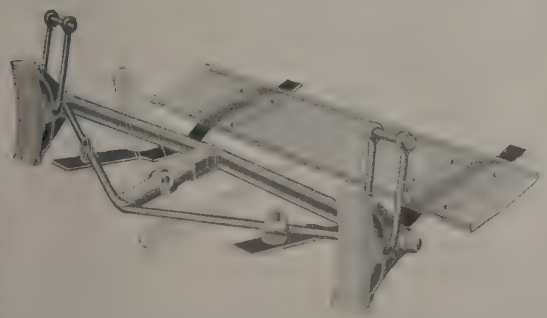


Fig. 1850—Creco Four Point Support

preserves the correct relation between the brake shoes and wheels under all conditions.

By using the CRECo Support and maintaining even brake shoe wear, torsional strains in the brake beams are eliminated, thereby greatly increasing the life of the beams.

The CRECo Support and Safety Device is furnished in two types—the "Third-Point" and "Four-Point."

The Third-Point Support and Safety Device consists of an underhung spring attached to the center of, and at right angles to, the spring plank, extending under and beyond the brake beam; and a "sliding chair" attached to the brake beam strut extension ears. This spring supports the front end of the beam and prevents it from tilting downwardly, maintaining the brake shoe in its proper relation to the wheel and insuring uniform brake shoe wear; and, by accomplishing immediate and complete separation of the brake shoes from the wheels when brakes are released, eliminating all drag and consequent loss of power.

Fig. 1851—Creco Third Point Support Chair

All cars and locomotives built by the United States Railroad Administration during the period of Federal control were equipped with CRECo Third-Point Support.

The Four-Point Support and Safety Device embodies two underhung springs per truck instead of one, these being located intermediate of the strut and heads. The "sliding chairs" in this type are attached to the tension member of the beam,

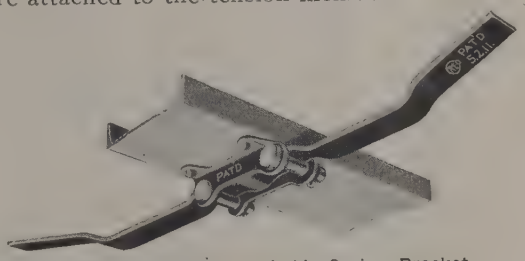


Fig. 1852—Creco Detachable Spring Bracket

thus providing two points of support instead of one, the operation being similar in every respect to that of the Third-Point type. The device can be used with any make of trussed brake beam, and the sliding chair attached without taking the beam apart or removing it from the car.

Suitable brackets are provided in connection with either the Third-Point or Four-Point Support for rigidly attaching the under-hung springs to the truck spring plank; or, in cases where it is desired to have the support springs readily detachable, a special form of bracket is used which permits a spring to be removed or reapplied by simply withdrawing or inserting two pins.

Fig. 1853—Creco Four Point Support Chair

The CRECo Support of either type serves also as a resilient, strong and positive Safety Device to prevent the beam from falling to the track through any failure of the brake rigging, eliminating the use of brake beam safety clips and the generally unsatisfactory safety chains.

CRECo Brake Beam Supports and Safety Devices are giving satisfactory service on over 400,000 cars.

For other products and branch offices, see classified and alphabetical indexes.

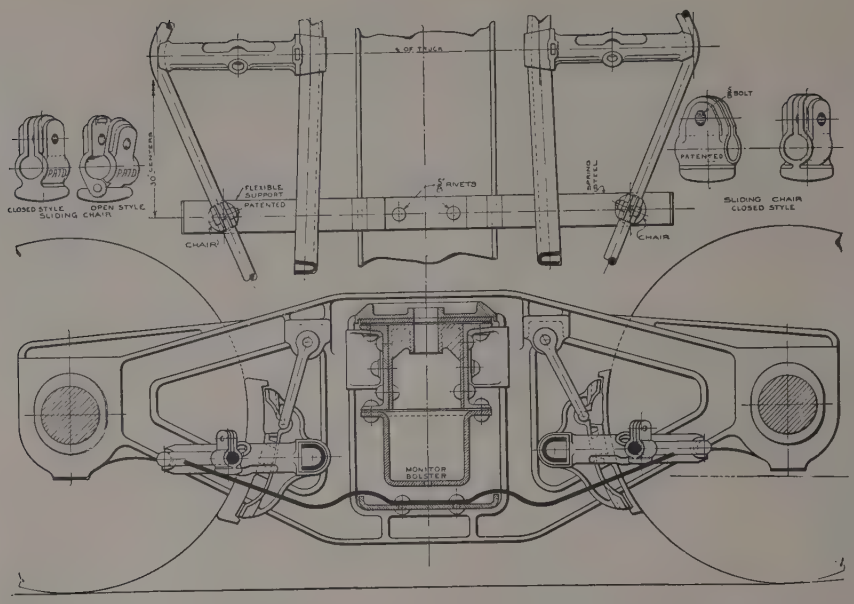


Fig. 1854—Creco Four-Point Support and Safety Device Applied to Top of Spring Plank.

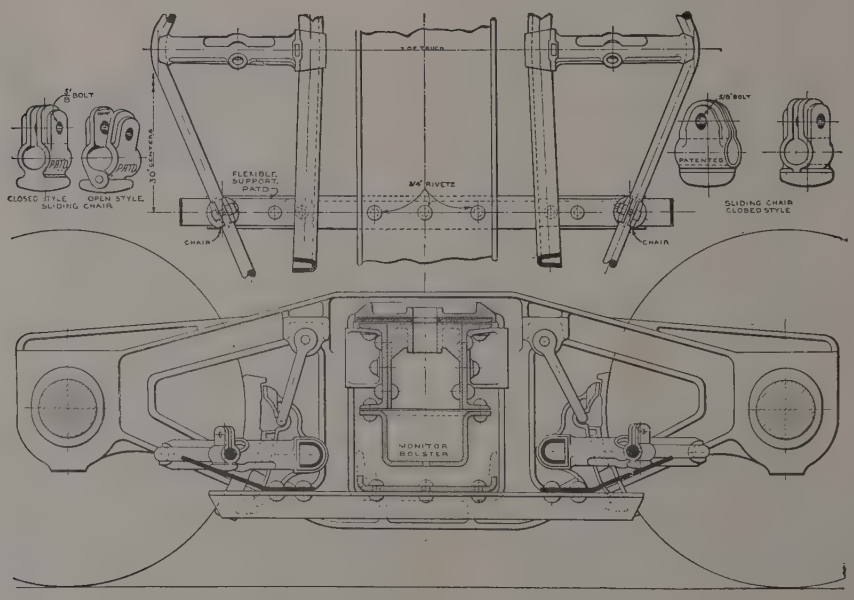


Fig. 1855—Creco Special Four-Point Support and Safety Device.

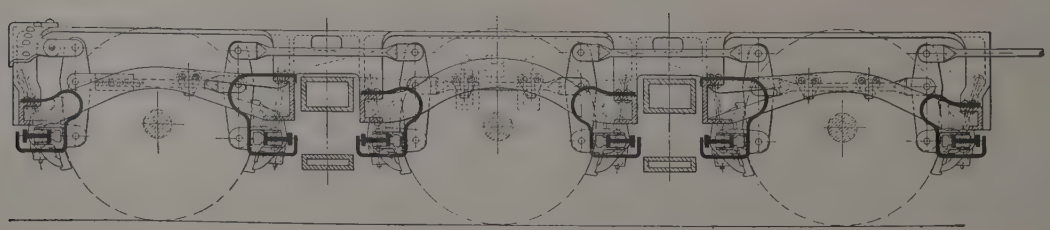


Fig. 1856—Creco Clasp Brake for Triple Truck.

Chicago Railway Equipment Company.

(*See also Page* 761.)

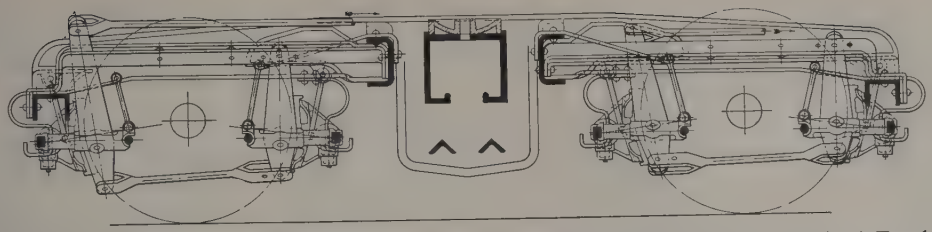


Fig. 1857—Diamond Special Brake Beam Clasp Brake Arrangement for Four-Wheel Trucks.

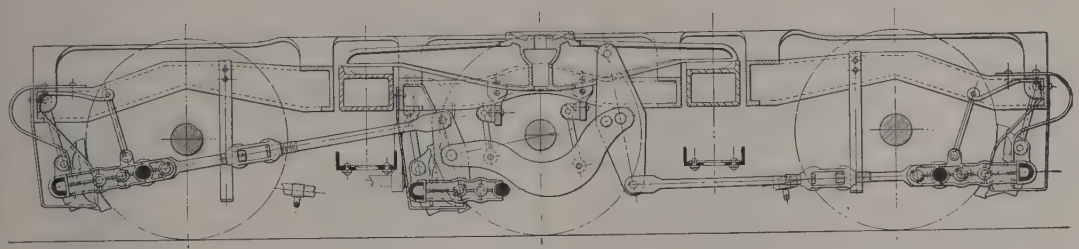


Fig. 1858—Arrangement of Brake Rigging for Triple Brakes on Six-Wheel Passenger Car Trucks.

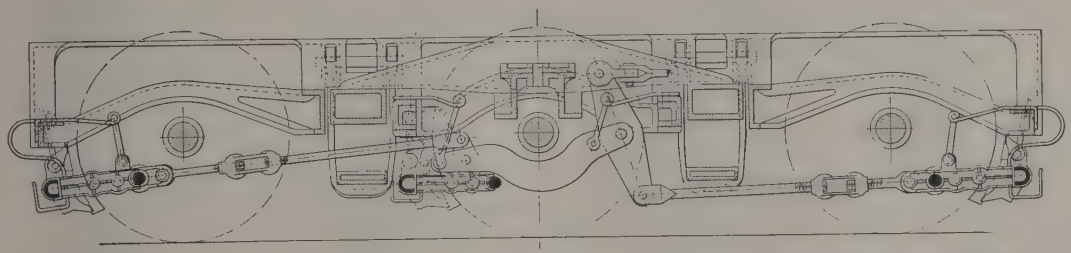


Fig. 1859—Standard Triple Arrangement of Brake Rigging for All-Steel Six-Wheel Passenger Car Trucks.

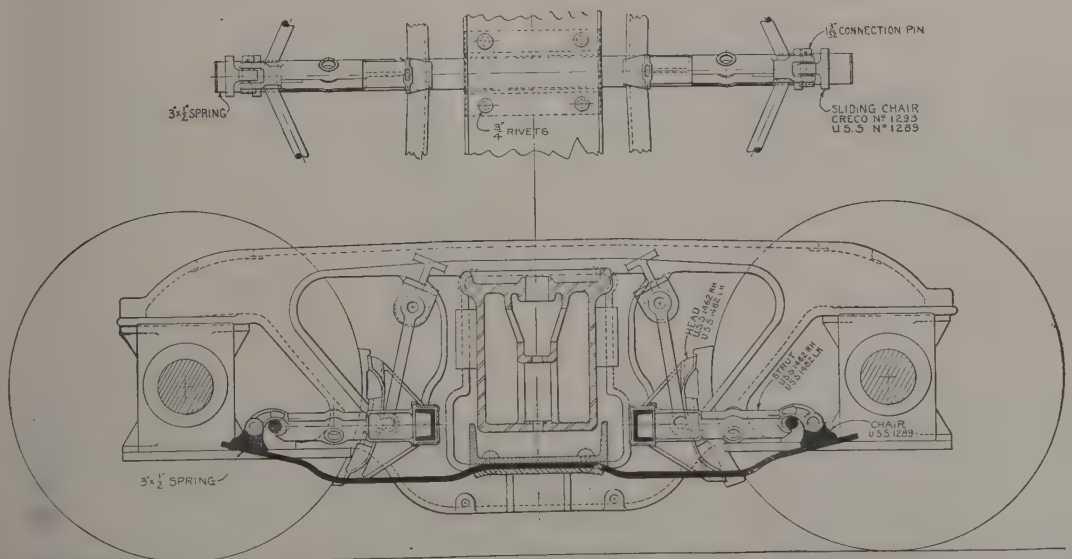


Fig. 1860—Creco Third-Point Support and Safety Device with Creco Third-Point Chair as Applied to Cars of 40, 50 and 70-ton Capacities, Built for the United States Railroad Administration.

Chicago Railway Equipment Company.

(See also Page 761.)

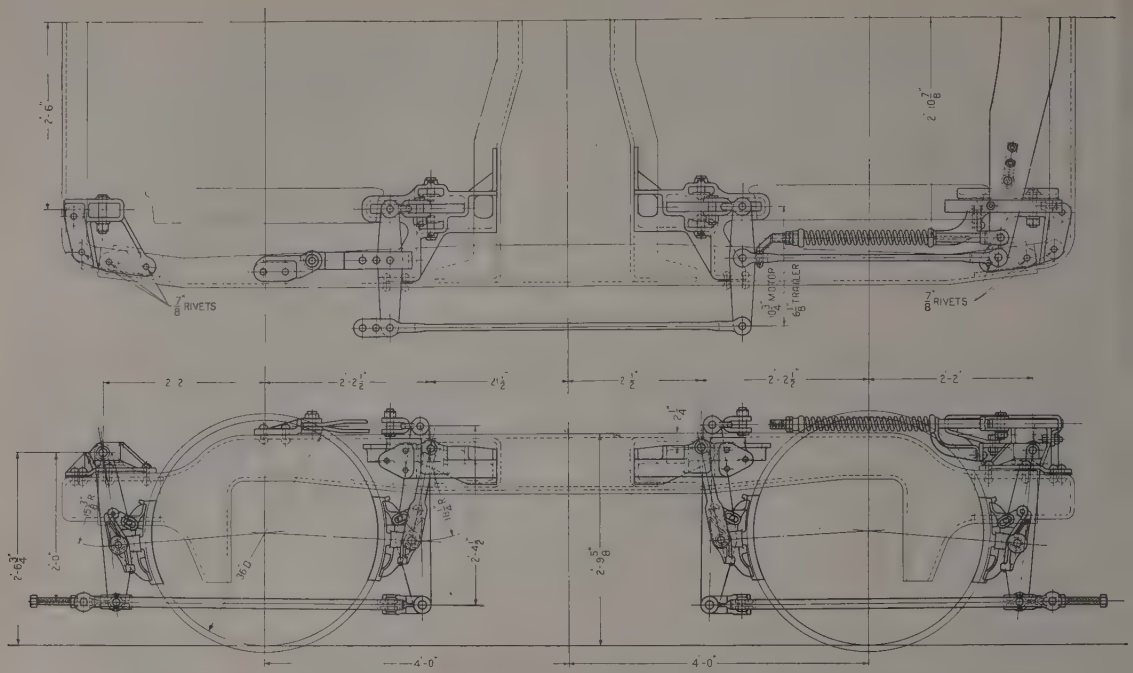


Fig. 1861—American Clasp Brake for New York Central Multiple-Unit Electric Passenger Equipment.

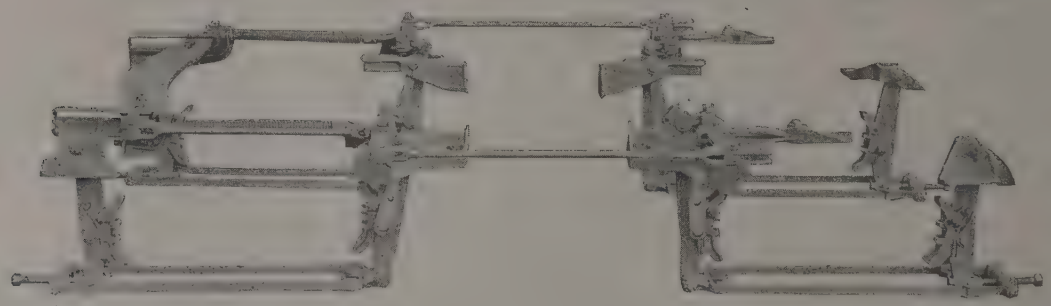


Fig. 1862—American Clasp Brake Parts Assembled for New York Central Multiple-Unit Electric Passenger Equipment.

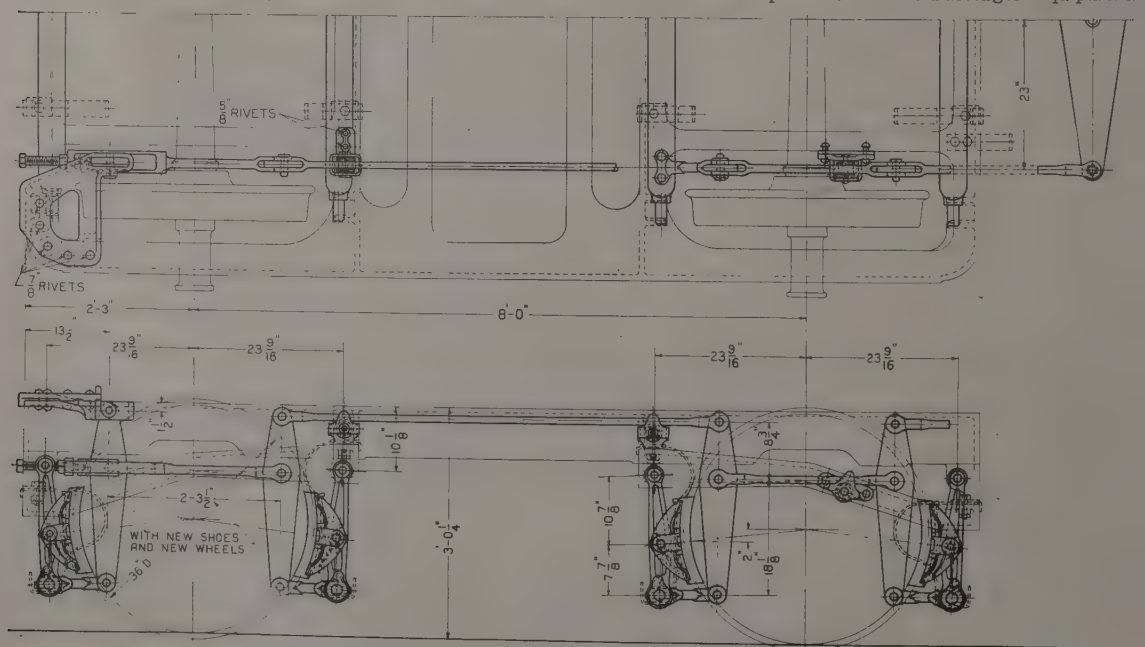


Fig. 1863—American Clasp Brake for Four-Wheel Passenger Truck.

American Steel Foundries.

(*See also Page 766.*)

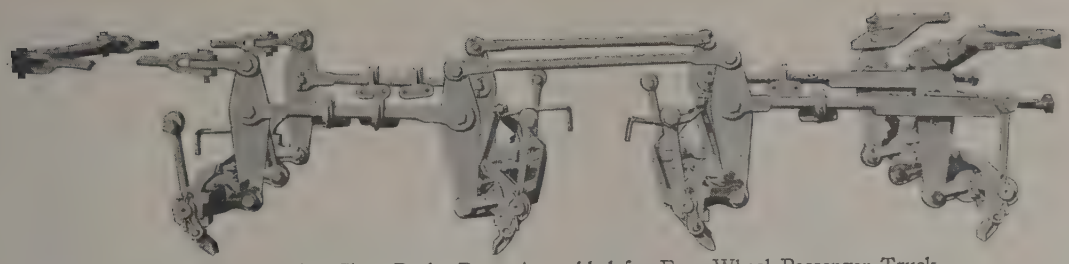


Fig. 1864—Simplex Clasp Brake Parts Assembled for Four-Wheel Passenger Truck.

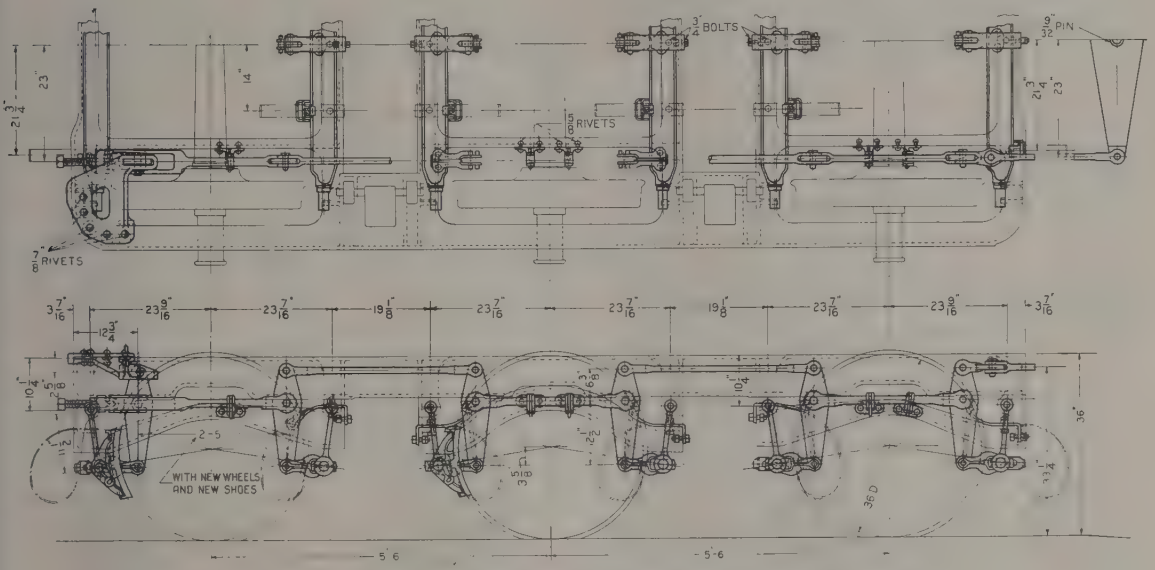


Fig. 1865—Simplex Clasp Brake for Six-Wheel Passenger Trucks.

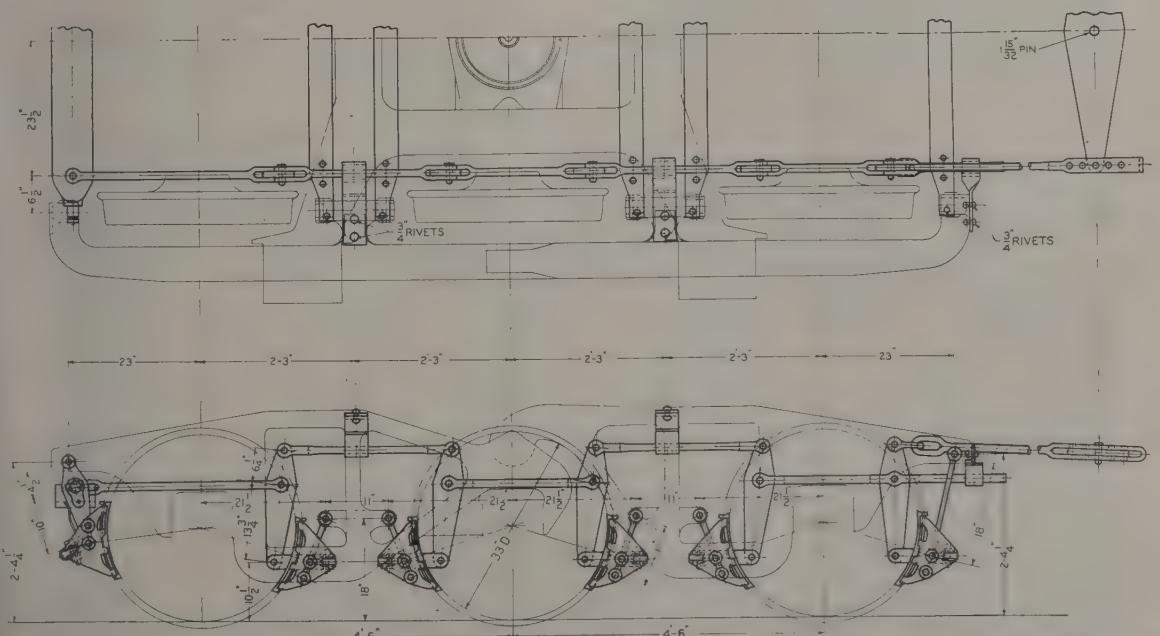


Fig. 1866—Simplex Clasp Brake Applied to Lewis Truck for Virginian Railway 120-Ton Gondola Coal Cars Equipped with Westinghouse Empty and Load Brake.

American Steel Foundries.

(*See also Page 766.*)

Clasp Brakes and Brake Beams

Present day operating conditions, particularly as to passenger car braking, have resulted in the development of the clasp type of foundation brake rigging which granting proper design, permits relief from many of the limitations of the single-shoe brake.

The brake levers are what is termed a double system of vertical levers located just inside the

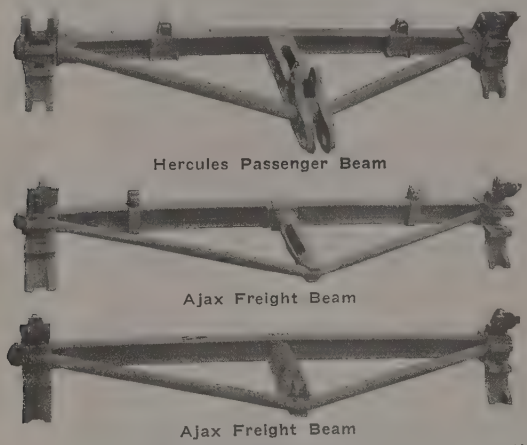


Fig. 1867—Types of Brake Beams Manufactured by the American Steel Foundries

wheel on both sides of the truck, providing ample clearance for draft gears, underframe or car, etc.

In the Simplex design the lower end of each of these levers is connected to the fulcrum of the brake beam, resulting in a direct application of the braking load to the beam—the Simplex beam proper is a drop forging. To the center pin holes of the levers are connected the intermediate pull rods, and the top pull rods are connected to the top holes of the truck levers. All brake parts are pin-connected throughout, thus reducing the internal friction of the gear to a minimum. The pull rods are all located above some portion of the truck, which would prevent the rigging from dropping to the track in case of accident.

A series of balance hanger supports located on the center line of the truck hold the brake beam level, and act as a third-point support, as well as a safety device, for the entire brake rigging. This design of brake arrangement eliminates many of the usual connections and auxiliary levers; it reduces the weight of the brake gear and especially that of the moving parts to an absolute minimum, thus reducing the inertia of the moving parts and quickening the response of the brake gear to brake application and release.

Compared with the ordinary single-shoe brakes the Simplex or American type clasp brake: reduces shoe pressure; reduces shoe wear; reduces false piston travel; eliminates necessity of disconnecting brake rods to remove wheels; reduces wear and displacement of journals; reduces load on pedestals and truck frames; reduces load on equalizers and equalizer springs; reduces the number of flat wheels and produces the much desired uniform retardation of speed.

Ajax brake beams for freight service are furnished in any capacity desired. Requirements for single-shoe passenger and tender service are met by Hercules and Ajax beams. All these beams are manufactured with varying weights of three-inch channel compression members and round tension rods, a type of construction which has been found to give the most satisfactory results.

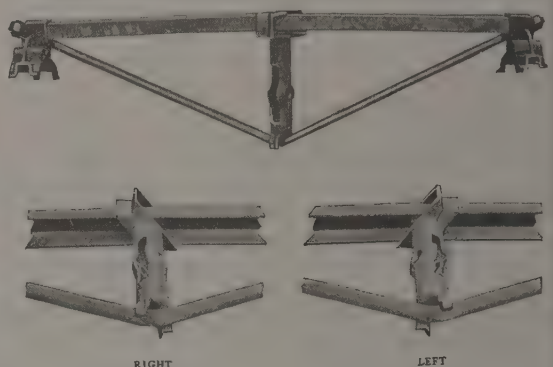


Fig. 1869—Ajax "One-Piece" Reversible Fulcrum Brake

Compression channels and rods are made of open hearth steel and to rigid specifications. All tension rod nuts are furnished cold-punched semi-finished. The tension rod ends are riveted over after the nuts are applied.

By following careful and accurate methods in the manufacture of Ajax and Hercules beams all initial play and lost motion are eliminated, thus prolonging the life of the beams.

The Acme I-section beam can be furnished, although solid beams of this type or simalir sections are practically obsolete. The rating of these beams does not exceed A. R. A. No. 1 capacity.

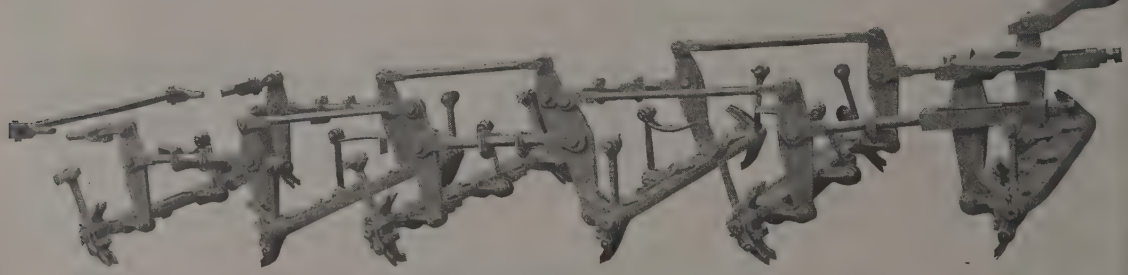


Fig. 1868—Simplex Clasp Brake for Six-Wheel Truck

Brakes

THE NECESSITY FOR ACCURATE AND POSITIVE control of railway trains requires the use of efficient brakes and has led to the development of the modern air brake; the use of air brakes is compulsory on American railways and this apparatus has been perfected to a very high state of efficiency. Hand brakes are also required on all cars in order to control them when they are not coupled to a locomotive, as is the case in switching operations.

Air Brakes.

The term Air Brakes includes any brake operated by air pressure, but usually is restricted to systems of continuous brakes operated by compressed air as generally used in American railway practice, in distinction from Vacuum Brakes, which are operated by creating a vacuum. The air is compressed by some form of pump on the locomotive, or a motor compressor on electric cars, and is conveyed by pipes and flexible hose between the cars to cylinders and pistons under each car, by which the pressure is transmitted to the brake levers, and thence to the brake shoes. This system is termed the Straight Air Brake but it is now obsolete in steam road practice, having been replaced by the Automatic Air Brake.

A combination of the Straight Air and Automatic Air Brake has also come into use and is known as the Automatic Straight Air Brake. Other types of brakes are: the Quick Action Automatic Air Brake; High Speed Brake; Empty and Load Brake; Vacuum Brake; Electro-Pneumatic Brake; and the Traction Air Brake.

Straight Air Brake

The Straight Air Brake is the original form of the Westinghouse air brake, and it is still used on street railway cars. With this form of brake, the compressed air is used as a direct force from the main reservoir supply of the locomotive, through direct piping to the brake cylinders on each car to apply the brakes. The valve on the locomotive is used to admit air to the brake pipe and brake cylinders in order to apply the brakes, to hold it there when admitted, and to exhaust it when desiring to release the brakes. This form of brake was superseded by the plain automatic air brake.

Automatic Air Brake

The Automatic Air Brake is designed so that the brake will be applied automatically in case air escapes from the system. To accomplish this there is added to each car equipped with the Straight Air Brake an auxiliary reservoir, in which is stored a supply of compressed air sufficient to operate the brake on that vehicle, and a triple valve to which the brake pipe, auxiliary reservoir and brake cylinder are all connected.

The brake is applied by reducing the pressure in the brake pipe below that in the auxiliary reservoirs. Such a reduction is caused by an opening made from the brake pipe, or its connections, to the atmosphere, and may be intentional, as when the engineer opens the brake pipe to the atmosphere through the brake valve, or accidental, as in case of a burst hose or broken pipe. The reduction in brake pipe pressure thus made destroys the equality of brake pipe and auxiliary reservoir pressures which existed when the brake system was fully charged, and the auxiliary reservoir pressure, being then higher than that in the brake pipe, causes the triple valve on each car to operate so as to apply the brakes by admitting compressed air from the auxiliary reservoir to the brake cylinder, where it exerts its pressure on a piston, pushing it outward and thus applying the brakes.

The brake is released by admitting compressed air from the main reservoir on the locomotive through the brake valve into the brake pipe, thus increasing its pressure above that remaining in the auxiliary reservoir. This causes the triple valve parts to return to their original positions, again opening communication from the brake pipe to the auxiliary reservoir, recharging the latter and making a connection through which the compressed air in the brake cylinder escapes to the atmosphere, thus permitting the release spring in the brake cylinder to return the piston to its former position, thereby releasing the brakes.

Quick Action Automatic Air Brake

In the Quick Action Automatic Air Brake, the triple valve is so modified that when a relatively quick reduction in brake pipe pressure is made, it also opens a direct communication from the brake pipe through the triple valve to the brake cylinder. This not only increases the brake cylinder pressure in proportion to the amount of air flowing into it from the brake pipe locally on each car, but, by venting air from the brake pipe locally on each car, hastens and increases the effect of the reduction made at the brake valve. This shortens the time from the movement of the brake valve handle until a full brake application is obtained on the entire train, and increases the total braking power obtainable by such an operation—emergency application—about 20 per cent over the maximum obtainable during ordinary operations—service application—or when using the plain automatic brake.

Automatic Straight Air Brake

The Automatic Straight Air Brake combines features of the Automatic Air Brake and the Straight Air Brake. The apparatus comprises a triple valve, a high-volume feed valve and a compensating valve. The triple valve is of the 3-unit type—a service section, an emergency section and a change-over section.

It is designed to produce essentially the following operating results: Rapid serial action in service applications and in quick release; maintenance of uniform and constant brake cylinder pressure, irrespective of piston travel or cylinder leakage; graduated release, permitting a variation of brake cylinder pressure at the will of the engineman; quick release when desired; emergency applications of the brake available at any time during or after any service application, and an automatic emergency application on depletion of train pipe pressure to approximately five pounds.

The design of the triple valve is such that in a service application the build-up of brake cylinder pressure as compared with the reduction of brake pipe pressure is in the ratio of two to one.

The high-volume feed valve and the compensating valve

of this system form a part of the brake equipment installed on the locomotive. The high-volume feed valve performs the functions and takes the place of the feed valve commonly used, the purpose of this valve being to remove any restriction between brake valve and brake pipe when brake pipe pressure is below the pressure for which the feed valve is adjusted. The compensating valve is designed to compensate for brake pipe leakage during service application, as well as for depletion of brake pipe pressure by action of the triple valves in automatically compensating for brake cylinder leakage; its function is to maintain brake pipe pressure equal to the equalizing reservoir pressure. It also performs the equalizing discharge valve functions.

In a service application, brake cylinder air is obtained from the brake pipe and the service reservoir, the auxiliary reservoir serving as a constant pressure chamber to regulate and govern brake cylinder pressure in proportion to brake pipe reduction. Auxiliary reservoir air is used only in emergency application.

High Speed Brake

The high speed attained in passenger service demonstrated that considerably greater brake shoe pressure must be applied to the wheels at high speeds in order to then resist the motion of the train as effectively as it is resisted with a more moderate brake shoe pressure at low speeds. This is accomplished by the use of a higher brake pipe air pressure with the standard quick action apparatus, with only the addition of a high speed reducing valve attached directly to the brake cylinders. This device limits the brake cylinder pressure obtainable during a service application of the brakes to what is considered safe and necessary, but when an emergency application of the brakes is made, the brake cylinder pressure rises to a considerably higher value than the maximum permitted in a service application. Then a gradual reduction of brake cylinder pressure occurs and proportions, as far as possible, the blowdown of the brake cylinder pressure to the reduction in speed as the stopping point is approached.

The M. C. B. committee on this subject presented a brief progress report in 1906 as noted on page 410 of the Proceedings for that year.

Empty-and-Load Brake

The unequal loads imposed upon the air brake apparatus in freight service, due to the periodic hauling of either empty or heavily loaded cars, has resulted in the development of a double-capacity or "empty-and-load" brake. This equipment not only operates to materially increase the total braking power controlling train units on grades but gives a practically uniform braking power on car units—whether empty or loaded—in any service. In addition to the standard brake cylinder, auxiliary reservoir, and other details now used with the standard freight brake, this equipment comprises: (1) An extra brake cylinder, called the "load" cylinder, with notched push rod and enclosed locking mechanism, which operates when the equipment is set in load position; (2) suitable connections, levers, etc., to form the connection and required multiplication of power from the "load" cylinder to the empty cylinder lever system; (3) a triple valve, slightly modified to handle the extra cylinder and volumes; (4) a change-over valve, whereby the equipment may be placed in either the empty or load position, as desired; (5) additional reservoir capacity to furnish the air supply for the "load" brake.

A topical discussion on the desirability of adjusting brake pressure to light and loaded cars will be found in the 1906 M. C. B. Proceedings, page 450.

A topical discussion on the advisability of increasing the train line pressure on loaded cars will be found in the M. C. B. Proceedings, 1901, page 338.

Independent Brake

In handling long trains of cars, it is not always desirable to operate the air brakes on the entire train and the independent locomotive brake—controlled by a brake valve in the locomotive cab and acting only on the locomotive wheels—which forms part of the modern air brake equipment, may be used with or independently of the train brakes and without regard to the position of the locomotive in the train.

This brake may be applied with any desired pressure between the minimum and the maximum, and this pressure automatically maintained in the locomotive brake cylinders regardless of leakage from them and of variation in piston travel, until released by the brake valve. The brake can be graduated on or off with either the automatic or the independent brake valves; a train may be handled without shock or danger of parting, and in passenger service, smooth, accurate stops can be made.

On heavy grades it is the practice to alternate the use of the independent brakes on the locomotive and the train brakes in order to prevent overheating of driving-wheel tires and to assist the pressure retaining valves on the cars in holding the train while the auxiliary reservoirs are being recharged. This is done by keeping the locomotive brakes released by the use of the independent brake valve when the train brakes are being applied and applying the locomotive brakes just before the train brakes are released, then releasing the locomotive brakes as the train brakes are being reapplied after they are recharged.

Traction Air Brake

The Traction Air Brake is an adaptation of air brake equipment to electrically propelled cars or trains. The changed conditions of motive power and method of operating such cars or trains have necessitated changes in the details of brake equipment, and the Electro-Pneumatic Brake, in various different arrangements, is used.

The complete Electro-Pneumatic Brake is designed for use on long high speed electric trains, such as are used in subway service. In addition to the functions performed by a quick action automatic air brake means are provided for applying and releasing the brakes on each car through the action of electro-pneumatic valves energized by current taken from contacts on the motorman's brake valve and continuous train wires. With this device brakes on long trains can be applied instantaneously and simultaneously, eliminating any tendency to surging.

Triple Valve

The triple valve is one of the most important parts of air brake equipment. The device consists of a body or case, called the triple valve body, which has connections to the brake pipe, the auxiliary reservoir and the brake cylinder, in which a slide valve is operated by a piston, so that when the pressure of the air in the brake pipe is increased the auxiliary reservoir is charged and the air in the brake cylinder is released to the atmosphere; and so that, when the air pressure in the brake pipe is reduced, air from the auxiliary reservoir is discharged into the brake cylinder for applying the brakes. A triple valve performing only these functions is known as the plain triple valve.

The quick-action triple valve has all the features and performs all the functions of the plain triple valve, and has the additional function of causing a discharge of air from the brake pipe to the brake cylinder, when, in emergencies, the maximum force of the brakes is instantly required.

More recent developments in triple valve design have added the retarded release and the uniform recharge features.

The triple valve for freight air brakes is a special form, not differing in principle from the passenger brake valve but combined with the reservoir and brake cylinder in one single part for economy and convenience when attaching it to a car.

Retarded release and uniform recharge are important features of the modern design of triple valve.

Universal Valve

The universal valve is a mechanism used with Universal brake equipment on both electric road and steam road passenger brakes. It corresponds in a general way to the triple valve, in that it operates to charge the reservoirs and to control the admission of air to and exhaust from the brake cylinder. This valve, however, possesses many special features which are made necessary by the rigid requirements of modern traffic conditions.

The universal valve is of the built-up type, a simple form of triple valve being the base. This makes it possible to install and operate an equipment, if desired, in stages by adding to the simplest arrangement of apparatus such portions as are demanded by an advance in service requirements, up to the complete form of the device, which is electro-pneumatically operated.

The complete electro-pneumatic device consists of an equalizing portion, which controls the pneumatic service and release of the brake and the charging and recharging of the reservoirs of the equipment; a quick action portion with high pressure cap, which controls the transmission of serial quick action and the obtaining of high emergency pressure in the brake cylinders when an emergency application of the brakes is made; an electric portion which comprises the magnets, switch, etc., controlling the electric service application, electric release and electric em ergency applications of the brake; and a pipe bracket to which the various portions of the valve device are bolted and to which all pipe connections are permanently made.

Compensating Valve

The compensating valve is designed for use on high speed trains to regulate the brake cylinder pressure so that the maximum retarding power may be obtained without injury to the wheels.

In service application, with both plain and quick action triple valves, it acts as a safety valve, to relieve the cylinder of surplus pressure. In emergency applications part of the vented brake pipe air passes from the side cap of the triple valve into the spring box of the compensating valve and, exerting a pressure on the diaphragm in addition to the pressure of the spring, prevents the valve from opening. After a few seconds, the pressure of air in the spring box has become so reduced, by back leakage through the small hole in the check valve, that the brake cylinder pressure is able to force the piston down, permitting brake cylinder air to escape until the pressure becomes reduced to that at which the valve is adjusted, when the spring moves the piston back and closes the exhaust. With this valve the maximum brake cylinder pressure in emergencies is gradually reduced to that at which the valve is adjusted.

Vacuum Brake

The Vacuum Brake is a system of continuous brakes operated by exhausting the air from some appliance located under each car, by which operation the pressure of the external air is transmitted to the brake levers and shoes. It is so called in distinction from air brakes, which are technically understood to refer only to brakes operating with compressed air, although in a literal sense the vacuum brake is also an air brake. An ejector on the engine, connected with the rest of the train by pipes and flexible hose between the cars, is ordinarily used for exhausting the air. Under each car is a large cylinder with a piston and rod connected to the brake levers actuating the brake shoes. These cylinders are connected to the train pipe through a simple form of ball valve. The ejector maintains a vacuum of from 20 to 24 inches in the train pipe and in the cylinders under each car.

In the release position the piston rests by its own weight in the bottom of the cylinder. To apply the brakes air is admitted to the train pipe and through the ball valve under each car to the space below the piston. The vacuum above the piston permits the atmosphere pressure below the piston to raise it and apply the brakes. A vacuum is always maintained above the piston and is available for applying the brakes at any time. In case the train parts the admission of air to the broken train pipes applies the brakes in both sections of the train. A valve in the caboose may also be used to admit air to the train pipe and apply the brakes in case of emergency. To release the brakes, the vacuum is restored in the train pipe and under the pistons by operating the ejector.

This type of brake is almost entirely obsolete in America but is quite generally used in European countries.

Hand Brakes.

There are many different designs of hand-operated brakes: the ordinary straight-shaft equipped with a hand wheel at the top by means of which the brake chain is wound on or off of the lower end of the shaft; the ratchet type of brake in which a lever and ratchet is employed instead of the ordinary hand wheel; the drum or cone type, also employing a ratchet device; the geared brake, having gears which assist in applying power; and the screw type in which the brake shaft is turned by means of a screw and gear, or the brake is applied by means of a crank or toggle arrangement.

The design and application of hand brakes has been the subject of investigation by the American Railway Association, and Circular No. S III-11, issued by the Association in May, 1919, reads in part as follows:

"An 8-in. brake cylinder has a value of practically 2,500 lb. at 50 lb. pressure and the value of a 10-in. cylinder at 50 lb. pressure is, for all practical purposes, 3,950 lb. and all parties concerned should use these cylinder values as a basis in proportioning the levers in the air brake system for the percentage of braking power recommended for the air brake.

"With the body and truck levers properly proportioned for 60 per cent braking power, as specified in the foregoing, and based on the formulæ and diagrams shown in the circular, the hand brake wheel or hand brake ratchet lever, brake staff at chain, and the hand brake leverage between brake staff and cylinder shall be so proportioned that a force of 125 lb. at the rim of the brake wheel or three inches from outer end of hand brake ratchet lever will develop an equivalent load at the brake cylinder piston of not less than 2,500 lb. and 3,950 lb. respectively for cars having 8-in. and 10-in. cylinders. This will insure a minimum hand brake power at the shoes of 60 per cent of the empty car weight.

A single sheave wheel applied to the end of the hand brake rod should be treated as a two-to-one lever in figuring the hand brake power."

Train Signals.

The Train Air Signal Apparatus is a substitute for the older bell cord method of train signal and is arranged to give train signals by the use of compressed air. A separate line of signal pipe, similar to the brake pipe, extends throughout the train, being connected between the cars by hose and

couplings. A car discharge valve, connected to this signal pipe, is located in each car and attached to the bell cord in such manner that pulling on the cord releases air from the signal pipe. In the cab on the engine or motor car is a signal valve, which is also connected with the main signal pipe and a small signal whistle. The supply of air is received from the main reservoir through a reducing valve, which maintains a pressure of about 45 lb. per square inch in the signal apparatus.

When the car discharge valve is opened, by pulling on the cord, the diaphragm in the signal valve is operated so as to blow the whistle. Signals can be given in this way with rapidity and great certainty. If the train breaks in two the whistle is blown loudly for a considerable time.

The Electro-Pneumatic Train Signal is an electrically operated air-signal system, adapted to either single cars or trains which may or may not carry trailers. Means are provided for signaling to the motorman from any part of the train and in as rapid succession as desired, the signals being sharp, distinct and coincident with the pulling of the signal cord. The system is so designed that, if desired, the whistle on each end of every car in the train may be sounded from a signal given from any part of the train. The equipment includes a conductor's signal switch, combined magnet and bracket, signal whistle, jumper and receptacle, cut-out cocks, fuses, snap switches, etc. For cars which operate in both steam road and electric road service, an electro-pneumatic car discharge valve is used, electric operation being used in electric road service and pneumatic operation in steam road service.

General Arrangement and Details of Air Brakes

Standard

Rods, levers, jaws and pins for car brakes are to be made in accordance with Figs. 1870 and 1871.

All levers to be 1 in. in thickness.

All pins to be 1 3/32 in. in diameter.

All jaws and devices to be made of ¾ in. by 2½ in. iron.

All rods must be at least ¾ in. in diameter.

The form of jaws may be varied provided the essential dimensions are adhered to.

Jaws may be made with two (or more) holes if desired.

rods and levers should be increased, if necessary, so that the fiber stress shall not exceed 15,000 pounds per square inch for rods and 23,000 pounds per square inch for levers. Adopted, 1909.

Truck connections shall be made of round iron or steel not less than 1⅝ in. in diameter. Adopted, 1909; revised, 1916.

A standard bottom rod for use with all steel or steel tired wheels was adopted in 1911; modified, 1917.

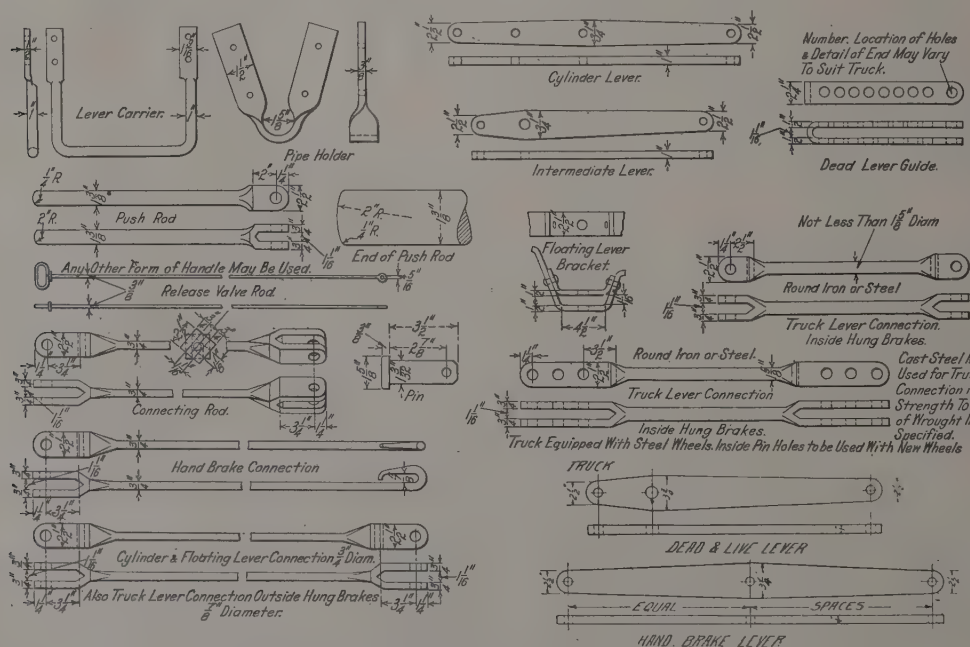

Lever Carrier.
Pipe Holder
Cylinder Lever.
Intermediate Lever.
Number, Location of Holes & Detail of End May Vary To Suit Truck.
Dead Lever Guide.
Push Rod
End of Push Rod
Any Other Form of Handle May Be Used.
Release Valve Rod
Floating Lever Bracket.
Not Less Than 1⅝" Diam
Round Iron or Steel
Truck Lever Connection. Inside Hung Brakes.
Connecting Rod.
Pin
Round Iron or Steel
Truck Lever Connection
Inside Hung Brakes.
Cast Steel May Be Used for Truck Lever Connection if of Equal Strength To The Section of Wrought Iron or Steel Specified.
Truck Equipped With Steel Wheels. Inside Pin Holes to be Used With New Wheels
Hand Brake Connection
TRUCK
DEAD & LIVE LEVER
Cylinder & Floating Lever Connection ¾" Diam.
Also Truck Lever Connection Outside Hung Brakes ⅝" Diameter.
EQUAL SPACES
HAND BRAKE LEVER

FIG. 1870—A. R. A. STANDARDS FOR AIR BRAKES ON FREIGHT CARS.

Truck lever connection for outside lining brakes must be at least ⅞ in. in diameter. Adopted, 1898.

Hole for cotter in air brake pin to be 7/16 in. Adopted, 1898.

Truck lever connection, if made of round iron or steel, must not be less than 1⅝ in. in diameter. Adopted, 1898.

Release valve rod to be ⅜ in. in diameter. Adopted, 1898.

All holes for brake pins to be not less than 1 3/32 in. in diameter nor more than 1⅛ in. in diameter. Adopted, 1908.

For brake cylinders larger than 8 in. or for brake cylinder pressures above 50 pounds per square inch, the size of brake

An additional lever was adopted in 1912 in order that hand brake and air brake will work in harmony on double brake cars.

Cast steel may be used for truck lever connections. Adopted, 1911.

Cylinders, Triple Valves and Dirt Collectors.

These parts are to be in accordance with Fig. 1872.

For cars built after January 1, 1915, weighing between 37,000 lb. and 58,000 lb. 10 in. air brake cylinders should be used. Adopted, 1914.

The K1 triple valve should be used for 8 in. equipment and the K2 triple valve for 10 in. equipment. Adopted, 1917.

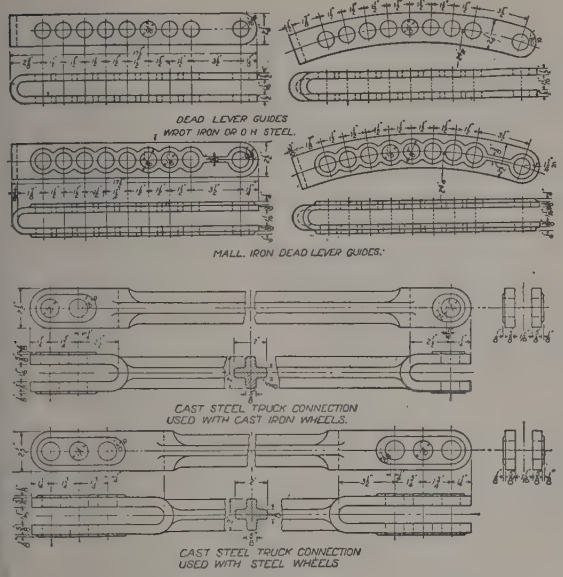

DEAD LEVER GUIDES
WROT IRON OR O H STEEL.
MALL. IRON DEAD LEVER GUIDES.
CAST STEEL TRUCK CONNECTION
USED WITH CAST IRON WHEELS.
CAST STEEL TRUCK CONNECTION
USED WITH STEEL WHEELS

FIG. 1871—DEAD LEVER GUIDES AND TRUCK CONNECTIONS.

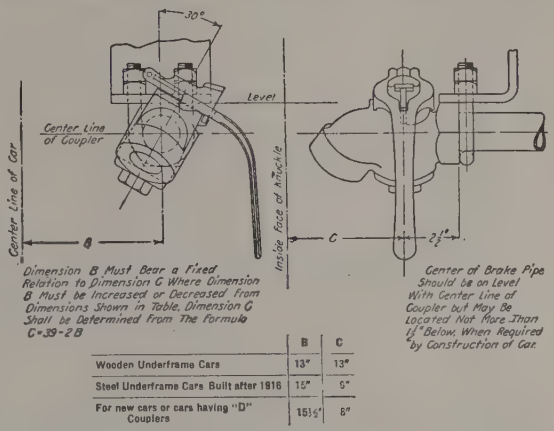
Installation of centrifugal dirt collectors for freight equipment cars. Adopted, 1916. See Fig. 3 shown in Fig. 1872.

Adjustment of cylinder piston travel should be not less than 6 in. nor more than 8 in. Adopted, 1917.

Location of main air pipe and angle cock. Adopted, 1904; revised, 1920.

BRAKE CHAIN

Brake chain shall be of not less than ⅜ in., preferably 7/16 in., wrought iron or steel, with a link on the brake rod end of not less than 7/16 in., preferably ½ in., wrought iron or steel, and shall be secured to brake shaft drum by


30°
Level
Center Line of Coupler
Center Line of Car
Inside face of knuckle
B
C
2½"
Dimension B Must Bear a Fixed Relation to Dimension C Where Dimension B Must be Increased or Decreased from Dimensions Shown in Table. Dimension C Shall be Determined From The Formula C=39-2B
Center of Brake Pipe Should be on Level With Center Line of Coupler but May Be Located Not More Than ½" Below When Required by Construction of Car.

	B	C
Wooden Underframe Cars	13"	13"
Steel Underframe Cars Built after 1916	15"	9"
For new cars or cars having "D" Couplers	15½"	8"

FIG. 1873—LOCATION OF MAIN AIR PIPE AND ANGLE COCK.

not less than ½ in. hexagon or square head bolt. Nut on bolt shall be secured by riviting end over nut. Adopted, 1911.

FORMULA FOR CEMENT FOR MOUNTING AIR BRAKE HOSE.

Adopted, 1917.

Shellac: Dissolve 5 lb. of dry shellac in 1 gal. of denatured alcohol and add 2 oz. of castor oil.

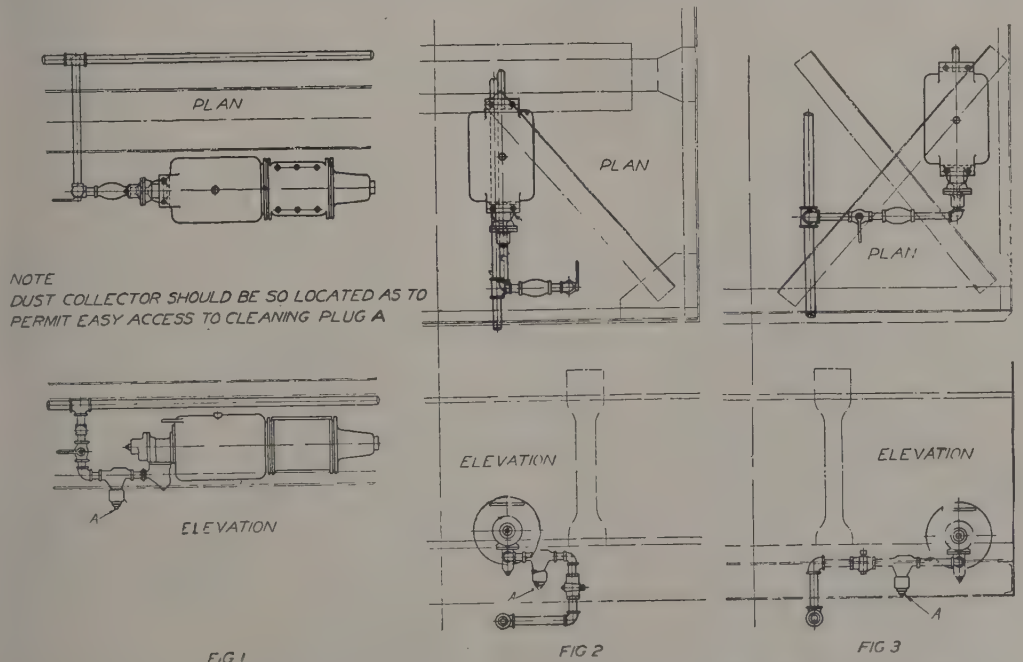


FIG. 1872—A. R. A. RECOMMENDED PRACTICE FOR INSTALLATION OF CENTRIFUGAL DUST COLLECTOR.

PIPING—To be in accordance with Figs. 1875 and 1876.

Diameter of brake pipe for freight equipment cars shall be 1¼ in. Adopted, 1889.

Standard brake pipe nipple shall be 10 in. long. Adopted, 1900.

Rubber: Dissolve from 4 to 10 oz. of raw rubber (preferably Para) in 1 gal. of gasoline or benzol.

MISCELLANEOUS.

Maximum train pipe pressure 70 pounds per square inch

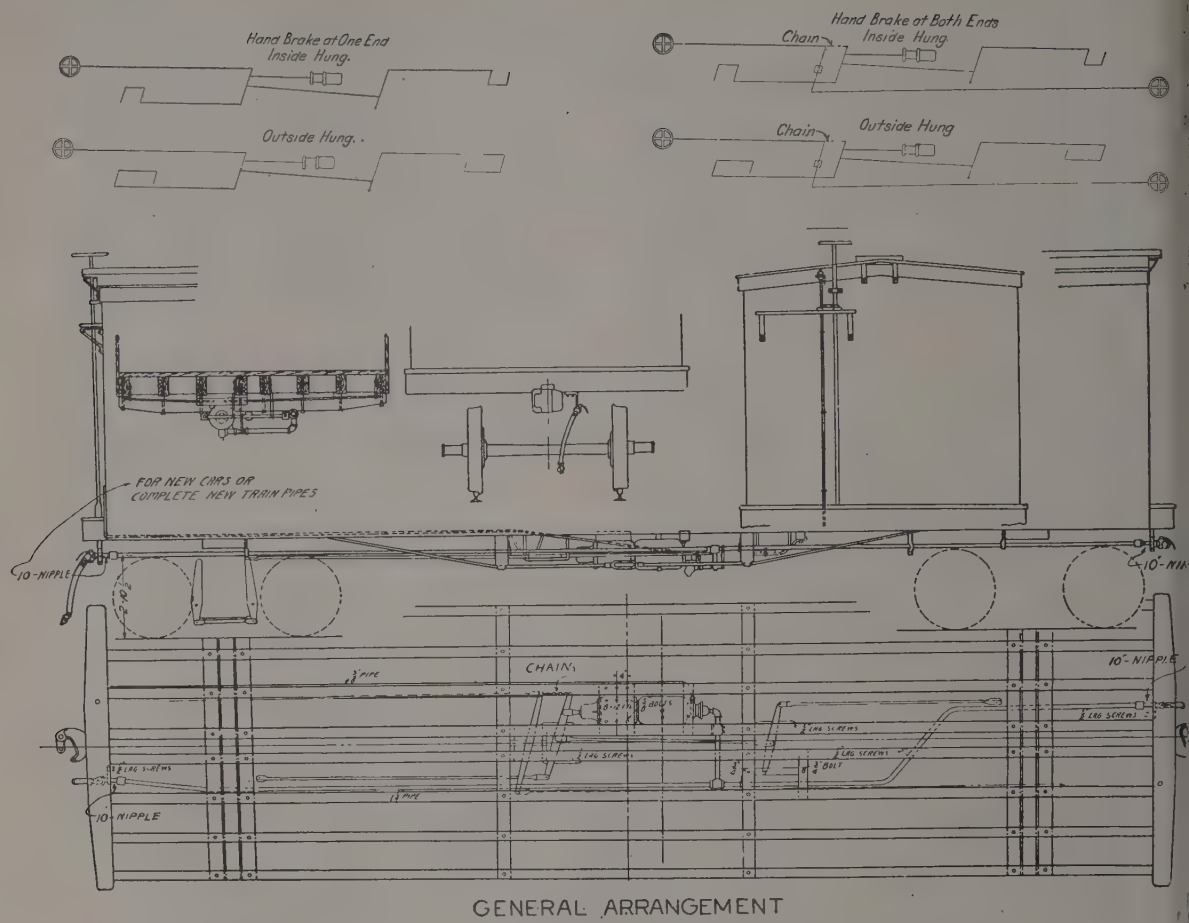
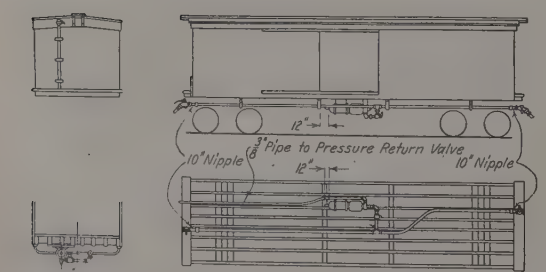


FIG. 1874—A. R. A. STANDARDS FOR AIR BRAKES ON FREIGHT CARS. (A. R. A. SHEET 18.)



NOTE.— Pipes Should be Secured to the Framework of Car with a Liberal Number of Clamps.

Bolts Securing Brake Cylinders, Auxiliary Reservoirs and Pipe Clamps to Have Double Nuts or Lock Nuts, Preferably the Latter.

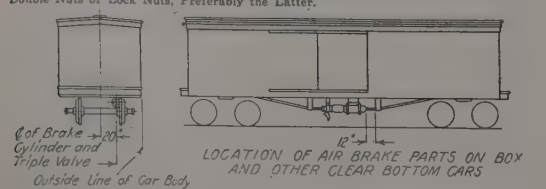
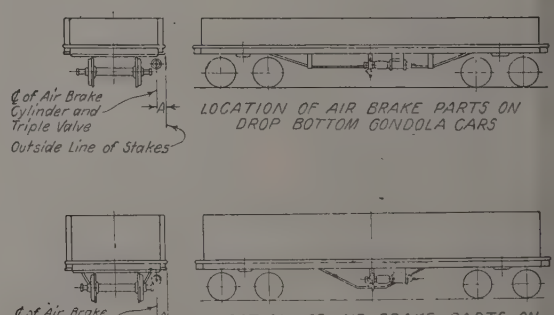
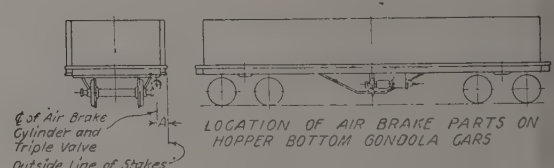

℄ of Brake Cylinder and Triple Valve
20"
Outside Line of Car Body
12"
LOCATION OF AIR BRAKE PARTS ON BOX AND OTHER CLEAR BOTTOM CARS

FIG. 1875—GENERAL ARRANGEMENT OF AIR BRAKES.

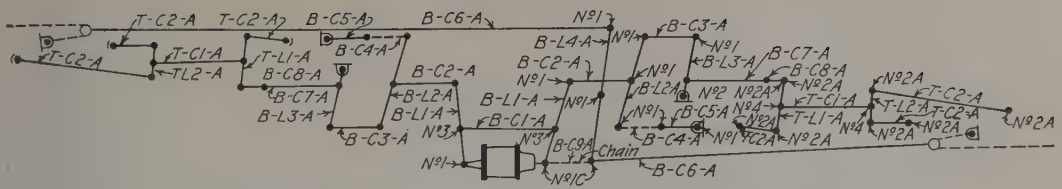



℄ of Air Brake Cylinder and Triple Valve
A
Outside Line of Stakes
LOCATION OF AIR BRAKE PARTS ON HOPPER BOTTOM GONDOLA CARS

NOTE.— Dimension "A" From Center of Air Brake Cylinder and Triple Valve to Outside Line of Stakes Should be Made to Suit Construction of Car, Locating the Air Brake Cylinder and Triple Valve as Near to the Outside Line of Stakes as Practicable for Safety and Convenience in Cleaning and Repairs.

Bolts Securing Brake Cylinders, Auxiliary Reservoirs and Pipe Clamps to Have Double Nuts or Lock Nuts, Preferably the Latter.

FIG. 1876—GENERAL ARRANGEMENT OF AIR BRAKES.



The use of the floating lever fulcrum connection and chain may be discontinued and cylinder and floating lever connection (B-C2-A) and intermediate and truck-lever connection (B-C7-A) made in one piece, thereby eliminating five parts: B-C5-A, B-C4-A, B-L2-A, B-C3-A, and B-L3-A.

TABLE I.
SCHEDULE A-1.
For Cars Weighing 80 000 to 100 000 Lbs.

14" BRAKE CYLINDER
CYLINDER LEVER B-L1-A

FOR CARS WEIGHING	Per Cent Braking Power for Cylinder Pressure of 60 Lb. per Sq. in.	Lever No.	A	B
		1	13"	23"
78 500 to 80 800	90.0 to 87.5	2	13¼"	22¾"
80 900 to 83 200	90.0 to 87.5	3	13½"	22½"
83 300 to 85 700	90.0 to 87.5	4	13¾"	22¼"
85 800 to 88 300	90.0 to 87.5	5	14"	22"
88 400 to 90 900	90.0 to 87.5	6	14¼"	21¾"
91 000 to 93 500	90.0 to 87.5	7	14½"	21½"
93 600 to 96 200	90.0 to 87.5	8	14¾"	21¼"
96 300 to 99 000	90.0 to 87.5	9	15"	21"
99 100 to 101 900	90.0 to 87.5	10	15¼"	20¾"
		11	15½"	20½"

Brake beams should be suitable for maximum load at middle of beam of 22 000 lbs.

TABLE II.
SCHEDULE A.
For Cars Weighing 100 000 to 137 000 Lbs.

16" BRAKE CYLINDER
CYLINDER LEVER B-L1-A

FOR CARS WEIGHING	Per Cent Braking Power for Cylinder Pressure of 60 Lb. per Sq. in.	Lever No.	A	B
99 600 to 102 500	90.0 to 87.4	1	13"	23"
102 600 to 105 600	90.0 to 87.4	2	13¼"	22¾"
105 700 to 108 700	90.0 to 87.5	3	13½"	22½"
108 800 to 112 000	90.0 to 87.5	4	13¾"	22¼"
112 100 to 115 300	90.0 to 87.5	5	14"	22"
115 400 to 118 700	90.0 to 87.5	6	14¼"	21¾"
118 800 to 122 200	90.0 to 87.5	7	14½"	21½"
122 300 to 125 700	90.0 to 87.5	8	14¾"	21¼"
125 800 to 129 400	90.0 to 87.5	9	15"	21"
129 500 to 133 100	90.0 to 87.5	10	15¼"	20¾"
133 200 to 137 000	90.0 to 87.5	11	15½"	20½"

Brake beams should be suitable for maximum load at middle of beam of 28 000 lbs.

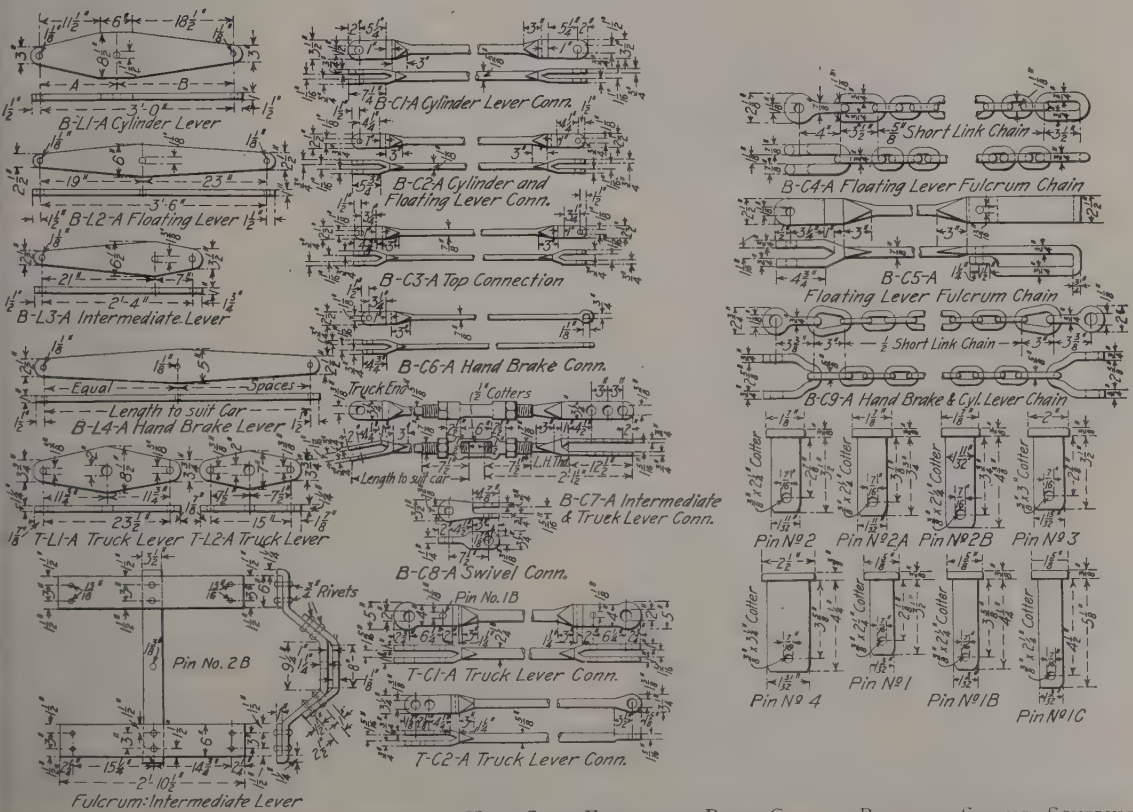


FIG. 1877—A. R. A. RECOMMENDED PRACTICE FOR HIGH SPEED FOUNDATION BRAKE GEAR FOR PASSENGER SERVICE; SCHEDULE FOR SIX-WHEEL TRUCKS.

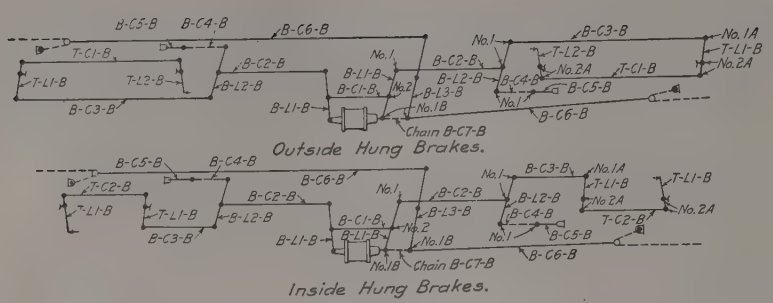


Table I.
Schedule B-1.
For Cars Weighing 50,000 to 70,000 Lbs.

12" Brake Cylinder Cylinder Lever B-L1-B.				
For Cars Weighing	% Brkg. Power for Cyl. Press. of 60 Lbs. Per Sq. In.	Lever No.	A	B
49,000 to 50,500	90.0 to 87.3	1	13"	20"
50,600 to 52,100	90.0 to 87.4	2	13½"	19¾"
52,200 to 53,700	90.0 to 87.5	3	13½"	19½"
53,800 to 55,300	90.1 to 87.6	4	13¾"	19¼"
55,400 to 57,200	90.2 to 87.4	5	14"	19"
57,300 to 59,000	90.0 to 87.4	6	14¼"	18¾"
59,100 to 60,800	89.8 to 87.3	7	14½"	18½"
60,900 to 62,700	90.0 to 87.3	8	14¾"	18¼"
62,800 to 64,600	90.0 to 87.5	9	15"	18"
64,700 to 66,700	90.0 to 87.4	10	15¼"	17¾"
66,800 to 68,700	90.0 to 87.5	11	15½"	17½"
68,800 to 70,800	90.0 to 87.5	12	15¾"	17¼"
Brake Beams should be suitable for maximum load at middle of beam of 72,000 pounds.				

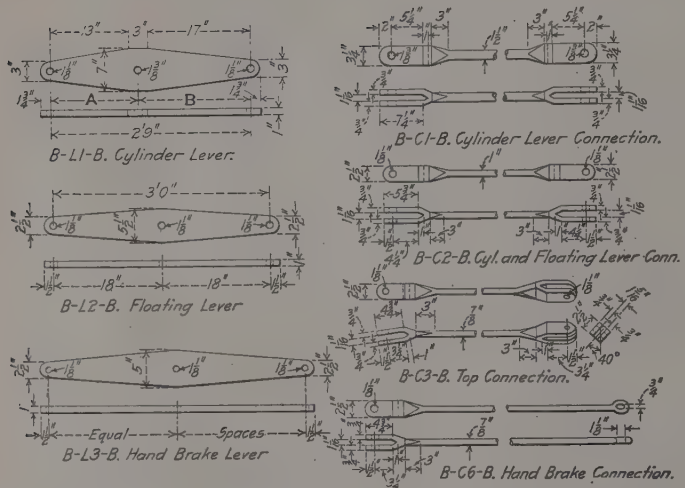


Table II.
Schedule B.
For Cars Weighing 70,000 to 90,000 Lbs.

14" Brake Cylinder Cylinder Lever B-L1-B.				
For Cars Weighing	% Brkg. Power for Cyl. Press. of 60 Lbs. Per Sq. In.	Lever No.	A	B
		1	13"	20"
68,800 to 70,900	90.0 to 87.4	2	13⅜"	19¾"
71,000 to 73,200	90.0 to 87.4	3	13⅝"	19⅝"
73,300 to 75,500	90.0 to 87.5	4	13¾"	19¼"
75,600 to 77,900	90.0 to 87.4	5	14"	19"
78,000 to 80,300	90.0 to 87.4	6	14⅜"	18⅝"
80,400 to 82,800	90.0 to 87.4	7	14½"	18⅜"
82,900 to 85,400	90.0 to 87.4	8	14¾"	18¼"
85,500 to 88,000	90.0 to 87.5	9	15"	18"
88,100 to 90,800	90.0 to 87.4	10	15⅜"	17⅞"
Brake Beams should be suitable for maximum load at middle of beam of 78,000 pounds.				

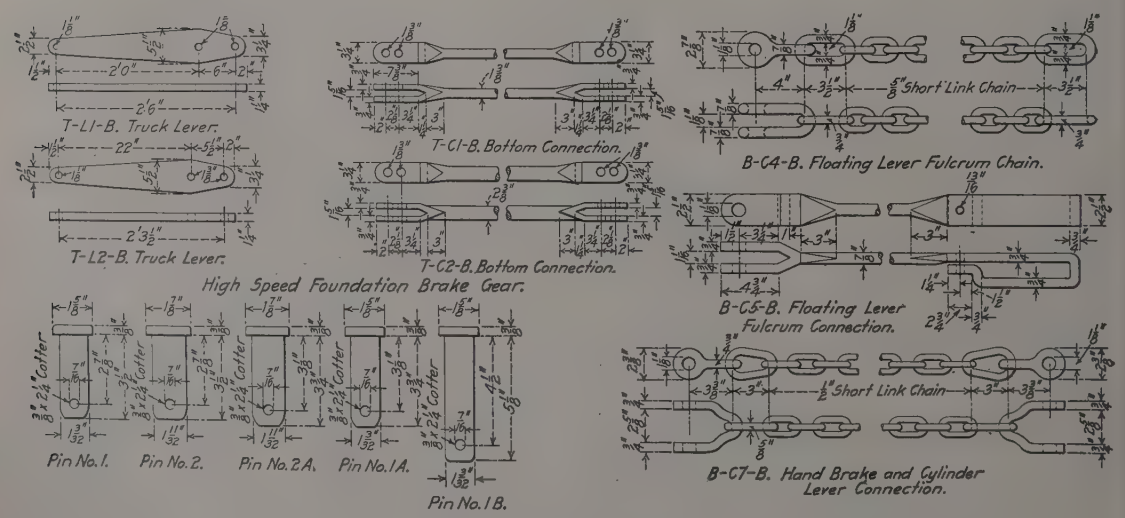


FIG. 1878—RECOMMENDED PRACTICE FOR HIGH SPEED FOUNDATION BRAKE GEAR FOR PASSENGER SERVICE. SCHEDULE FOR FOUR-WHEEL TRUCKS.

Schedule C.
For Cars Weighing 39000 to 50000 Lbs

10" Brake Cylinder. Cylinder Lever B-L1-C.				
For Cars Weighing	B. Brkg Power for Cyl. Pres. of 80 Lbs. per Sq. In.	Lever No.	A	B
38600 to 39700	89.9 to 87.2	1	14"	19"
39800 to 40900	90.0 to 87.6	2	14½"	19⅜"
41000 to 42200	90.1 to 87.5	3	14½"	19⅛"
42300 to 43500	90.0 to 87.5	4	14⅝"	19"
43600 to 44900	90.1 to 87.4	5	15"	18"
45000 to 46300	89.9 to 87.4	6	15⅛"	17⅝"
46400 to 47700	89.9 to 87.5	7	15⅜"	17⅛"
47800 to 50000	90.0 to 86.0	8	15⅝"	17¼"
Brake Beams Should Be Suitable for Maximum Load at Middle of Beam of 15,200 Pounds.				

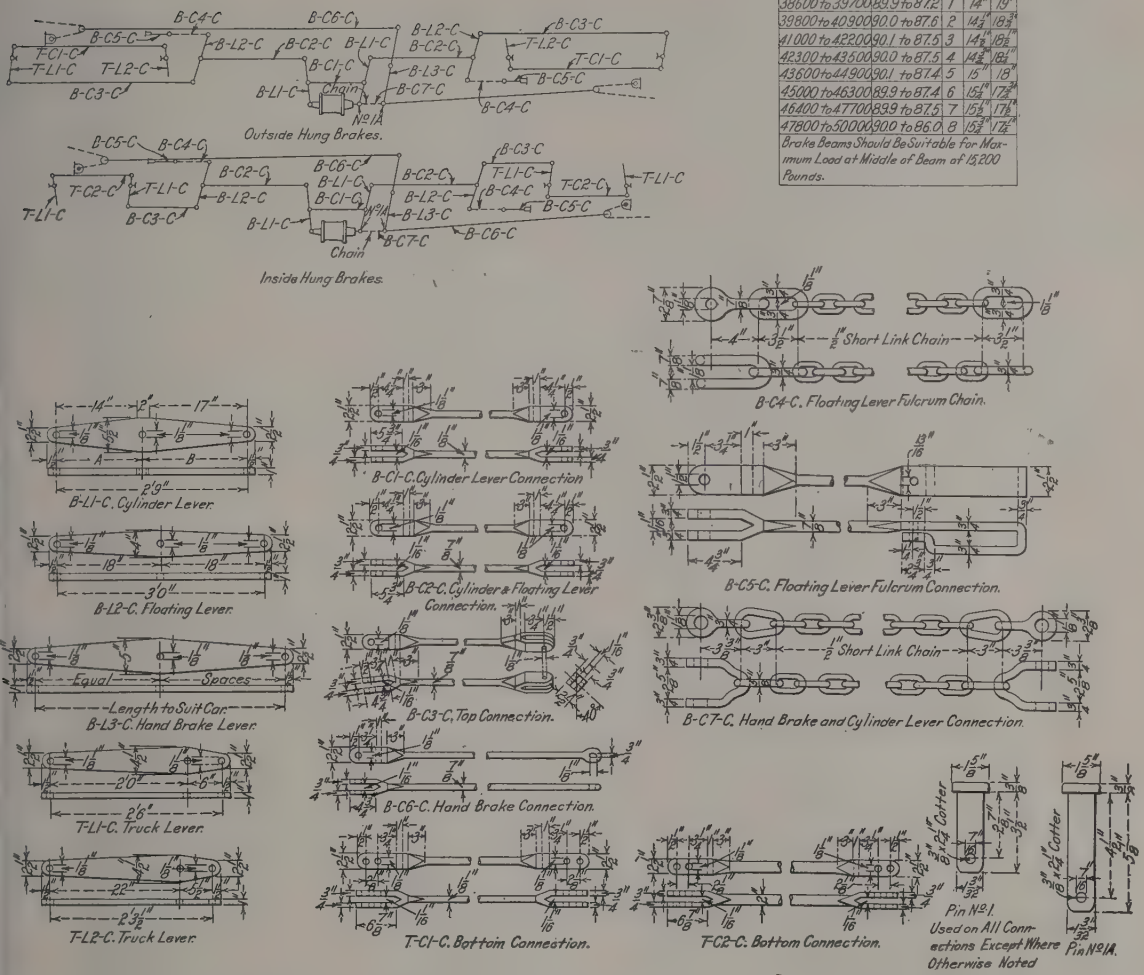


FIG. 1879—A. R. A. RECOMMENDED PRACTICE FOR HIGH SPEED FOUNDATION BRAKE GEAR FOR PASSENGER SERVICE.

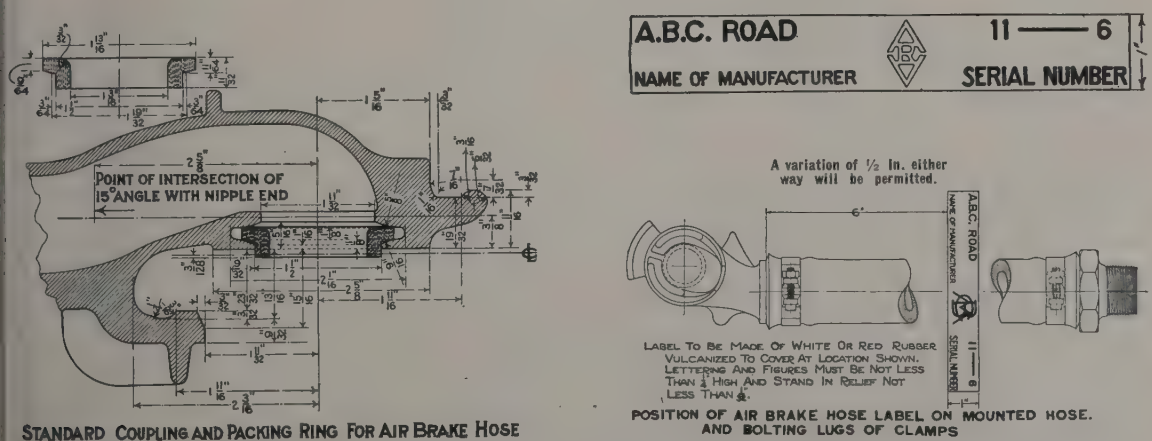

POINT OF INTERSECTION OF 15° ANGLE WITH NIPPLE END
STANDARD COUPLING AND PACKING RING FOR AIR BRAKE HOSE
A.B.C. ROAD
NAME OF MANUFACTURER
11 — 6
SERIAL NUMBER
A variation of ½ in. either way will be permitted.
LABEL TO BE MADE OF WHITE OR RED RUBBER VULCANIZED TO COVER AT LOCATION SHOWN. LETTERING AND FIGURES MUST BE NOT LESS THAN ¼ HIGH AND STAND IN RELIEF NOT LESS THAN ⅛.
POSITION OF AIR BRAKE HOSE LABEL ON MOUNTED HOSE. AND BOLTING LUGS OF CLAMPS

FIG. 1880—STANDARD COUPLING AND PACKING RING FOR AIR BRAKE HOSE. ALSO LABEL FOR AIR BRAKE HOSE AND INSTRUCTIONS FOR ITS APPLICATION.

Maximum brake power in freight cars shall be 70 per cent of the light weight of car.

Bolts securing brake cylinders, auxiliary reservoirs and pipe clamps shall have double nuts or nut locks, preferably the latter. Adopted, 1919.

Brake beams must not be hung from any portion of body of cars, on cars built after September 1, 1909.

General Arrangement and Details of Air Brakes

Recommended Practice

CYLINDERS. TRIPLE VALVES AND RETAINING VALVES.

Location of air brake cylinders and triple valves on box cars and other clear bottom cars to be as in Fig. 1875. Adopted, 1899.

Location of air brake cylinder and triple valves on hopper gondola cars and drop bottom gondola cars to be as in Fig. 1876. Adopted, 1889.

Retaining Valves for Freight Equipment Cars. Adopted, 1919. The two pressure spring type retaining valve of such capacity as may be required by the individual road should be used. No standard for capacity of retaining valves has been adopted.

ing an internal diameter of less than 1 inch standard weight to be used, and on all new equipment 1¼ in., extra heavy pipe, should be used. Adopted, 1913.

CLASP BRAKES.

Truck clasp brakes should be applied to four-wheel truck passenger equipment cars weighing 96,000 pounds or over, and to six-wheel truck passenger equipment cars weighing 136,000 pounds or over. Adopted, 1915.

WATER RAISING SYSTEM.

Air Supply for Passenger Equipment Cars. Adopted, 1918. To be taken from the following points for different types of brakes, namely:

(a) Schedule PM—From auxiliary reservoir.
(b) Schedule PC—From emergency reservoir.
(c) Schedule UC—From emergency reservoir.
(d) Schedule LN—From supplementary reservoir.

Where a cutout cock is used in the brake system for cutting out the supplementary or emergency reservoir, the air connection for the water raising system should be made between the reservoir cutout cock and the triple valve or control valve.

MISCELLANEOUS.

The braking power for freight equipment cars should be 60 per cent of the light weight of the car, based on 50

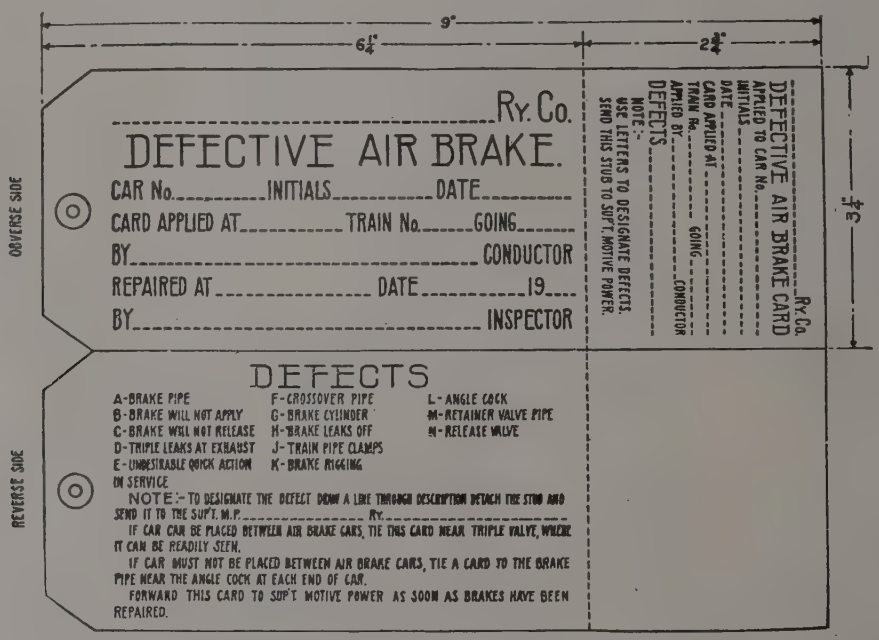

9"
6¼"
2¾"
3"
OBVERSE SIDE
REVERSE SIDE
Ry. Co.
DEFECTIVE AIR BRAKE.
CAR No. INITIALS DATE
CARD APPLIED AT TRAIN No. GOING
BY CONDUCTOR
REPAIRED AT DATE 19
BY INSPECTOR
DEFECTIVE AIR BRAKE CARD Ry. Co.
APPLIED TO CAR No.
INITIALS
DATE
CARD APPLIED AT
TRAIN No. GOING
APPLIED BY CONDUCTOR
DEFECTS
NOTE:- USE LETTERS TO DESIGNATE DEFECTS. SEND THIS STUB TO SUPT. MOTIVE POWER.
DEFECTS
A-BRAKE PIPE
B-BRAKE WILL NOT APPLY
C-BRAKE WILL NOT RELEASE
D-TRIPLE LEAKS AT EXHAUST
E-UNDESIRABLE QUICK ACTION
F-CROSSOVER PIPE
G-BRAKE CYLINDER
H-BRAKE LEAKS OFF
J-TRAIN PIPE CLAMPS
K-BRAKE RIGGING
L-ANGLE COCK
M-RETAINER VALVE PIPE
N-RELEASE VALVE
ON SERVICE
NOTE:- TO DESIGNATE THE DEFECT DRAW A LINE THROUGH DESCRIPTION DETACH THE STUB AND SEND IT TO THE SUP'T. M.P. Ry.
IF CAR CAN BE PLACED BETWEEN AIR BRAKE CARS, TIE THIS CARD NEAR TRIPLE VALVE, WHERE IT CAN BE READILY SEEN.
IF CAR MUST NOT BE PLACED BETWEEN AIR BRAKE CARS, TIE A CARD TO THE BRAKE PIPE NEAR THE ANGLE COCK AT EACH END OF CAR.
FORWARD THIS CARD TO SUP'T MOTIVE POWER AS SOON AS BRAKES HAVE BEEN REPAIRED.

FIG. 1881—A. R. A. STANDARD FOR AIR BRAKE DEFECT CARD.

PIPING—To be in accordance with Figs. 1874 and 1875.

Arrangement of piping for clear bottom cars, or cars of the box car type, as adopted in 1899 are shown in Fig. 1875.

Air pipes should be fastened to the framework of the car with a liberal number of clamps. Adopted, 1899.

One elbow should be applied to the retaining valve pipe, it being located at the end sill of the car where pipe turns upwards. Adopted, 1899.

One union should be applied to the retaining valve pipe as close to the triple valve as practicable to permit the easy removal of same; the pipe to be carried along under side of intermediate sill, when practicable, from the triple valve to end of car, and be supported by either staples or clamps, not to exceed six feet apart. Adopted, 1899.

Brake Pipe—Passenger Equipment Cars. No pipe having an internal diameter of less than 1 inch standard weight to be used, and on all new equipment 1¼ in., extra heavy pipe, should be used. Adopted, 1913.

CLASP BRAKES.

Truck clasp brakes should be applied to four-wheel truck passenger equipment cars weighing 96,000 pounds or over, and to six-wheel truck passenger equipment cars weighing 136,000 pounds or over. Adopted, 1915.

WATER RAISING SYSTEM.

Air Supply for Passenger Equipment Cars. Adopted, 1918. To be taken from the following points for different types of brakes, namely:

(a) Schedule PM—From auxiliary reservoir.
(b) Schedule PC—From emergency reservoir.
(c) Schedule UC—From emergency reservoir.
(d) Schedule LN—From supplementary reservoir.

Where a cutout cock is used in the brake system for cutting out the supplementary or emergency reservoir, the air connection for the water raising system should be made between the reservoir cutout cock and the triple valve or control valve.

MISCELLANEOUS.

The braking power for freight equipment cars should be 60 per cent of the light weight of the car, based on 50 pound per square inch cylinder pressure. Adopted, 1913.

Brake Levers, Rods, Connections and Pins for Passenger Equipment Cars High Speed Foundation Brake Gear

Recommended Practice—ADOPTED, 1903; REVISED, 1912.

FUNDAMENTALS OF DESIGN.

Braking force, 90 per cent of light weight of car.
Equalized pressure in brake cylinder, 60 lb. per sq. in.
Maximum pressure in brake cylinder, 85 lb. per sq. in.
Maximum stress in levers, 23,000 lb. per sq. in.
Maximum stress in rods, except jaws, 15,000 lb. per sq. in.; no rod to be less than ⅞ in. diameter.

Maximum stress in jaws, 10,000 lb. per sq. in.

Maximum shear on pins, 10,000 lb. per sq. in.

Diameter of pins to provide a bearing value not to exceed 23,000 lb. per sq. in.

The reduction of stresses in rods, levers and jaws due to friction of the foundation brake, and the reduction of braking force due to the same cause and to the action of release springs should be neglected, because it is considered to be too difficult to determine their value even with a fair degree of accuracy.

The location of fulcrum hole in the cylinder lever is made to vary by quarters of the inch to suit the weight of the cars, but only one fulcrum hole should be drilled in each lever.

DESIGNATION OF RODS AND LEVERS.

On drawings, location of same is designated by letters, first letter distinguishing between the body and the truck.

Second letter distinguishing between the levers and connections.

Figure following second letter is number for lever or connection; following this figure is the schedule letter for lever or connection.

For example, B-C2-B shows body connection two (second from cylinder piston rod), Schedule "B," and T-L2-B shows truck lever two, Schedule "B."

The length of cylinder end of cylinder lever should be shown at some convenient place on car, so that no calculation will be necessary to determine the proper cylinder lever to be used.

If desirable to mark each lever to indicate the schedule to which it belongs and its location, it is suggested that the markings be as indicated on the drawings.

Air-Brake and Train Air-Signal Hose

Standard—ADOPTED, 1903; REVISED, 1916.

In 1898 the Air Brake and Signal Instructions which had been in use since 1892 were slightly revised and adopted as a Recommended Practice of the Association. Revised in 1904.

In 1911 Rule 121 was modified and some slight changes made in text and illustrations and the rules ordered printed in the Proceedings.

In 1914 the Air Brake and Train Air Signal Instructions were revised.

In 1914 the general questions regarding the use of the air brake and train air signal instructions were omitted in accordance with the result of letter ballot.

I. MANUFACTURE.

1. *Scope.*—These specifications supersede all previous specifications for air-brake and signal hose, including that for "Woven and combination woven and wrapped air-brake hose." Air-brake hose of the woven and combination woven and wrapped type shall meet all tests of these specifications except that of friction, Section 4, on those constructions, where friction can not be made.

2. *Physical Properties.*—All hose shall be soft and pliable and not less than four-ply. They shall be made of rubber and cotton fabric, each the best of its kind for the purpose.

II. TESTS.

3. *Tests.*—Hose shall be subjected to the following tests, which shall be made with the temperature of the air not lower than 65 or higher than 90 deg. F., and the samples shall be kept at a temperature within these limits for at least one-half hour previous to the time of test.

4. *Friction Test.*—The quality of friction shall be determined by suspending a 20-lb. weight from the separated end of the duck of one of the 1-in. test specimens described in Section 9, the force being applied radially. The separation shall be uniform and regular, and the average speed shall not exceed 8 in. in 10 min., the distance being measured while the weight is still in place.

5. *Stretching Test.*—Test specimens from tube and cover will be quickly stretched until the 2-in. marks are 10 in. apart and immediately released. They will then be remarked as at first within 10 sec. after starting to release and again stretched to 10 in. between the new marks, remaining so stretched for 10 min. The specimens shall then be completely released, and within 30 sec. after starting to release the distance between the marks last applied will be measured, and the initial set must not be more than ¼ in. At the end of 10 min. the distance between the marks will again be measured, and the final set must not be more than ⅛ in. These test specimens may be cut from the tube and cover of the friction-test specimen, but shall not be used for tensile test.

6. *Tensile Strength.*—Test specimens from tube and cover shall be pulled in a tensile machine with a test speed of 20 in. per minute. The inner tube must have a tensile strength of not less than 800 lb. or more than 1,200 lb. per sq. in., and the cover not less than 700 lb. or more than 1,100 lb. per sq. in. The elongation shall be such that the marks, originally 2 in. apart, stretch to at least 10 in. before specimen breaks. If the tensile strength in lb. per sq. in. is greater than that required, the sample may be accepted, providing the per cent increase in elongation is equal to or greater than the per cent increase in tensile strength in lb. per sq. in. above the maximum figure.

7. *Porosity Test.*—The remaining 17 in. shall be mounted and placed in a test rack, the circumference will be measured and the hose filled with air at 140 lb. pressure per sq. in., the rubber cover shall be cut from clamp to clamp

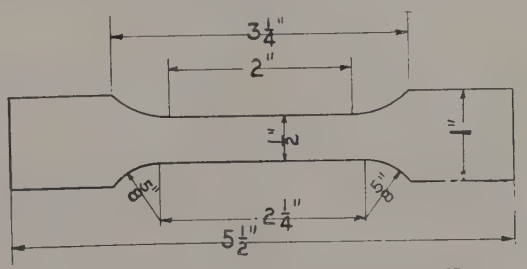


FIG. 1882—TEST SPECIMEN FOR AIR BRAKE HOSE.

(taking care not to injure the duck) and this pressure maintained for 5 min. At the end of this time the hose will be submerged in water to determine whether the inner tube is porous. The escape of air through the tube shall be distinct enough so that the porosity will not be confused with the escape of air which is confined in the structure of the hose. In the event the hose fails on bursting test at the point at which cut was made for porosity test and a satisfactory hydraulic test is not obtained, the porosity and hydraulic test will be repeated on another piece of hose.

8. *Bursting Tests.*—The section of hose, which was used

for porosity test, shall then be subjected to a hydraulic pressure of 200 lb. per sq. in., under which pressure it shall not expand in circumference more than ¾ in. for air-brake hose and 11/16 in. for air-signal hose, nor develop any small leaks or defects. After the above test, this section shall then stand a hydraulic pressure of 500 lb. per sq. in. for 10 min., without bursting or developing any small leaks or defects, after which the hydraulic pressure shall be increased to a minimum of 700 lb. per sq. in. without bursting, at the rate of not less than 100 or more than 200 lb. per five seconds.

9. *Test Specimen.*—(a) A hose shall be selected at random and a section 5 in. cut from one end. Two sections, each 1 in. long, shall be cut from the 5-in. section for making friction, stretching and tensile tests, the remaining 3-in. section shall be used for making additional tests, which may be desired on the tube and cover. Stretching and tensile test specimens shall be cut from the tube and cover with a die having the dimensions shown in Fig. 1882.

(b) In measuring the thickness of the test specimen in Fig. 1882 to determine the strength per square inch, a micrometer graduated to 0.001 in. having a shoe 0.24 to 0.26 in. in diameter, exerting a pressure of from 8 to 10 oz. on the test specimen, shall be used.

10. *Number of Tests.*—For each lot of 200 pieces of hose one extra hose shall be furnished free of costs for test purposes.

III. Permissible Variations.

	Length, In.	Outside Diameter, In.	Inside Diameter, In.	Thickness of Cap Vulcanized on, In.
Air-Brake Hose.				
Minimum	22	2 1/16	1 3/16	1/32
Maximum	22 1/2	2 1/16	1 7/16	1/32
Air Signal Hose.				
Minimum	22	1 13/16	1 5/16	1/32
Maximum	22 1/2	1 7/16	1 9/16	1/32

IV. Workmanship and Finish.

11. *Workmanship.*—(a) Tube. The tube shall be made either by hand or machine. It shall be free from holes and imperfections, and in joining must be so firmly united to the cotton fabric that it will meet the friction tests prescribed in Section 3. The tube shall be of such a composition and so cured as to successfully meet the requirements of tests given in Sections 4 and 5, the tubes to be not less than 3/32 in. thick.

(b) Cover. The cover shall be of the same quality of rubber as the tube and shall be not less than 1/16 in. thick, and shall meet the requirements of tests given in Sections 4 and 5.

12. *Duck.*—Construction. The canvas or duck used as a wrapping for the hose shall be made from long-fiber cotton, and shall weigh not less than 22 oz. per lineal yard, 40 in. wide. It shall have five threads per strand and not less than 16 nor more than 22 strands per inch of width, for both warp and filler. The duck shall be cut and applied on a bias of from 42 to 46 deg., with edges lapped at least 0.5 in. on both sides well frictioned.

13. *Finish.*—The hose shall be smooth and regular in size throughout its entire length.

V. Marking.

14. *Serial Number.*—Each lot of 200 or less shall bear the manufacturer's serial number, commencing at 1 on the first of the year and continuing consecutively until the end of the year.

15. *Label.*—Each length of hose shall have vulcanized on it a label of red rubber, as in Fig. 1880 on page 775. This label shall be applied on the hose at a point 6 in. from the end (a variation of ½ in. either way will be permitted) and with the top of the lettering toward the center of the hose.

VI. Inspection and Rejection.

16. *Inspection.*—(a) The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

17. *Rejection.*—Material which, subsequently to above tests at the mills or elsewhere, and its acceptance, or prior to being placed in service, develops weak spots or imperfections, or fails to pass any one of the tests herein required, within 60 days from date of shipment, will be rejected and shall be replaced by the manufacturer at his own expense.

18. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report to the manufacturer.

Each length of hose must have vulcanized to it a standard air-brake hose label of red rubber as shown. The following information must be branded on the label: On the top of the badge the initials or name of road or

Label for Air Brake Hose

Standard—adopted, 1902; revised, 1920.

purchaser and date of manufacture; on the bottom the name of manufacturer and serial number. In the center a monogram as shown. The label should be applied around the hose within 6 inches of one end (a variation of ½ inch either way being permitted), as shown in Fig. 1880 on page 775. In mounting the air hose, the coupling should be applied to the end near which the label is located, so that the drawbar will not obscure the same when an inspector is on the right forward or left back side of the car.

Air-Brake Hose Gaskets

Standard—adopted, 1913; revised, 1919.

1. *Scope.*—These specifications cover all gaskets for use in air-brake and air-signal hose couplings.

I. Manufacture.

2. *Material.*—Gaskets shall be made of a rubber compound that will be tough and have enough elasticity to conform to the requirements for strength and elongation, and that the gasket can be readily applied in the couplings under all service conditions and form an air-tight seat.

II. Physical Properties and Tests.

3. *Deflection Test.*—(a) Gaskets shall be subjected to a deflection test by suspending a weight of 20 lb. on the

gasket. Under this load the increase in the inside diameter shall not exceed ⅞ in., the measurement to be taken on the inside of the gasket within 15 to 20 seconds after the application of the load, with the load applied. The support and the hook to which the weight is attached shall each have a diameter of ¼ in.

(b) When the deflection test has been completed the gaskets shall be allowed to relax, before subjecting them to the tension test, for a period of not less than 15 minutes.

4. *Tension Test.*—Gaskets shall be subjected to a tension test by inserting into the gasket two semi-circular blocks, each having a 180-deg. fillet of the same radius as the original inner radius of the gasket, and pulled at a

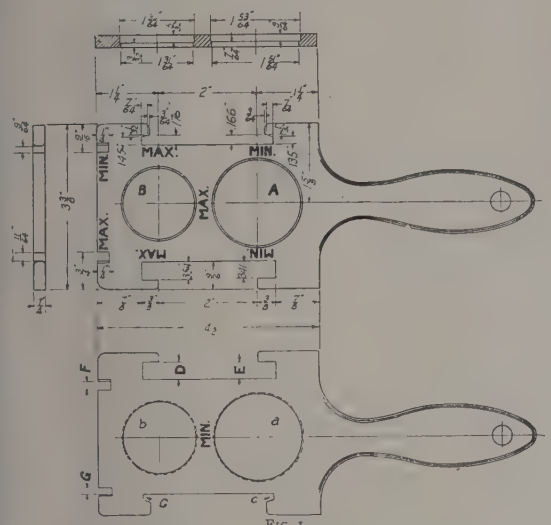


FIG. 1.

Openings "A" and "a" are for gaging max. and min. (external) diameter of packing ring flange.

Openings "B" and "b" are for gaging max. and min. (external) diameter of projecting wall or face portion of ring.

Slots "C" and "c" are for gaging max. and min. thickness of flange and bevel on surface of flange.

Slots "D" and "E" are for gaging max. and min. over all depth of ring at face.

Slots "F" and "G" are for gaging max. and min. thickness of projecting wall or face portion of ring.

Rings must enter all sections of gage marked "max." and must not enter any section of gage marked "min."

FIG. 1883—AIR BRAKE HOSE COUPLING PACKING RING GAGE.

speed of 20 in. per minute. Under this test the gasket shall show a minimum tensile strength of 90 lb. and a minimum elongation of 200 per cent.

5. *Test Specimens.*—Deflection and tension test specimens shall be the finished gasket, and tests shall be made with the temperature of the air not lower than 65 or higher than 90° F., and the specimens shall be kept at a temperature within these limits for at least one-half hour previous to the time of test.

6. *Number of Tests.*—(a) One deflection and one tension test shall be made on each of five gaskets selected, to represent each lot of 1,000 gaskets or fraction thereof.

(b) Not less than 80 per cent of the gaskets tested shall conform to the requirements of both the deflection and tension tests.

III. PERMISSIBLE VARIATIONS.

7. *Dimensions.*—All gaskets shall conform to the nominal dimensions as in Fig. 1883, and as adopted by the Association in 1911. All gaskets shall be uniform in size and section.

IV. WORKMANSHIP.

8. *Workmanship.*—The gaskets shall be free from fins and surface defects.

V. MARKING.

9. *Marking.*—All gaskets shall have the manufacturer's name or trade-mark, A. R. A. standard monogram and the date when made legibly marked on the inside edge, as shown in Fig. 1885.

VI. INSPECTION AND REJECTION.

10. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the material is being furnished in accordance with those specifications. All tests and inspection shall be made at the place of manufacture prior to shipment unless otherwise specified.

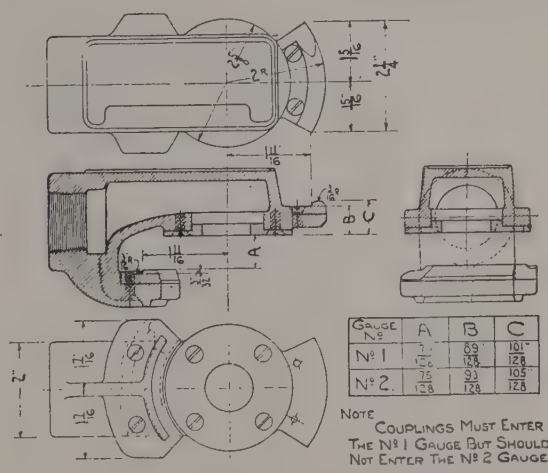


FIG. 1884—A. R. A. RECOMMENDED PRACTICE FOR GAGE FOR AIR BRAKE COUPLINGS.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

	A	B	C	D	E	F	G
Nominal	9/64"	11/64"	11/32"	1 13/16"	1 3/16"	1 1/2"	5/32"

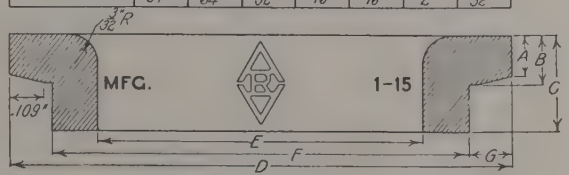


FIG. 1885—MARKING FOR AIR HOSE GASKET.

11. *Rejection.*—(a) Gaskets represented by samples

which fail to conform to the requirements of these specifications will be rejected.

(b) Gaskets which, subsequent to test and inspection at the factory or elsewhere and their acceptance, show defects or imperfections will be rejected and shall be replaced.

12. *Rehearing.*—Samples tested in accordance with these specifications, which represent rejected gaskets, shall be preserved for two weeks from the date of test report.

Steam and Air Connections for Passenger Cars

Standard

Train line pipe shall be 2 inches internal diameter. Adopted, 1912.

End valve shall have not less than 1½ in. opening. Adopted, 1912.

STEAM AND AIR CONNECTIONS FOR PASSENGER CARS.

Recommended Practice

The steam heat, air brake and air signal connection should be located as adopted in 1903 and as shown in Fig. 1886.

Air brake hose must be 1⅜ in. inside diameter and 22 in. long. Adopted, 1911.

Air signal hose must be 1 in. inside diameter and 22 in. long. Adopted, 1903; revised, 1911.

Angle cock should be 30 degrees from the vertical. Adopted, 1911.

Air signal elbow should be 30 degrees from the vertical. Adopted, 1916.

Specifications for steam and air connections were adopted in 1903.

Steam hose, 1⅝ in. inside diameter and of such length as to provide 31 in. from face of coupling gasket to end of hose nipple; 1½ in. steam hose couplings of dimensions to agree with those shown in chapter on "Passenger Train Heating." Gaskets to have 1½ in. diameter opening and constructed so that normal diameter of opening will be maintained; couplings not provided with gravity traps; inlet valves to have reduced openings which should be as small as possible and maintain the volume of steam required by the radiating pipes of the car heating system for the severest weather conditions.

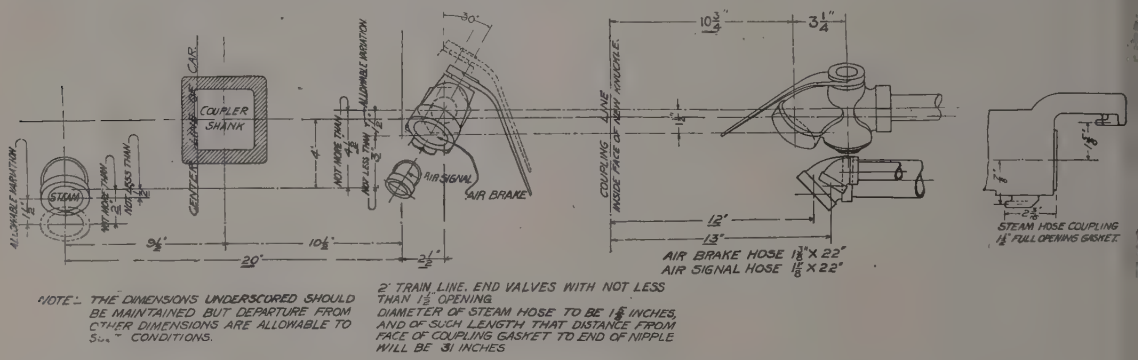

COUPLER SHANK
STEAM
AIR SIGNAL
AIR BRAKE
COUPLING LINE
INSIDE FACE OF ANY KNUCKLE
AIR BRAKE HOSE 1⅜" X 22"
AIR SIGNAL HOSE 1" X 22"
STEAM HOSE COUPLING
1½" FULL OPENING GASKET
NOTE:- THE DIMENSIONS UNDERSCORED SHOULD BE MAINTAINED BUT DEPARTURE FROM OTHER DIMENSIONS ARE ALLOWABLE TO SUIT CONDITIONS.
2" TRAIN LINE. END VALVES WITH NOT LESS THAN 1½" OPENING.
DIAMETER OF STEAM HOSE TO BE 1⅝ INCHES, AND OF SUCH LENGTH THAT DISTANCE FROM FACE OF COUPLING GASKET TO END OF NIPPLE WILL BE 31 INCHES

FIG. 1886—A. R. A. RECOMMENDED PRACTICE FOR STEAM AND AIR CONNECTIONS FOR PASSENGER CARS.

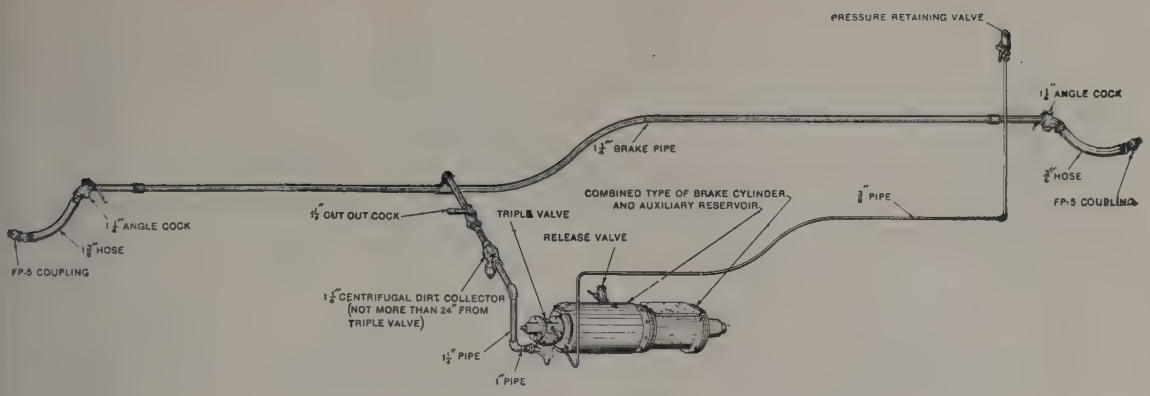


Fig. 1887—Westinghouse KC Single Capacity Brake Equipment for Freight Cars.

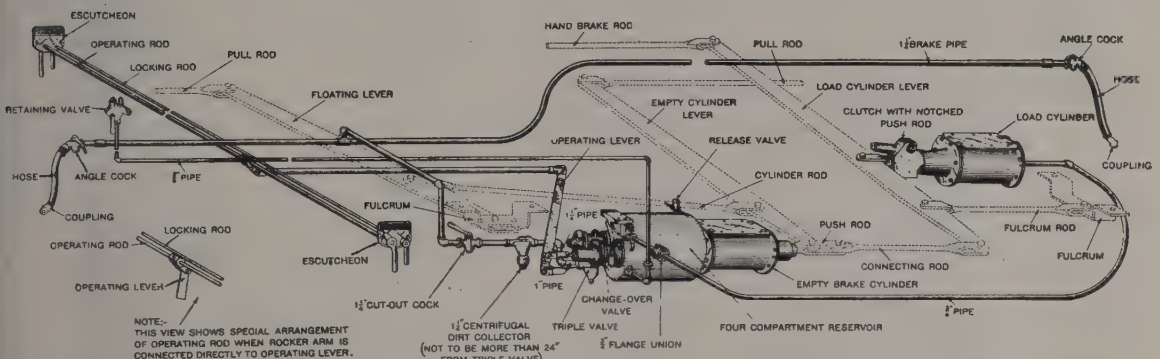


Fig. 1888—Westinghouse KCE (combined type) Double Capacity Brake Equipment for Freight Cars.

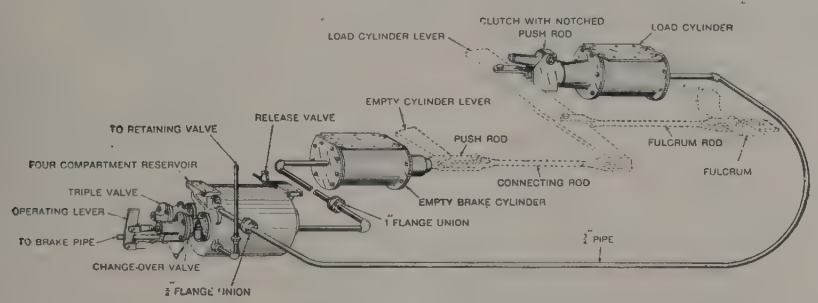


Fig. 1889—Westinghouse KDE (detached type) Double Capacity Brake Equipment for Freight Cars on which the combined type can not be conveniently installed.

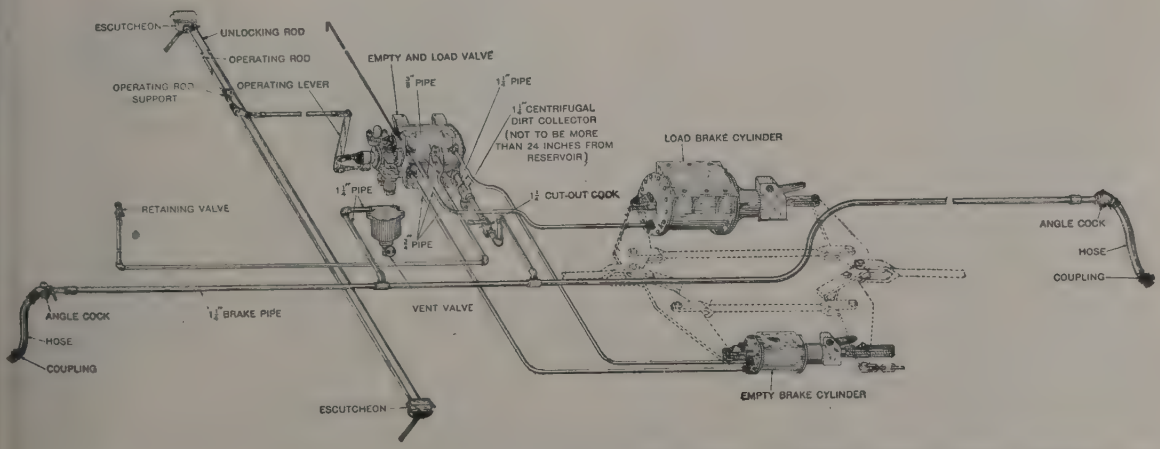
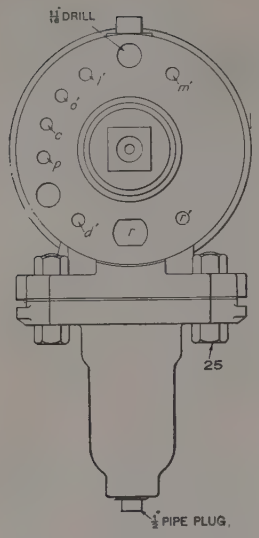


Fig. 1890—Westinghouse KDE-4-10-16 Double Capacity Brake Equipment for Heavy, High Capacity Freight Cars.



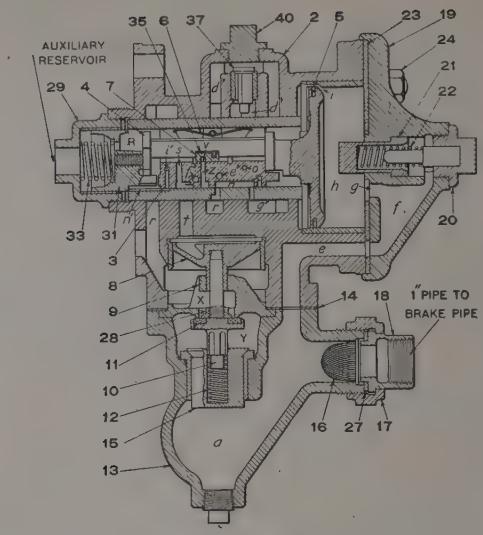


Fig. 1891—Westinghouse Type K-L Triple Valve as used with the KCE Double Capacity Freight Brake Equipment.

Names of Parts of Figs. 1891-1893

2 *Body, complete*
3 *Slide Valve*
4 *Main Piston*
5 *Main Piston Ring*
6 *Slide Valve Spring*
7 *Graduating Valve*
8 *Emergency Piston*
9 *Emergency Valve Seat*
10 *Emergency Valve*
11 *Rubber Seat*
12 *Check Valve Spring*
13 *Check Valve Case*
14 *Check Valve Case Gasket*
15 *Check Valve*
16 *Strainer*
17 *Union Nut*
18 *Union Swivel*
19 *Clyinder Cap*
20 *Graduating Stem Nut*
21 *Graduating Stem*
22 *Graduating Spring*
23 *Cylinder Cap Gasket*
24 *Bolt and Nut (for cylinder cap)*
25 *Bolt and Nut (for check valve case)*
27 *Union Gasket*
28 *Emergency Valve Nut*
29 *Retarding Device Body*
31 *Retarding Stem*
33 *Retarding Spring*
35 *Graduating Valve Spring*
37 *Take up Reservoir Check Valve (includes 38)*
40 *Take up Reservoir Check Valve Cap Nut*

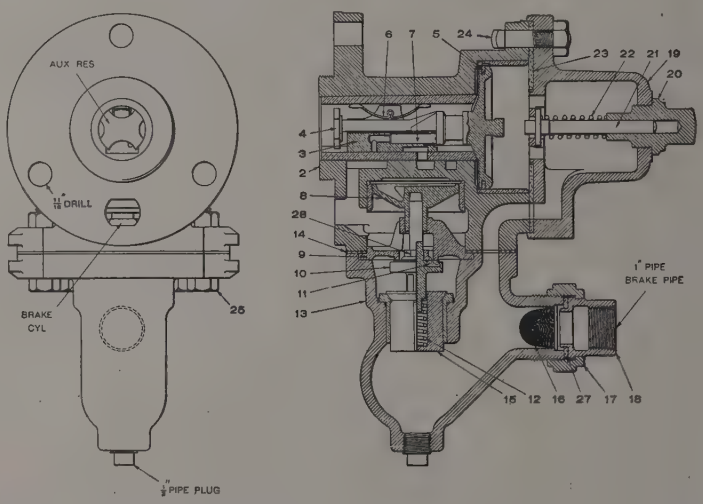


Fig. 1892—Westinghouse Type H Triple Valve as formerly used with Old Standard HC Single Capacity Brake Equipment.

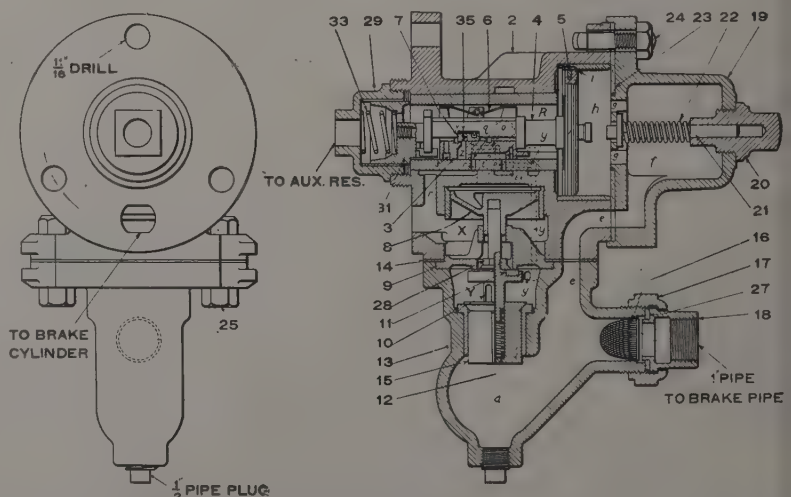


Fig. 1893—Westinghouse Type K Triple Valve as used with the KC Single Capacity Freight Brake Equipment.

Freight Car Brake Equipments

The Westinghouse KC and KD Equipments are now the recognized standards for general freight service, the K Triple Valve embodying important features not possessed by the H Type used on the old style quick action brake.

Quick service, by which a serial service action of train brakes is obtained similar to that in

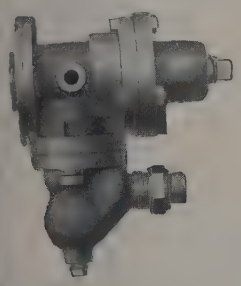


Fig. 1894—"H" Triple Valve

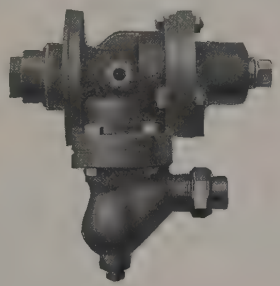


Fig. 1894A—"K" Triple Valve

emergency but less in degree, brings about a more certain, more nearly uniform application on the train as a whole.

Uniform release causes the head brakes of a train to release at a slower rate, though beginning earlier than the rear brakes, which will release at the normal rate—the ultimate result being practical uniformity of action over the train.

Uniform recharge retards the charging of auxiliary reservoirs on the head end of a train so as to produce a practically uniform recharge throughout the train, which makes possible a more nearly uniform reapplication shortly after a release.

All three of these features—quick service, uniform release and uniform recharge—make for smoother operation of long freight trains.

The K Triple Valve is shown in Fig. 1893 and a piping diagram in Fig. 1887.

The Double Capacity Brake Equipment—sometimes called the Empty and Load—has been designed so that a uniform retarding force may be obtained in solid trains of empty cars, solid trains of loaded cars, or in mixed trains.

Fig. 1895—Load Cylinder

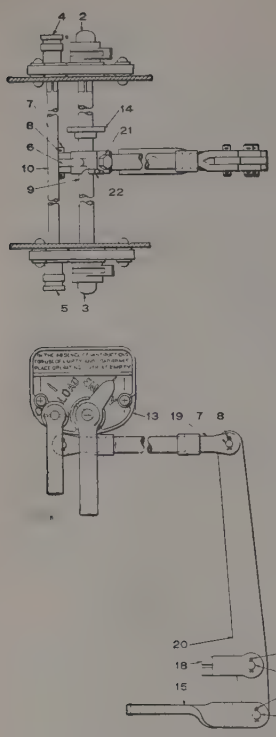
With the single capacity brake such as the HC or KC, the braking force is constant in magnitude but varies in its relation to the car weight; consequently it is much less effective on a loaded car than on an empty car. The usual practice (A.R.A. standard) has been to so design the brake layout as to provide the highest practicable percentage of braking force on the empty car, and then to accept whatever reduced braking ratio might be available for the loaded car. This means that in grade service the retarding force on a loaded train may not be adequate for safe control, and in level road service the retarding force may vary so much throughout a mixed train as to preclude the possibility of the desired smoothness of train operation. Furthermore in long trains of empties, smooth train operation is often impossible because of the inherent serial action of a purely pneumatic brake, and the high braking ratio, which manifestly cannot be lowered if any appreciable braking force is to be realized on a loaded car.

With the Double Capacity brake equipment the brake layout is usually designed to provide for an empty car 40 per cent braking ratio as against the usual 60 per cent thus permitting smoother brake operation on long trains of empty cars; for the loaded car, it is designed to provide 40 per cent as against the usual average of 15 per cent, although the percentage of braking force to be used and the relative proportion on loaded and empty cars varies according to service conditions.

Fig. 1896—Empty Brake Cylinder, Reservoir, Triple Valve, Change-over Valve, and Operating Mechanism

One form of this equipment, called the KCE or KDE and in use on a number of railroads, consists of the usual type of cylinder for the "Empty" Cylinder; an additional one, called the "Load" Cylinder; a Four Compartment Reservoir, consisting of the usual auxiliary reservoir and other compartments involved in loaded car brake operation; a Triple Valve, having the functions of the standard K type; a Change Over Valve, which functions similarly to a number of cut out cocks, to effect the proper volume and port arrangements for empty or loaded car operation as desired; an operating mechanism consisting of rods and levers with handles projecting to the sides of the car, by which the Change Over Valve is manually shifted to the desired position. This valve automatically returns to empty position when the pressure in the system leaks down to about 15 lbs., as would be the case when the car is being unloaded on a siding or at a terminal. This insures that the brake will be in the proper position for empty car operation.

When set for empty car operation, the equipment functions the same as the standard single capacity brake, the empty cylinder only coming



Names of Parts of Figs. 1897-1898.

2 *Operating Rod Handle*
3 *Operating Rod Handle*
4 *Locking Rod Handle*
5 *Locking Rod Handle*
5 *Pawl*
6 *Rocker Arm*
7 *Rocker Arm Pin*
8 *Rocker Arm Pin Cotter*
9 *Operating Rod*
10 *Locking Rod*
10 *Unlocking Rod*
13 *Escutcheon*
14 *Support for Operating Rod*
15 *Operating Lever Rod*
16 *Cottered Pin*
17 *Cotter*
18 *Crosshead*
19 *Connecting Rod Jaw*
20 *Operating Lever*
21 *Set Screw*
22 *Rocker Arm Key*
23 *Escutcheon*
24 *Cam*
25 *Fulcrum*
26 *Cotter*

Fig. 1897—Westinghouse Operating Mechanism as Used with KCE Equipment.

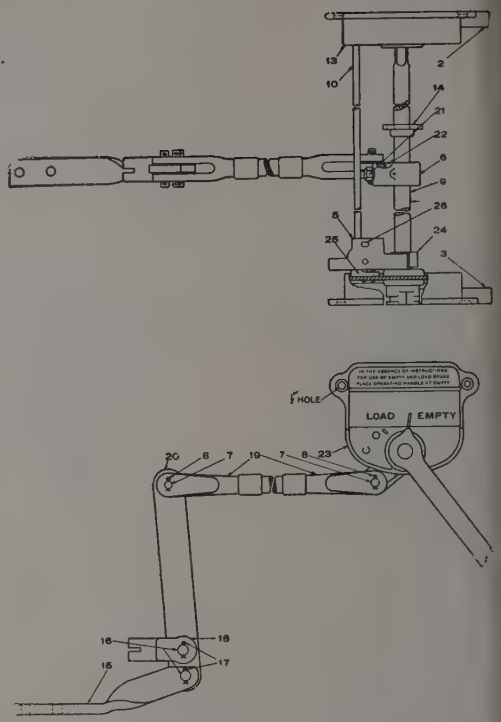


Fig. 1898—Westinghouse Operating Mechanism as Used with KDE-4-10-16 Equipment.

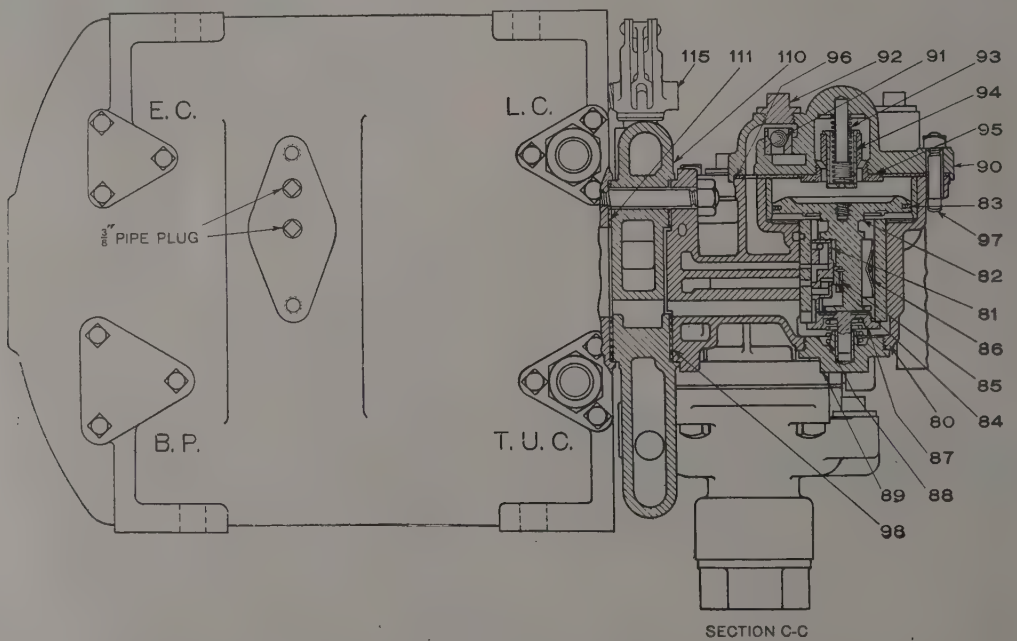


Fig. 1899—Westinghouse Triple Valve, Change-Over Valve and Reservoir as used with KDE 4-10-16 Equipment. Section through Triple Valve

Names of Parts of Figs. 1899-1903.

2 *Reservoir Body*
3 ¾" *Flanged Union Coupling*
4 ¾" *Flanged Union Ring*
5 ¾" *Flanged Union Nut*
6 1¼" *Flanged Union Coupling*
7 1¼" *Flanged Union Ring*
8 1¼" *Flanged Union Nut*
9 *Square Head Cap Screw*
10 ¾" *Blanking Pad*
11 1¼" *Blanking Pad*
12 *Triple Valve Stud and Nut*
13 *Change-Over Valve Stud and Nut*
15 ¾" *Flanged Union Gasket*
16 1¼" *Flanged Union Gasket*
17 ½" *Slotted Plug*
22 *Change-Over Valve Body*
23 *Stud and Nut*
24 *Main Piston Bush*
25 *Main Piston*
26 *Piston Ring*

(Continued on Page 786)

Freight Car Brake Equipments (*Cont'd*)

into play. When set for loaded car operation, the empty cylinder first operates to take up all slack in the rigging and brings the shoes firmly against the wheels, after which the load cylinder cuts in, its travel being reduced to a minimum by means of a clutch arrangement. This feature, combined with leverage between the two cylinders, insures that the brake force may be augmented for the loaded car without materially increasing the air consumption or interfering with proper shoe clearance.

Another form of this equipment has been developed for very high capacity cars whose loaded weight is many times that of the empty weight.

Fig. 1900—Combined Take-up and Empty Cylinder

This equipment includes three cylinders—the Take-up cylinder, the Empty cylinder and the Load cylinder—numerals indicating sizes.

When the equipment is set for empty car operation the Take-up and Empty Cylinders, which are built into one structure with a small piston operating within a larger one, operate as one cylinder in a manner similar to the standard single capacity brake. When the equipment is set for loaded car operation, the Take-up Cylinder piston first takes up the slack in the rigging and brings the shoes firmly against the wheels, the Empty Cylinder and the Load Cylinder pistons moving out in sequence to supply the additional force required. By this means the air consumption is more economical than by any other form of equipment for a corresponding degree of train control, and still within the capacity of the standard brake pipe.

Fig. 1901—Brake Pipe Vent Valve

In addition to the brake cylinders mentioned the equipment comprises a Two Compartment Reservoir; a Change Over Valve; a "plain" Triple Valve; a separate quick action device; and the Brake Pipe Vent Valve, as well as the usual fittings common to all freight brake equipments.

The salient advantages accruing from the use of the Double Capacity Brake Equipment may be briefly summarized in the following manner.

Hauling of very long trains of empty cars is made more practicable because of reduced braking ratio—40 per cent instead of 60 per cent—which minimizes the effect of serial action and consequently tends to eliminate rough handling.

A reduction in damage to equipment and lading due to shocks, breaks-in-two, etc., in mixed trains on the level roads, is made possible even though only a part of the cars are equipped with empty and load brakes.

The margin of safety is greatly increased on grades because of (a) the greater retarding force developed, and (b) the reduced air consumption for a given retarding force, with a consequent shorter time required to replenish the brake system, as well as reduced compressor operation and greater increased safety reserve.

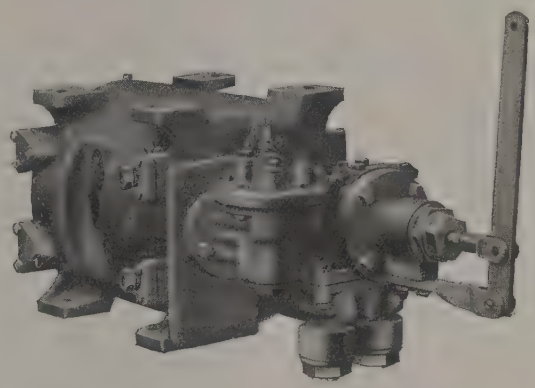


Fig. 1902—Reservoir, Triple Valve and Change-over Valve

The movement of heavy trains over grades impracticable with the single capacity brake, is made possible.

Cars of higher capacity and longer trains can be used; this contributes to operating economy.

Utilization of the power of heavy locomotives is permitted to the fullest extent.

Broadly speaking then, the use of the Double Capacity Brake Equipment will enhance the earning power of a road by expediting train movement and reducing transportation cost, as it permits handling the same tonnage with greater economy, speed, and margin of safety, or increasing the movement of tonnage which can be handled with the required safety and economy.

The Westinghouse HC and HD Equipments are the old style quick action brakes now obsolete as equipment for new cars, but still in use on cars which are not in general interchange service and where trains are short. The H Type of Triple Valve used with these equipments is shown in Fig. 1892.

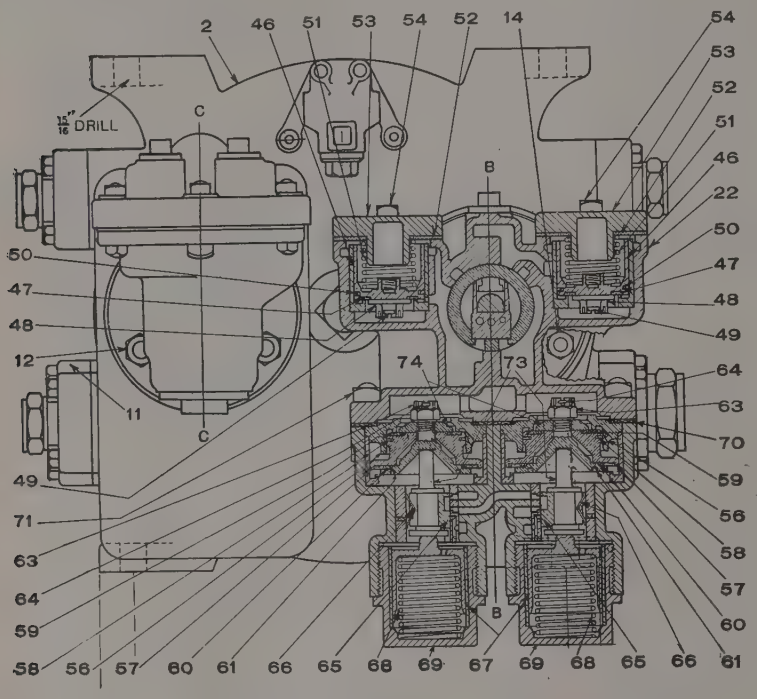
To obtain the best results in air brake operation it is essential that the unit devices comprising the complete equipment, especially the triple valves, be maintained in the highest practicable state of efficiency. The 3-T Test Rack, illustrated in Fig. 1905, is employed not only to determine, promptly and accurately, whether the triple valves are up to the standard of workmanship and general condition before being returned to service, but also to check the important functions performed by them.

For other products and branch offices, see classified and alphabetical indexes.

WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PA.

Names of Parts of Figs. 1899-1903 (Continued).

27 *Slide Valve*
28 *Slide Valve Spring*
29 *Cylinder Cover*
30 *Stud and Nut for Fulcrum*
31 *Cylinder Cover Gasket*
32 *Square Head Cap Screw*
33 *Piston Sleeve*
34 *Piston and Pull Rod Spring*
35 *Gage Nut*
36 *Pull Rod Valve Stem*
37 *Valve Seal*
38 *Valve Head*
39 *Valve Stem Nut*
40 *Cotter*
41 *Pull Rod*
42 *Cotter*
43 *Pull Rod Guide*
44 *Ball Check Valve*
45 *Check Valve Cap Nut*
46 *Vent Valve*
47 *Vent Valve Seat*
48 *Vent Valve Nut*
49 *Cotter*
50 *Piston Ring*
51 *Vent Valve Spring*
52 *Vent Valve Gasket*
53 *Vent Valve Cover*
54 *Square Head Cap Screw*
55 *Transfer Valve Case*
56 *Transfer Piston Bush*
57 *Transfer Piston*
58 *Piston Ring*
59 *Small Piston Seal*
60 *Large Piston Seal*
61 *Piston Spider*
63 *Castle Nut*
64 *Cotter*
65 *Slide Valve*
66 *Slide Valve Spring*
67 *Graduating Sleeve*
68 *Transfer Valve Spring*
69 *Graduating Sleeve Nut*
70 *Transfer Valve Case-Gasket*
71 *Tee Head Bolt and Nut*
72 *Gasket*
73 *Transfer Piston Stem*
74 *Piston Follower*
80 *Triple Valve Body*
81 *Slide Valve*
82 *Piston*
83 *Piston Ring*
84 *Graduating Valve*
85 *Graduating Valve Spring*
86 *Slide Valve Spring*
87 *Retarding Device Stop*
88 *Retarding Device Spring*
89 *Cap Nut*
90 *Cylinder Cap*
91 *Ball Check Valve*
92 *Check Valve Cap Nut*
93 *Piston Spring*
94 *Graduating Sleeve*
95 *Graduating Sleeve Nut*
96 *Cylinder Cap Gasket*
97 *Tee Head Bolt and Nut*
98 *Triple Valve Gasket*
110 *Quick Service Reservoir Body*
111 *Gasket*
115 *Release Valve*



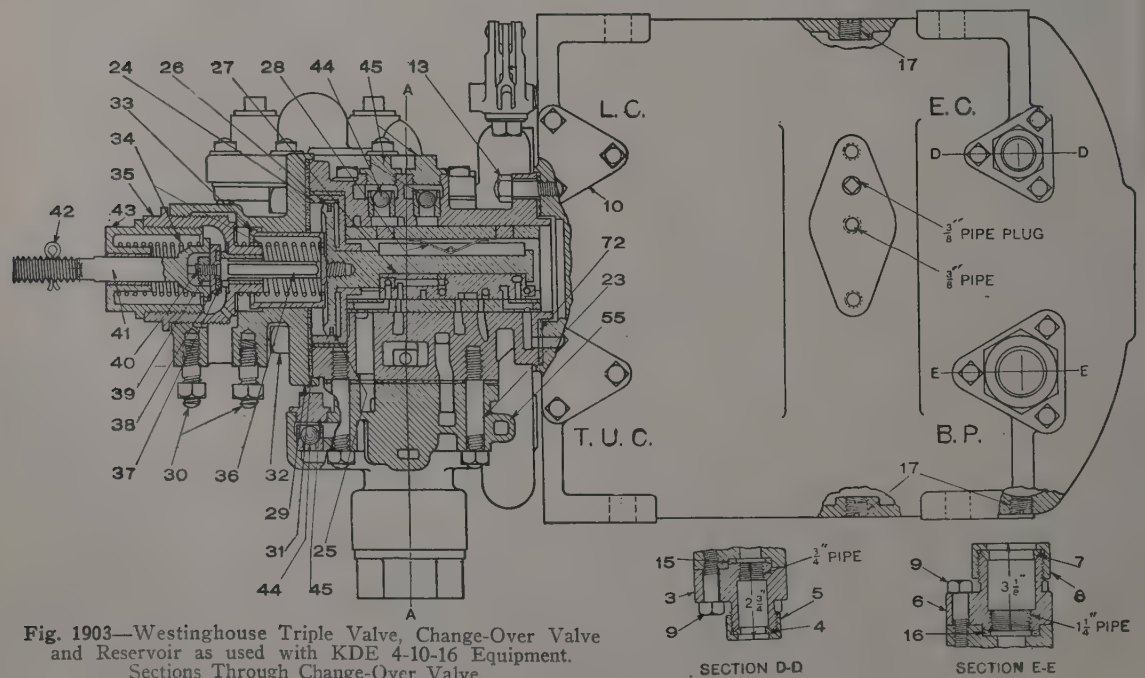


Fig. 1903—Westinghouse Triple Valve, Change-Over Valve and Reservoir as used with KDE 4-10-16 Equipment. Sections Through Change-Over Valve.

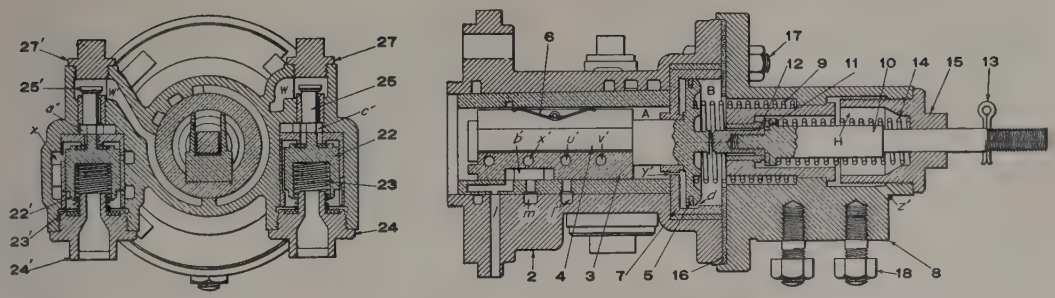


Fig. 1904—Westinghouse H-3 Change-Over Valve as used with KCE Double Capacity Brake Equipment.

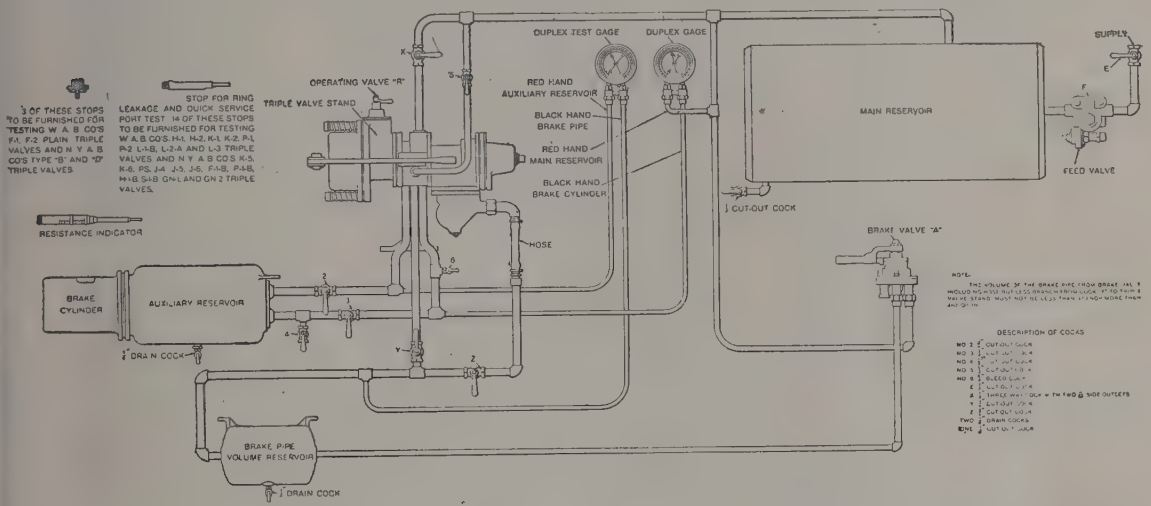


Fig. 1905—Westinghouse 3-T Test Rack. Diagrammatic Piping.

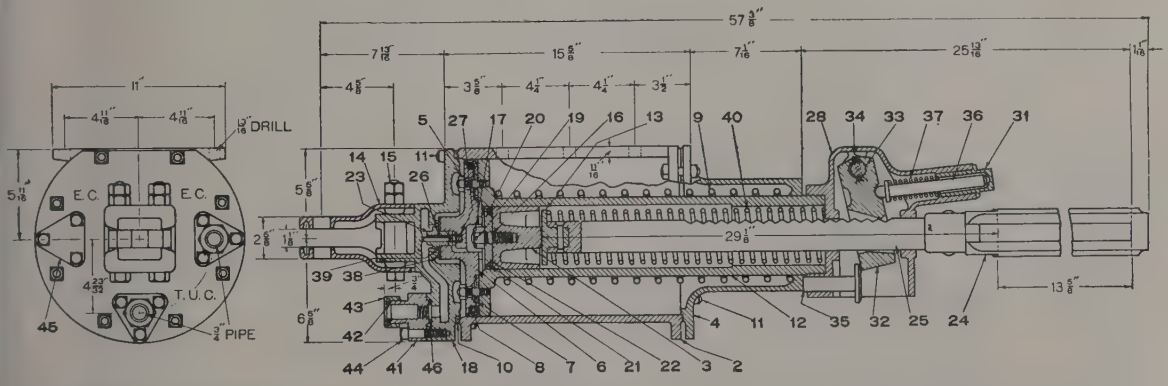


Fig. 1906—Westinghouse 4" and 10" x 12" Duplex Brake Cylinder as used with KDE 4-10-16 Double Capacity Brake Equipment.

Names of Parts of Fig. 1906

2 *Cylinder Body*
3 *Internal Piston*
4 *Non-Pressure Head*
5 *Stud with Hexagon Nut*
6 *External Piston Follower*
7 *Large Packing Leather*
8 *Large Packing Expander*
9 *Large Piston Spring*
10 *Cylinder Gasket*
11 *Tee Head Bolt with Nut*
12 *External Piston Head*
13 *Push Rod Spring Seat*
14 *Lever Bracket*
15 *Bolt with Nuts*
16 *Internal Piston Cottered Stud*
17 *Castle Nut*
18 *Pressure Head*
19 *Cotter*
20 *Small Piston Follower*
21 *Small Packing Expander*
22 *Small Piston Packing*
23 *Valve Seat*
24 *Slotted Crosshead*
25 *Push Rod*
26 *Valve*
27 *Valve Spring*
28 *Latch Box*
31 *Latch Box Cap Nut*
32 *Latch*
33 *Latch Pin*
34 *Cotter*
35 *Release Pin*
36 *Spring Guide*
37 *Latch Spring*
38 *Valve Seat*
39 *Washer*
40 *Push Rod Spring*
41 *Flanged Union Coupling*
42 *Flanged Union Ring*
43 *Flanged Union Nut*
44 *Square Head Cap Screw*
45 *Blanking Pad*
46 *Flanged Union Gasket*

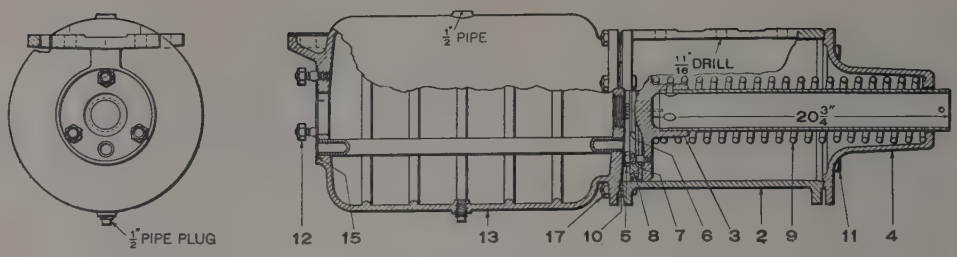


Fig. 1907—Westinghouse Type C Brake Cylinder and Reservoir as used with KC Single Capacity brake equipment.

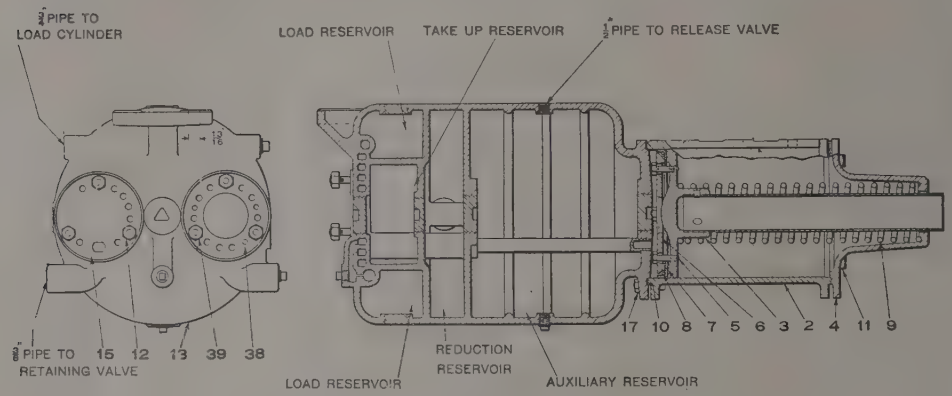

3/4 PIPE TO LOAD CYLINDER
LOAD RESERVOIR
TAKE UP RESERVOIR
1/2 PIPE TO RELEASE VALVE
3/4 PIPE TO RETAINING VALVE
15 12 13 39 38
17 10 8 7 5 6 3 2 4 11 9
REDUCTION RESERVOIR
LOAD RESERVOIR
AUXILIARY RESERVOIR

Fig. 1908—Westinghouse Type C "Empty" Brake Cylinder and Reservoir as used with KCE Double Capacity brake equipment.

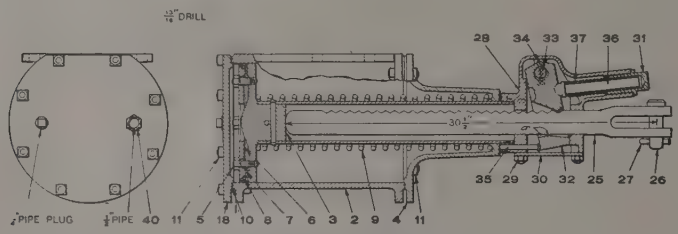


Fig. 1909—Westinghouse "Load" Brake Cylinder as used with KCE Double Capacity brake equipment.

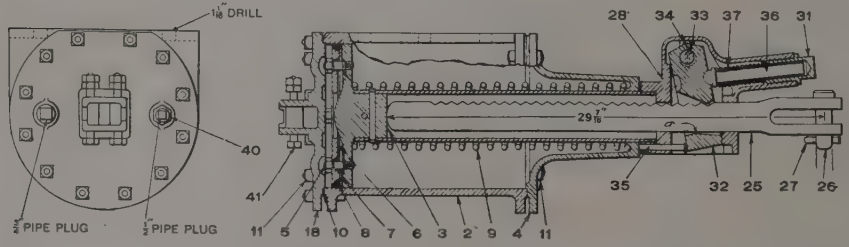


Fig. 1910—Westinghouse "Load" Brake Cylinder as used with KDE 4-10-16 Double Capacity brake equipment.

Names of Parts of Figs. 1907-1910.

2 *Cylinder Body*
3 *Piston and Rod*
4 *Non-Pressure Head*
5 *Follower Stud and Nut*
6 *Follower*
7 *Packing Leather*
8 *Packing Expander*
9 *Release Spring*
10 *Cylinder Gasket*
11 *Cylinder Head Bolt and Nut*
12 *Triple Valve Stud and Nut*
13 *Reservoir*
15 *Triple Valve Gasket*
17 *Reservoir Cylinder Bolt and Nut*
18 *Pressure Head*
25 *Push Rod*
26 *Push Rod Pin*
27 *Push Rod Pin Cotter*
28 *Latch Box*
29 *Stud and Nut*
30 *Latch Box Cover*
31 *Latch Box Cap Nut*
32 *Latch*
33 *Latch Pin*
34 *Latch Pin Cotter*
35 *Release Pin*
36 *Spring Guide*
37 *Latch Spring*
38 *Change-Over Valve Gasket*
39 *Stud and Nut*
40 *Reducing Bush.*

Passenger Car Brake Equipments

The Westinghouse PM Equipment is the old style quick action brake, now obsolete for new cars, but still maintained as a standard on some roads. It includes the "P" triple valve, and in many cases the High Speed Reducing Valve, which when 110 lbs. brake pipe pressure is used, limits the service brake cylinder pressure to 60 lbs., and permits a high initial but gradually reducing emergency pressure down to 60 lbs. This constitutes the High Speed Brake. The Triple Valve and High Speed Reducing Valve are shown in Figs. 1916 and 1923, respectively. A piping diagram of the equipment, as in Fig. 1911.

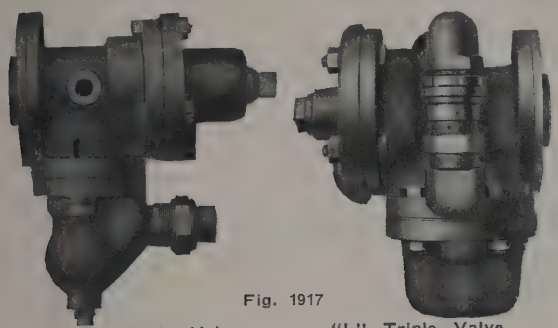


Fig. 1917

"P" Triple Valve "L" Triple Valve

The LN Equipment embodies additional features, such as: quick service, by which a serial service action of the train brakes is obtained similar to that in emergency but less in degree; quick recharge, by which the system is promptly recharged after an application; the graduated release, by which the brakes may be released in a series of steps, thus permitting a high initial pressure which may be reduced gradually as the train slows down. This makes possible a shorter and smoother stop and permits the train to start more promptly due to the short time required to make the final release; high emergency brake cylinder pressure, to provide maximum stopping force when necessary, which pressure is maintained at its maximum throughout the stop—unlike the High Speed Brake. These three features of Quick Recharge, Graduated Release and High Pressure, are made possible by the use of a Supplementary Reservoir in addition to the usual Auxiliary Reservoir. The "L" Triple Valve is shown in Fig. 1915, while a piping diagram of the equipment is shown in Fig. 1912.

The PC Equipment was developed for the long and heavy high-speed passenger trains now common on main trunk line railroads. The operation of such trains has introduced new factors into the braking problem because of the greater energy to be controlled in stopping the train, and the greater volume of air to be handled due to the larger brake cylinders and reservoirs required.

A piping diagram of the equipment is shown In Fig. 1913, the No. 3 E Control Valve, which displaces the triple valve, is shown in Fig. 1919.

The Control Valve operates on the well known principle of the distributing valve, there being an equalizing portion and an application portion, which insures uniformity and maintenance of brake cylinder pressure irrespective of brake cylinder piston travel and leakage.

The service and emergency functions are controlled by independent valve portions which insures that (1) the necessary flexibility and responsiveness in the service action of the valve will be obtained without making the emergency parts any more likely to operate when not desired, or, in other words, undesired quick action cannot originate from any action of the service parts of the device, while the possibility of this due to other causes is negligible; and (2) full emergency braking force can be obtained at any time irrespective of service applications previously made, since the quick action and emergency portions can always be actuated by an emergency rate of reduction no matter how created.

Certainty and uniformity of service action are among other improved features and are secured by causing the equalizing piston to close the feed groove on the slightest brake pipe reduction.

Service stability and release sensitiveness: The first prevents the brake from creeping on due to inevitable fluctuation of brake pipe pressure, and the engineman from making such light reduction as to render a release difficult, and the second insures that the valve will be responsive to an increase in brake pipe pressure and makes a release more certain.

Quick recharge without graduated release can be obtained if desired.

Quick rise in brake cylinder pressure is possible because of prompt movement of the valve parts and large direct passages from the reservoirs to the brake cylinders.

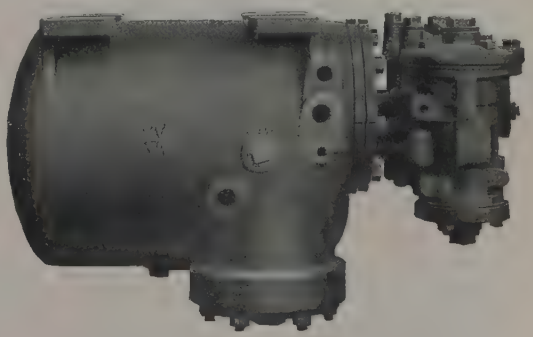
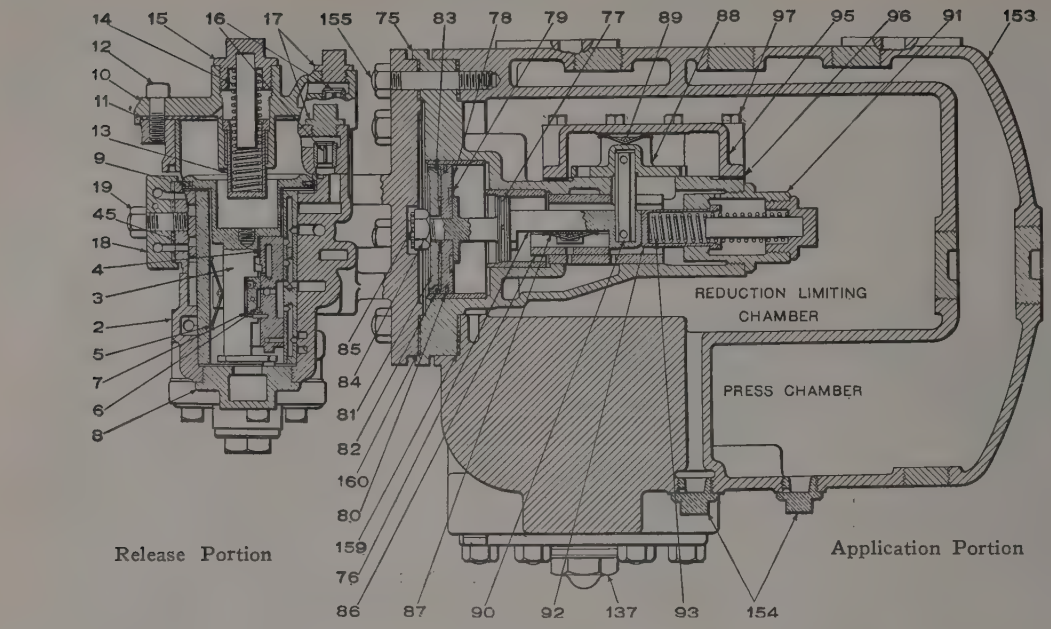
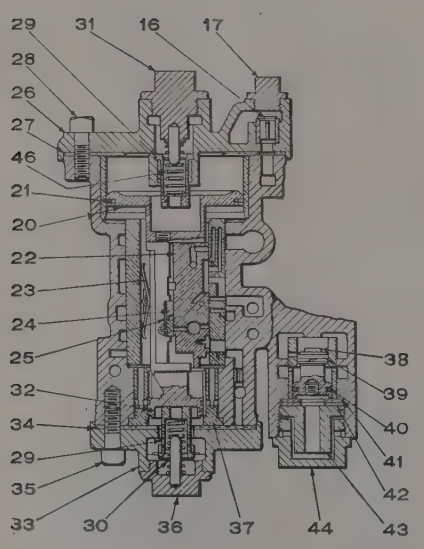


Fig. 1918—No. 3 E Control Valve

A protection feature insures that the pressure in the system cannot be reduced through leakage, careless manipulation, or other causes to such a value that the effectiveness of the brake will be seriously impaired. Emergency action is caused, not only by the predetermined rate of reduction, but also when a certain minimum pressure is reached from any cause.

For other products and branch offices, see classified and alphabetical indexes.





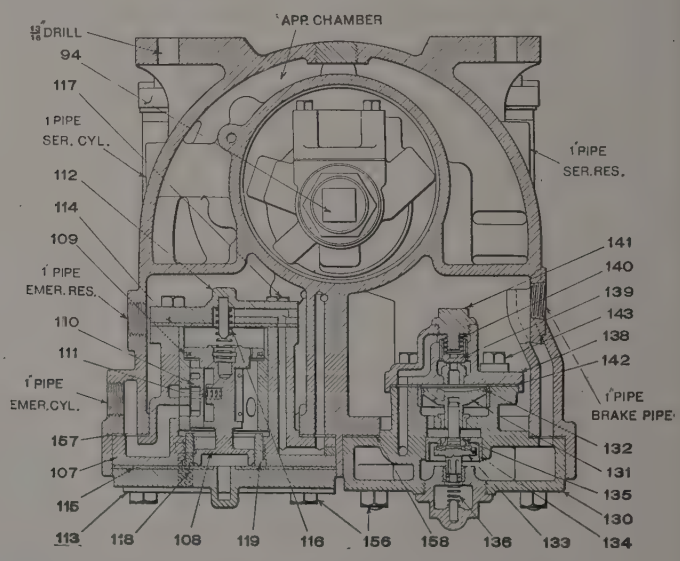


Fig. 1919—Westinghouse 3-E Control Valve as used with the PC Passenger Car Brake Equipment.

Names of Parts of Fig. 1919.

2 *Equalizing Body*
3 *Release Piston*
4 *Release Slide Valve*
5 *Release Slide Valve Spring*
6 *Release Graduating Valve*
7 *Release Graduating Valve Spring*
8 *Release Piston Cap Nut for Equalizing Piston*
9 *Release Piston Ring*
10 *Release Cylinder Cap*
11 *Release Cylinder Cap Gasket*
12 *½" x 1½" Square Head Cap Screw*
13 *Release Piston Graduating Sleeve*
14 *Release Piston Graduating Spring*
15 *Release Piston Graduating Nut*
16 *Check Valve*
17 *Check Valve Cap Nut*
18 *Release Regulating Cap*
19 *Stud and Nut for Release Regulating Cap*
20 *Equalizing Piston*
21 *Equalizing Piston Ring (large)*
22 *Equalizing Slide Valve*
23 *Equalizing Slide Valve Spring*
24 *Equalizing Graduating Valve*
25 *Equalizing Graduating Valve Spring*
26 *Large Equalizing Cylinder Cap*
27 *Large Equalizing Cylinder Cap Gasket*
28 *½" x 1½" Square Head Cap Screw*
29 *Equalizing Piston Stop Sleeve*
30 *Lower Equalizing Piston Stop Spring*
31 *Equalizing Graduating Nut*
32 *Equalizing Piston Ring (small)*
33 *Small Equalizing Cylinder Cap*
34 *Gasket for Small Equalizing Cylinder Cap*
35 *½" x 1½" Square Head Cap Screw*
36 *Cap Nut for Small Equalizing Cylinder Cap*
37 *Small Equalizing Piston Bush*
38 *Service Reservoir Charging Valve*
39 *1" Charging Valve Piston Ring*
40 *1¼" Charging Valve Piston Ring*
41 *Charging Valve Seat*
42 *Charging Valve Washer*
43 *Internal Charging Valve Nut*
44 *External Charging Valve Nut*
45 *Gasket for Release Regulating Cap*
46 *Upper Equalizing Piston Stop Spring*
75 *Application Body (bushed)*

(Continued on page 794)

Passenger Car Brake Equipments (*Cont'd.*)

Two brake cylinders are used, one for service and both for emergency applications, the same pressure, 86 lbs. from 110 lbs. reservoir pressure being obtained in both cases. Because of this higher pressure developed, a lower total leverage can be used in obtaining a given braking ratio. There are two reservoirs, Service and Emergency. The former is used in service applications and both for emergency applications. The emergency reservoir is also used for graduated release and quick recharge.

The UC Equipment is the latest development in brake equipment and is now considered standard for passenger service. The symbol, "UC," stands for universal control, the equipment being so named because it is designed to be universally applicable to all classes and conditions of passenger train service, as well as to cars of different weights, requiring different sizes of brake cylinders. A Universal Valve is used, with three reservoirs, Auxiliary, Service, and Emergency, and one brake cylinder for both service and emergency applications—except in case of very heavy cars which require the use of two cylinders.

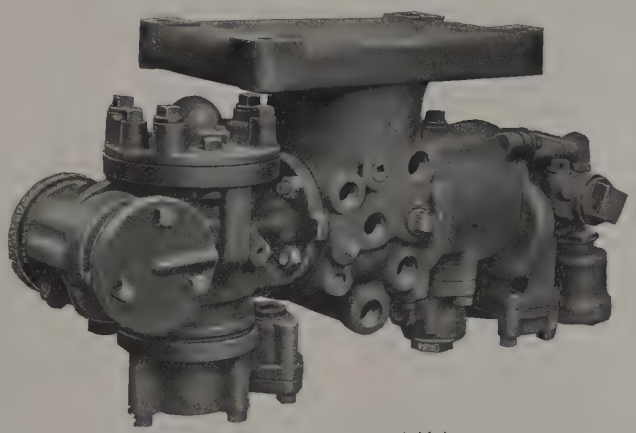


Fig. 1920—U-12 Universal Valve

The U-12 Universal Valve is shown in detail in Fig. 1921. Its distinguishing structural feature is the unit system of construction which permits any combination of operating parts which may be necessary to produce the desired results, and also facilitates removal of parts for cleaning and repairs. The valve has three main parts: the Equalizing or Service Portion; the Emergency Portion; and the Pipe Bracket. The bracket is permanently fastened to the car body and supports the two operative portions. In addition, all pipe connections are made to it. The operative portions are interchangeable, no change being required in them for use with various sizes of brake cylinders. The required variation is taken care of in the Pipe Bracket by the use of choke plugs in the application and release passages.

Many of the functions of the Universal Valve are similar to those of the Control Valve.

Maximum service stability and release sensitiveness are accomplished by providing a "resistance-increasing cavity" in the face of the equalizing slide valve. Just preceding application and after the feed groove is closed, this cavity is connected to atmospheric pressure; and just preceding release, to auxiliary pressure This means that the valve will go to release position on a lower pressure differential than is required to apply it. Thus the brake has the desired sensitiveness to release and at the same time is stable against undesired light application.

Improved quick recharge and graduated release features are accomplished in the valve design and by separating the auxiliary reservoir volume into two units, a small Auxiliary Reservoir and a Service Reservoir. When the graduated release is cut in—by means of an adjustable cap for the purpose—the Auxiliary Reservoir is recharged from the Emergency Reservoir to within a few pounds of the normal brake pipe pressure, during which time practically no air is being drawn from the brake pipe. When graduated release is cut out the Auxiliary Reservoir only is recharged from the Brake Pipe, while the Service Reservoir is recharged from the Emergency Reservoir. This means that (1) Graduated Release is positive and flexible, because the Emergency Reservoir, in effecting the graduations, has to increase the pressure in the small Auxiliary Reservoir only; (2) Quick Recharge is available at all times—even if the graduated release is cut out—and made more effective in providing for prompt and repeated re-applications; (3) Brake Pipe air is conserved, since the amount required to effect a release of the brakes is reduced to a minimum; (4) Rapid increase of brake pipe pressure is effected, insuring a more certain release of all brakes throughout the train.

Maximum practicable difference between service and emergency braking force is accomplished by limiting the brake cylinder pressure during service applications by means of a safety valve, and permitting the pressure in emergency applications to build up to the maximum attainable from the high pressure available in the system by a "two stage equalization" of the service and emergency reservoirs with the brake cylinder.

An Electric Portion may be added to this valve when conditions require. This converts the U-12 Universal valve into the UE-12, the equipment designation being "UCE." The operation then becomes "electro-pneumatic," in which the brakes apply instantly and simultaneously throughout the train. This results in a more responsive, flexible, and effective brake, making possible a somewhat shorter and a much smoother stop. A piping diagram of the UC Passenger Car Brake Equipment is shown in Fig. 1914 on page 790.

The 3-T Test Rack—Fig. 1905—and the 3-U Test Rack are designed especially for these equipments.

Names of Parts of Fig. 1919 (Continued).

76 *Piston Stem*
77 *Piston Ring (small)*
78 *Piston Head*
79 *Piston Seal*
80 *Piston Ring (large)*
81 *Piston Follower*
82 *Piston Packing Leather*
83 *Piston Packing Leather Expander*
84 *Piston Nut*
85 *3/32" x 1¼" Piston Cotter*
86 *Exhaust Valve*
87 *Exhaust Valve Spring*
88 *Application Valve*
89 *Application Valve Spring*
90 *Application Piston Bolt*
91 *Spring Box*
92 *Piston Spring Sleeve*
93 *Piston Spring*
94 *Graduating Nut*
95 *Application Valve Cover*
96 *Application Valve Cover Gasket*
97 *⅜" x 2½" Square Head Cap Screw for Application Valve Cover*
107 *Emergency Body*
108 *Piston*
109 *Piston Ring*
110 *Slide Valve*
111 *Slide Valve Spring*
112 *Small Cylinder Cap*
113 *Large Cylinder Cap Screw*
114 *Small Cylinder Cap Gasket*
115 *Large Cylinder Cap Gasket*
116 *Piston Spring*
117 *½" x 1½" Square Head Cap*
118 *Oval Fillister Head Cap Screw*
119 *Emergency Piston Bush*
130 *Quick Action Body*
131 *Piston*
132 *Piston Ring*
133 *Quick Action Valve*
134 *Quick Action Valve Seat*
135 *Quick Action Valve Nut*
136 *Quick Action Valve Spring*
137 *Quick Action Valve Cap Nut*
138 *Quick Action Valve Cover*
139 *Quick Action Closing Valve*
140 *Quick Action Closing Valve Spring*
141 *Cover Cap Nut*
142 *Cover Gasket*
143 *½" x 1½" Square Head Cap Screw for Cover*
153 *Reservoir*
154 *1¼" Cap Nut*
155 *Stud with Hexagon Nut 3¾" long*
156 *Stud with Hexagon Nut 3½" long*
157 *Emergency Cylinder Gasket*
158 *Quick Action Cylinder Gasket*
159 *Large Reservoir Gasket*
160 *Equalizing Cylinder Gasket*
161 *Exhaust Plug*

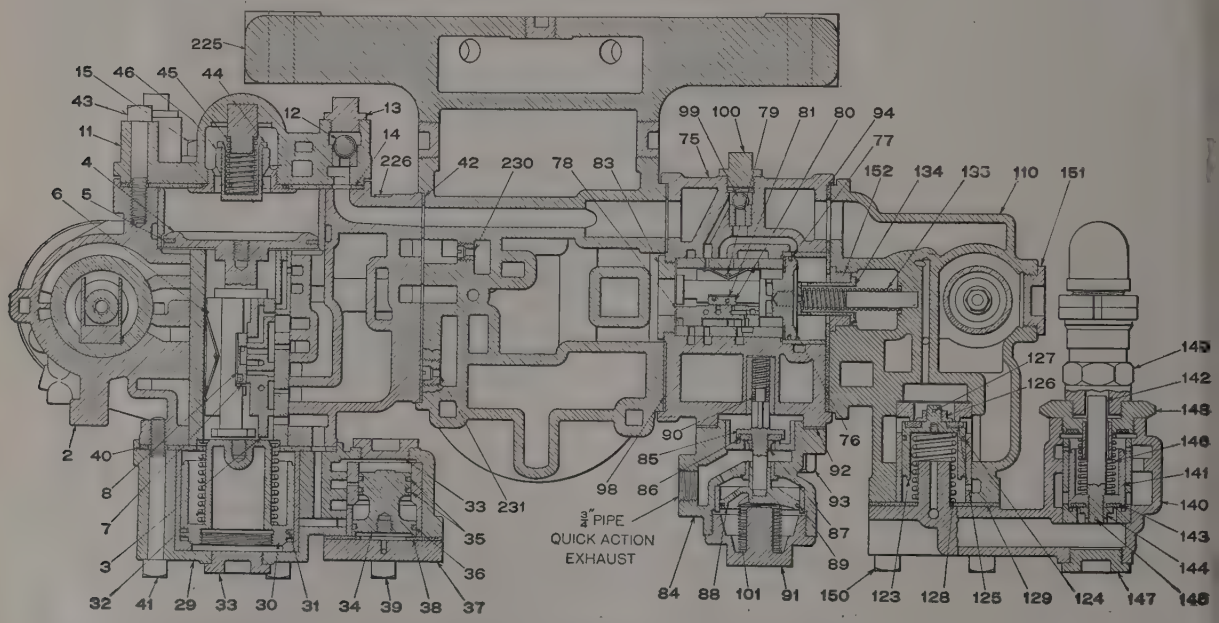


Fig. 1921—Westinghouse U-12 Universal Valve. Section Through Equalizing Piston, Charging Valve, Pipe Bracket, Emergency Piston, Quick Action Valve, High Pressure Valve, and Cut Off Valve. Used with UC Passenger Car Brake Equipment.

Names of Parts of Figs. 1921-1922.

Equalizing Portion

2 *Equalizing Body*
3 *Equalizing Slide Valve*
4 *Equalizing Piston*
5 *Equalizing Piston Ring*
6 *Equalizing Slide Valve Spring*
7 *Equalizing Graduating Valve*
8 *Graduating Valve Spring*
11 *Equalizing Cylinder Cap*
12 *⅝" Ball Check*
13 *Check Valve Cap Nut*
14 *Cylinder Cap Gasket*
15 *½" x 1⅝" Sq. Head Cap Screw*
16 *Release Piston*
17 *Release Piston Ring, 2¾" Dia.*
18 *Release Piston Ring, 2⅛" Dia.*
19 *Release Slide Valve*
20 *Release Slide Valve Spring*
21 *Release Piston Spring*
22 *Application Piston Cover*
23 *Application Piston Cover Gasket*
½" x 2" Sq. Head Cap Screw
25 *Release Piston Cover, complete*
26 *Release Piston Cover Gasket*
27 *½" x 1½" Sq. Head Cap Screw*
28 *Release Piston Bush*
29 *Charging Valve Body*
30 *Graduated Release Piston*
31 *Graduated Release Piston Ring*
32 *Graduated Release Piston Spring*
33 *Flush Nut*
34 *Charging Valve*
35 *Charging Valve Piston Ring*
36 *Charging Valve Piston Ring*
37 *Charging Valve Cover*
38 *Charging Valve Cover Gasket*
39 *¼" x 1⅜" Sq. Head Cap Screw*
40 *Charging Valve Body Gasket*
41 *½" x 4½" Sq. Head Cap Screw*
42 *Gasket between Equalizing Portion and Pipe Bracket*
43 *½" x 2¾" Sq. Head Cap Screw*
44 *Graduating Sleeve*
45 *Graduating Spring*
46 *Graduating Sleeve Nut*

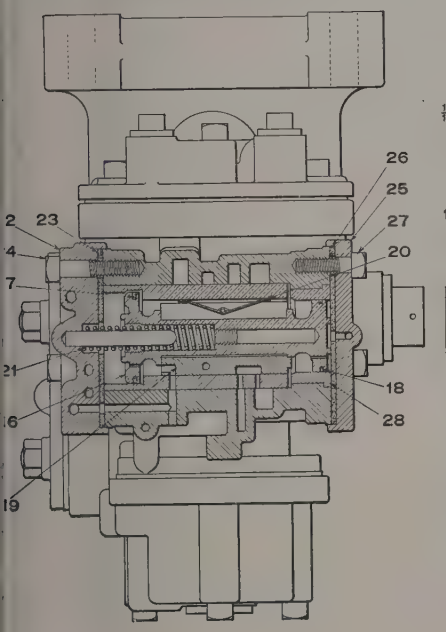
Quick Action Portion with High Pressure Cap Having Protection Valve and Safety Valve

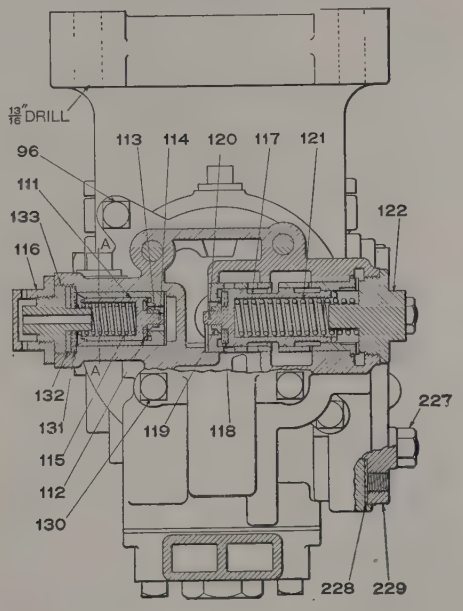
75 *Emergency Body*
76 *Emergency Piston complete*
77 *Emergency Piston Ring*
78 *Emergency Slide Valve*
79 *Emergency Slide Valve Spring*
80 *Emergency Graduating Valve*
81 *Emergency Graduating Valve Spring*

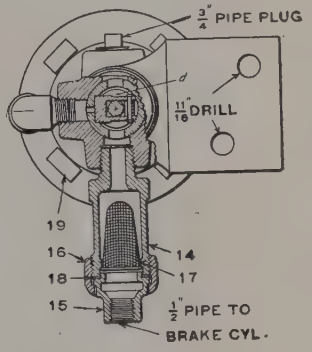
(Continued on Page 795.)

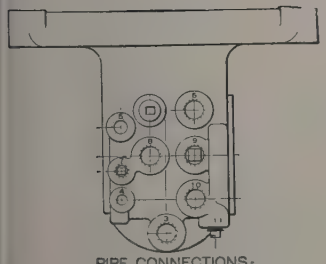
Names of Parts of Figs. 1921-1922 (Continued).

83 *Flush Nut*
84 *Quick Action Valve Case*
85 *Quick Action Valve*
86 *Quick Action Valve Seat*
97 *Quick Action Valve Nut*
88 *Quick Action Piston*
89 *Quick Action Piston Ring*
90 *Quick Action Valve Spring*
91 *Cup Nut for Quick Action Valve Case*
92 *Quick Action Valve Case Gasket*
93 5/8" x 2¼" *Stud and Nut*
94 *High Pressure Cap Gasket*
96 ½" x 1¾" *Hex. Head Cap Screw*
98 *Gasket between Quick Action Portion and Pipe Bracket*
99 ½" *Ball Check*
100 *Ball Check Cap Nut*
101 *Spring to hold Quick Action Piston against Quick Action Valve Case*
110 **High Pressure Cap Body**
111 *Protection Valve*
112 *Protection Valve Seat*
113 *Protection Valve Nut*
114 1/16" x 3/8" *Cotter*
115 *Protection Valve Spring*
116 *Protection Valve Cap Nut*
117 *Intercepting Valve*
118 *Intercepting Valve Seat*
119 *Intercepting Valve Nut*
120 1/16" x ½" *Cotter*
121 *Intercepting Valve Spring*
122 *Intercepting Valve Cap Nut*
123 *High Pressure Valve*
124 *Piston Ring, 1 11/16" Dia.*
125 *High Pressure Valve Seat*
126 *High Pressure Valve Seat Nut*
127 3/32" x 5/8" *Cotter*
128 *High Pressure Valve Spring*
129 *Safety Valve Bracket Gasket*
130 5/8" x 11½" *Sq. Head Cap Screw*
131 *Protection Valve Gasket*
132 *Protection Valve Washer*
133 *Protection Valve Seat Nut*
134 *Emergency Piston Stop*
135 *Emergency Piston Stop Spring*
140 *Safety Valve Bracket Body*
141 *Cut-off Valve*
142 *Cut-off Valve Stem*
143 *Cut-off Valve Seat*
144 *Cut-off Valve Nut*
145 1/16" x ¾" *Cotter*
146 *Cut-off Valve Spring*
147 *Flush Nut*
148 *Cut-off Valve Cap Nut*
149 *E-7 Safety Valve*
150 ½" x 2¼" *Sq. Head Cap Screw*
151 *Flush Nut*
152 *Emergency Piston Stop Nut*
153 ½" *Ball Check (Emer. Check)*
154 *Cap Nut*
225 †**Type C Pipe Bracket**
226 5/8" x 2½" *Stud and Hex. Nut*
227 5/8" x 2⅜" *Stud and Hex. Nut*
228 *Gasket between Blanking Flange and Bracket*
229 *Blanking Flange*
230 *Service Choke Plug*
231 *Exhaust Choke Plug*

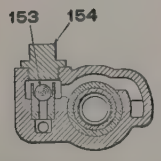








3 1" PIPE — BRAKE PIPE
4 ¾" PIPE — BRAKE CYLINDER EXHAUST
5 2" PIPE — AUXILIARY RESERVOIR
6 1" PIPE — SERVICE RESERVOIR
7 ¾" PIPE — EMERGENCY RESERVOIR (PLUGGED)
8 1" PIPE — EMERGENCY RESERVOIR
9 1" PIPE — EMERGENCY BRAKE CYLINDER (PLUGGED)
10 1" PIPE — SERVICE BRAKE CYLINDER
11 ¾" PIPE — M.R. BY-PASS AND LIMITING VALVE (PLUGGED)



SECTION TAKEN AT A-A

Names of Parts of Fig. 1923.

2 *Body, bushed*
3 *Spring Box, bushed*
4 *Piston*
5 *Piston Ring*
6 *Piston Stem*
7 *Piston Stem Nut*
8 *Slide Valve*
9 *Slide Valve Spring*
10 *Cap Nut*
11 *Regulating Spring*
12 *Regulating Nut*
13 *Check Nut*
14 *Union Stud*
15 *Union Swivel*
16 *Union Nut*
17 *Air Strainer*
18 *Union Gasket*
19 *Bolt and Nut*
20 *Piston Seat*
21 *Piston Disc*
22 *Spring Abutment*
23 *Cotter*
24 ½" *Street Ell*

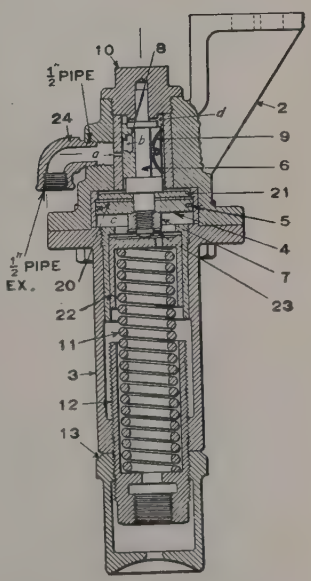


Fig. 1923—Westinghouse High Speed Reducing Valve as used with PM Passenger Car Equipment

Fig. 1922—Westinghouse U-12 Universal Valve. Sections Through Release Piston, Protection Valve, and Intercepting Valve. Used with UC Passenger Car Brake Equipment.

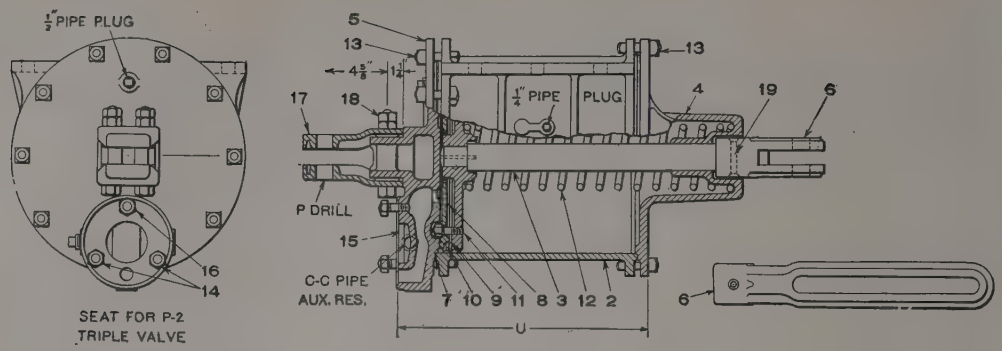


Fig. 1924—Westinghouse Type M Brake Cylinder as Used with PM Passenger Car Brake Equipment.

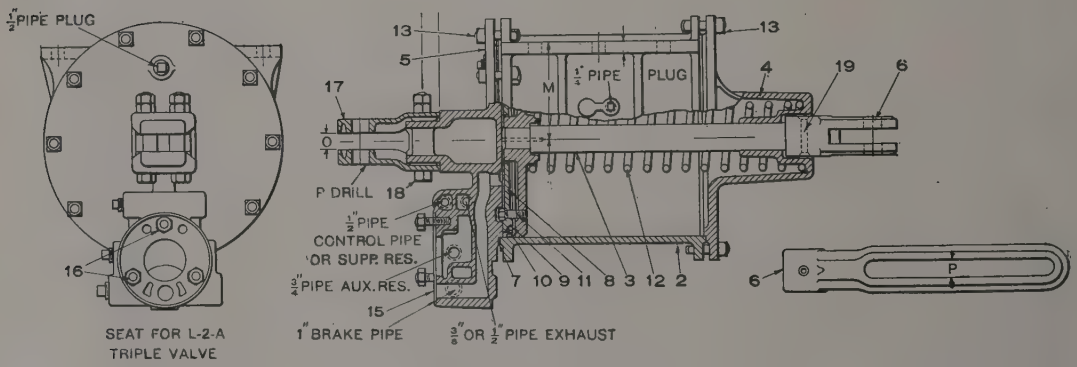


Fig. 1925—Westinghouse Type N Brake Cylinder as Used with LN Passenger Car Brake Equipment.

Names of Parts of Figs. 1924-1926.

2 *Cylinder Body*	8 *Follower*	14 *Triple Valve Bolt and Nut*
3 *Piston and Rod*	9 *Packing Leather*	15 *Triple Valve Gasket*
4 *Non-Pressure Head*	12 *Release Spring*	16 *Triple Valve Stud and Nut*
5 *Pressure Head*	13 *Cylinder Head Bolt and Nut*	17 *Lever Bracket*
6 *Crosshead*	10 *Packing Expander*	18 *Lever Bracket Bolt and Nut*
7 *Cylinder Gasket*	11 *Follower Stud and Nut*	19 *Crosshead Rivet*

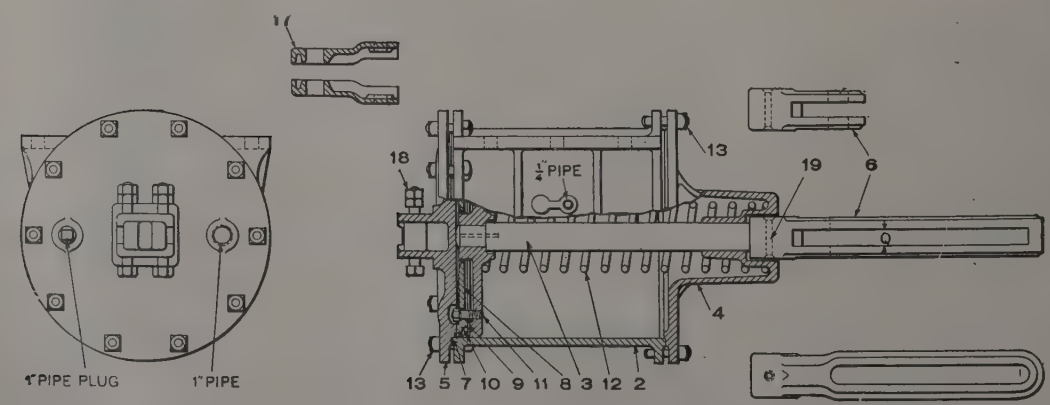


Fig. 1926—Westinghouse Type Q Brake Cylinder as Used with PC and UC Passenger Car Brake Equipments.

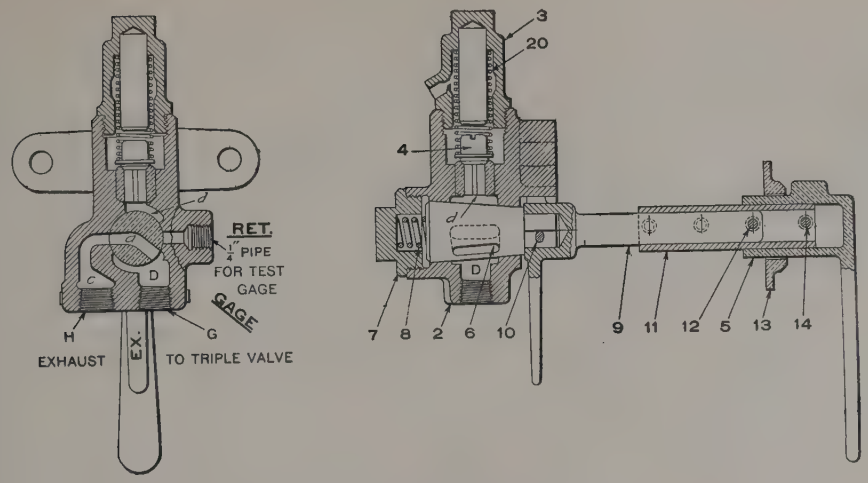


Fig. 1927—Westinghouse Single Pressure Retaining Valve as used with Brake Equipment for Vestibule Passenger Cars.

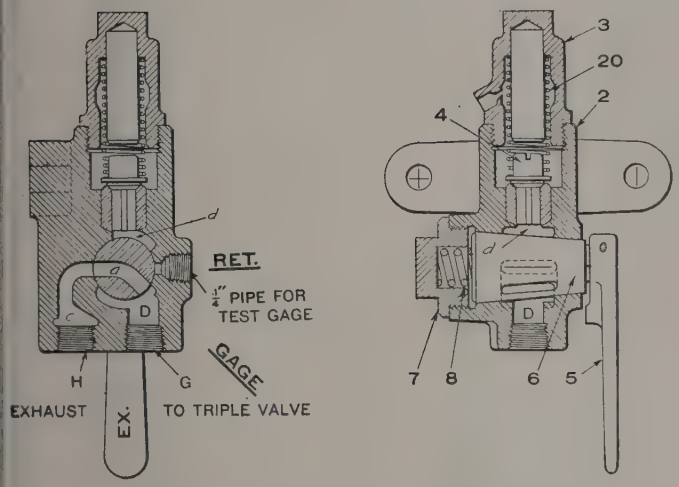


Fig. 1928—Westinghouse Single Pressure Retaining Valve as Used with Brake Equipment for Non-Vestibule Passenger Cars.

Names of Parts of Figs. 1921-1930.

2 *Body*
3 *Cap Nut*
4 *Valve*
5 *Handle*
6 *Cock Key*
7 *Cock Key Cap*
8 *Cock Key Spring*
9 *Extension Sockct*
10 *Cotter*
11 *Extension Sleeve*
12 *Socket and Sleeve Pin*
13 *Escutcheon*
14 *Handle Pin*
20 *Valve Spring*
21 *Cap Nut (Vented)*

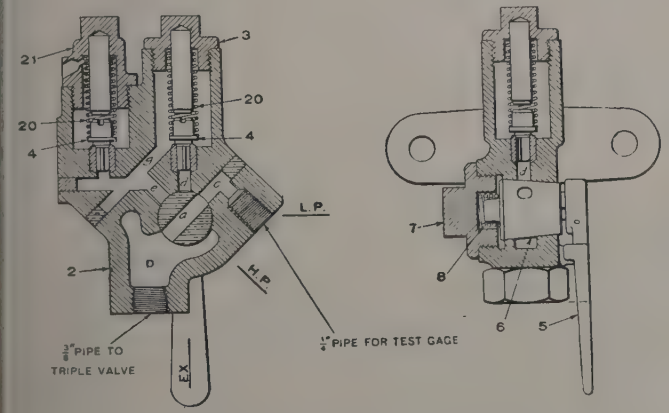


Fig. 1929—Westinghouse Double Pressure Retaining Valve as Used with Freight Car Brake Equipment.

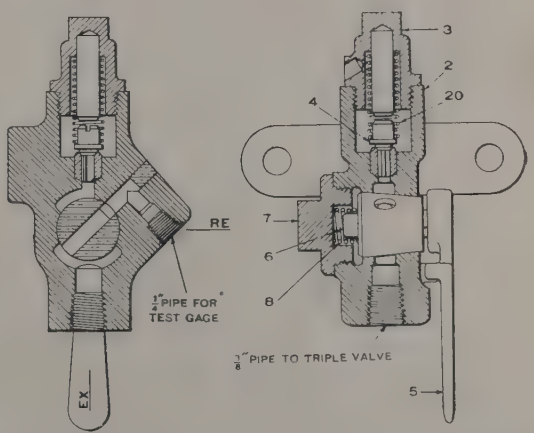


Fig. 1930—Westinghouse Single Pressure Retaining Valve as Used with Freight Car Brake Equipment.

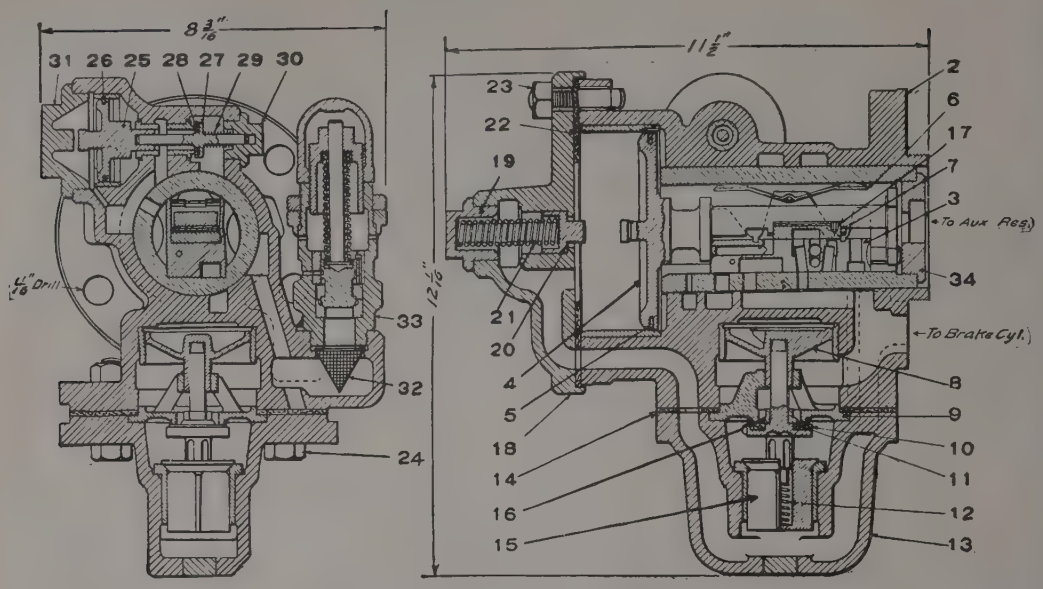


Fig. 1931—Quick Action Pipeless Triple Valve, L-3. Used with 16 and 18 in. Passenger Brake Cylinders.

Parts of Triple Valve, Fig. 1931.

2	*Body*	16	*Emergency Valve Nut*	25	*By-Pass Piston*
3	*Slide Valve*	17	*Graduating Valve Spring*	26	*By-Pass Piston Ring*
4	*Main Piston*	18	*Cylinder Cap*	27	*By-Pass Valve*
5	*Main Piston Ring*	19	*Graduating Spring Nut*	29	*By-Pass Valve Spring*
6	*Slide Valve Spring*	20	*Graduating Sleeve*	30	*By-Pass Valve Cap*
7	*Graduating Valve*	21	*Graduating Spring*	31	*By-Pass Piston Cap*
8	*Emergency Piston*	22	*Cylinder Cap Gasket*	32	*Strainer*
9	*Emergency Valve Seat*	23	*Bolt and Nut*	33	*E-7 Safety Valve*
10	*Emergency Valve*	24	*Bolt and Nut*	34	*End Cap*
11	*Rubber Seat for Emergency Valve*				
12	*Check Valve Spring*				
13	*Check Valve Case*				
14	*Check Valve Case Gasket*				
15	*Check Valve*				

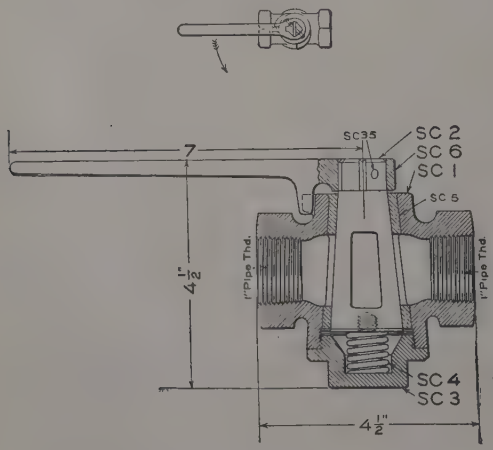


Fig. 1932—One Inch Cut-Out Cock.

Parts of One Inch Cut-Out Cock, Fig. 1932.

SC 1	*Body*	SC 4	*Spring*
SC 2	*Plug*	SC 6	*Handle*
SC 3	*Cap*	SC 35	*Handle Pin*

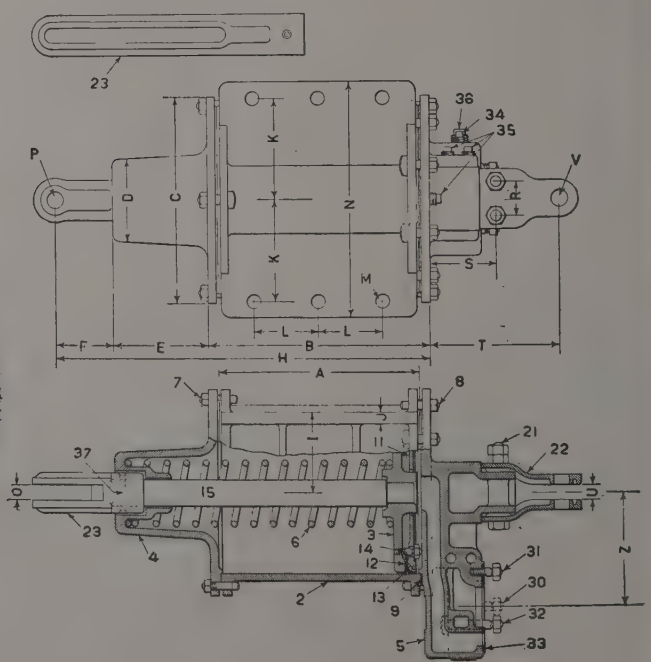


Fig. 1933—Passenger Train Car Cylinder, Style M, for Pipeless Triple Valve.

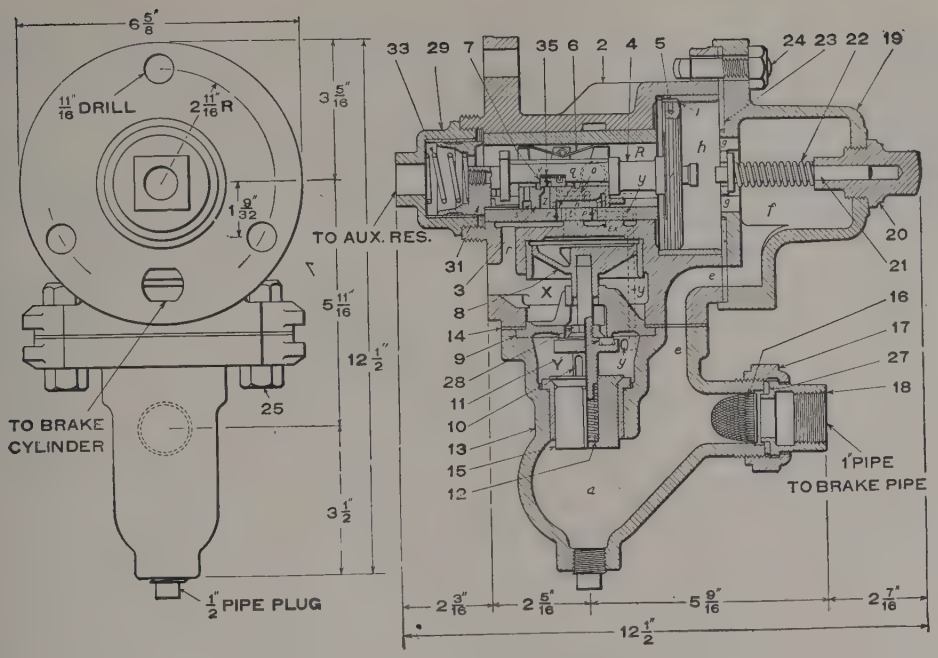


Fig. 1934—Quick Action Triple Valve, Style K-2, with Quick Service, Uniform Release and Uniform Recharge, for 10 in. Freight Brake Cylinders.

Parts of Triple Valve, Fig. 1934.

2 *Body*
3 *Slide Valve*
4 *Main Piston*
5 *Main Piston Ring*
6 *Slide Valve Spring*
7 *Graduating Valve*
8 *Emergency Piston*
9 *Emergency Valve Seat*
10 *Emergency Valve*
11 *Rubber Seat*
12 *Check Valve Spring*
13 *Check Valve Case*
14 *Check Valve Case Gasket*
15 *Check Valve*
16 *Strainer*
17 *Union Nut*
18 *Union Swivel*
19 *Cylinder Cap*
20 *Graduating Stem Nut*
21 *Graduating Stem*
22 *Graduating Spring*
23 *Cylinder Cap Gasket*
24 *Bolt and Nut*
25 *Bolt and Nut*
27 *Union Gasket*
28 *Emergency Valve Nut*
29 *Retarding Device Body*
31 *Retarding Stem*
33 *Retarding Spring*
35 *Graduating Valve Spring*

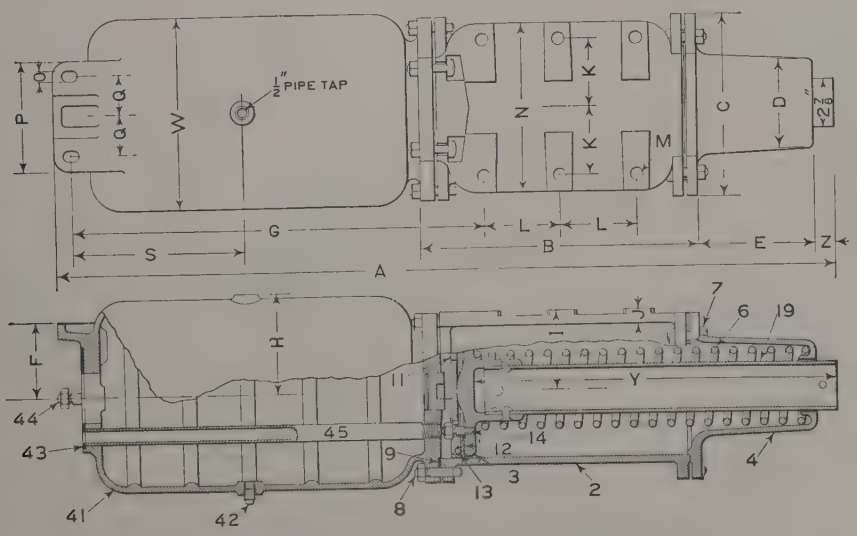


Fig. 1935—Combined Brake Cylinder and Reservoir for Freight Cars.

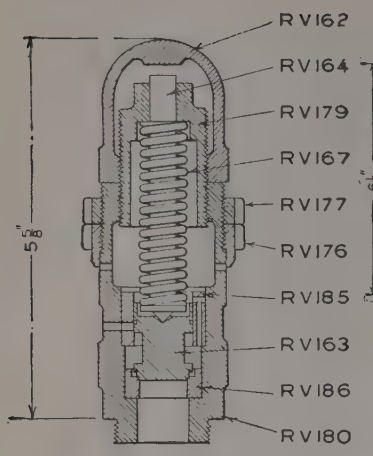


Fig. 1936—Safety Valve.

Parts of Safety Valve, Fig. 1936.

RV 162	*Cap Nut*
RV 163	*Valve*
RV 164	*Valve Stem*
RV 166	*Spring*
RV 176	*Exhaust Regulating Ring*
RV 177	*Lock Ring*
RV 179	*Regulating Nut*
RV 180	*Body*

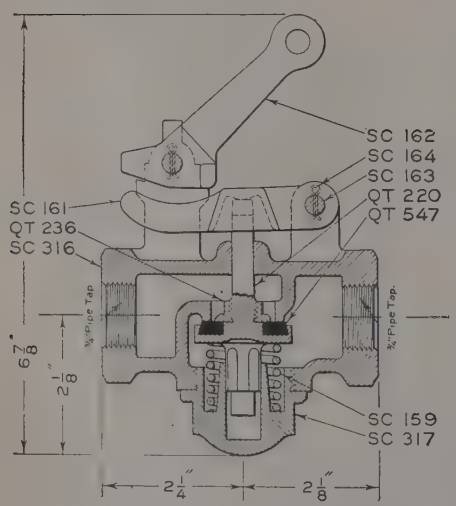


Fig. 1938—Conductor's Valve, Style B-3-A.

Parts of Conductor's Valve, Fig. 1938.

SC 159	*Spring*	SC 161	*Valve Lever*
SC 317	*Cap*	SC 162	*Lever*
SC 316	*Body*	QT 236	*Nut*
QT 220	*Vent Valve*	QT 547	*Seat*

Parts of Single Pressure Retaining Valve, Fig. 1939.

2	*Body*	6	*Plug*
3	*Cap Nut*	7	*Cap*
4	*Valve*	8	*Plug Spring*
5	*Handle*	20	*Valve Spring*

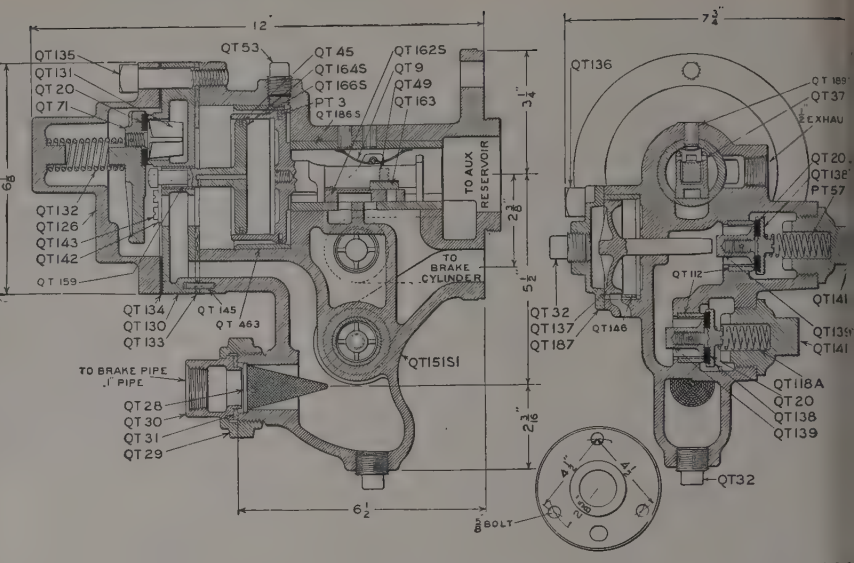


Fig. 1937—Quick Action Triple Valve, Style S1B, for 12 in., 14 in. and 16 in. Passenger Brake Cylinders.

Parts of Triple Valve, Fig. 1937.

QT 3	*Main Piston Spring*	QT 133	*Main Cylinder Gasket*
QT 9	*Exhaust Valve Spring*	QT 134	*Front Cap Gasket*
QT 20	*Rubber Valve Seat*	QT 135	*Front Cap Bolt*
QT 28	*Strainer*	QT 136	*Side Cap Bolt*
QT 29	*Union Nut*	QT 137	*Quick Action Valve Piston*
QT 30	*Union Swivel*	QT 138	*Check Valve*
QT 31	*Union Gasket*	QT 139	*Check Valve Guide*
QT 32	*Pipe Plug*	QT 141	*Check Valve Cap*
QT 37	*Exhaust Valve Pin*	QT 142	*Piston Stop*
QT 45	*Vent Valve Piston Ring*	QT 143	*Piston Stop Screw*
QT 49	*Graduating Valve Spring*	QT 151SI	*Triple Valve Body*
QT 53	*Pipe Plug*	QT 161S	*Exhaust Valve*
QT 69	*Triple Valve Gasket*	QT 163	*Graduating Valve*
QT 71	*Vent Valve*	QT 164S	*Vent Valve Piston*
QT 118A	*Check Valve Spring*	QT 166S	*Main Piston*
QT 126	*Front Cap*	QT 187	*Side Cap*
QT 130	*Vent Valve Seat*	PT 57	*Quick Action Valve Spring*
QT 131	*Vent Valve Guide*	QT 63S	*Bushing*
QT 132	*Vent Valve Spring*	QT 186S	*Bushing*

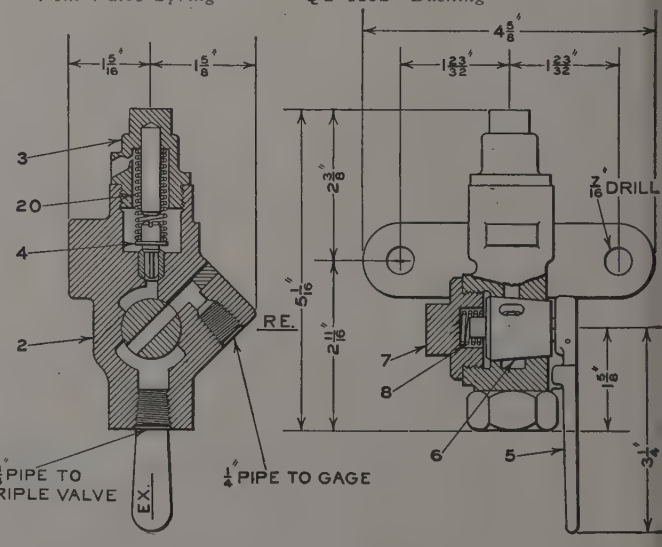


Fig. 1939—Single-Pressure Retaining Valve, Spring Type.

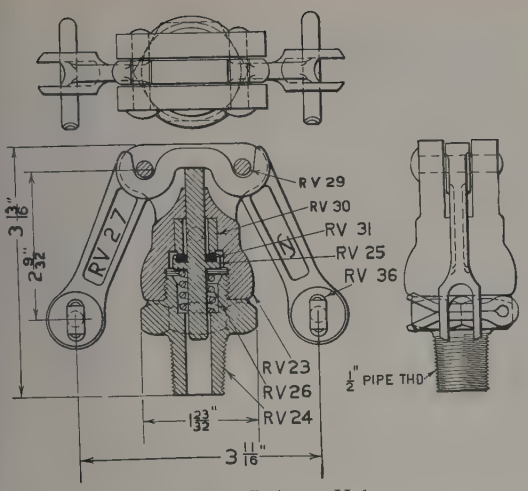


Fig. 1940—Release Valve.

Parts of Release Valve, Fig. 1478.

RV 23	*Cylinder*	RV 27	*Handle*
RV 24	*Stud*	RV 29	*Rivet*
RV 25	*Vent Valve*	RV 31	*Rubber Valve Seat*
RV 26	*Spring*	RV 36	*Handle Cotter*

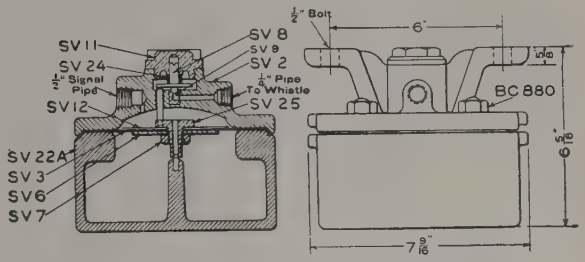


Fig. 1941—Signal Valve, Style BA.

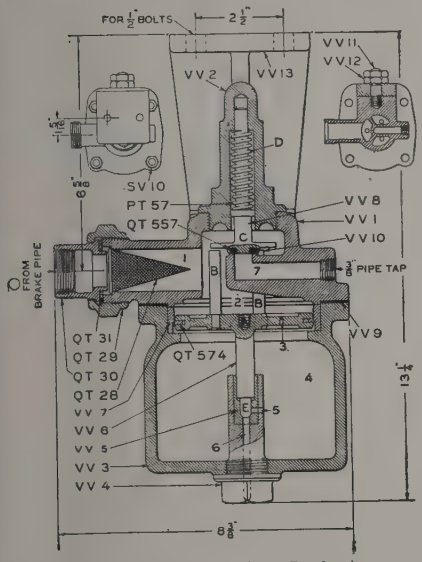


Fig. 1942—Vent Valve, Style A.

Parts of Signal Valve, Fig. 1941.

SV 2	*Upper Case*
SV 3	*Diaphragm*
SV 6	*Lower Diaphragm Plate*
SV 7	*Nut*
SV 8	*Valve*
SV 11	*Cap*
SV 12	*Upper Diaphragm Washer*
SV 22A	*Lower Case*
SV 24	*Spring*
SV 25	*Diaphragm Stem*
BC 880	*Stud and Nut*

Parts of Vent Valve, Fig. 1942.

VV 1	*Upper Case*
VV 2	*Upper Case Cap Nut*
VV 3	*Lower Case*
VV 4	*Post*
VV 6	*Piston*
VV 8	*Valve*
VV 9	*Lower Case Gasket*
VV 10	*Lifting Pins*
VV 12	*Holding Nut*
VV 13	*Bracket*
PT 57	*Valve Spring*
QT 28	*Strainer*
QT 29	*Union Nut*
QT 30	*Union Swivel*
QT 31	*Union Gasket*
QT 574	*Valve Seat*
QT 557	*Piston Ring*
SV 10	*Tee Head Bolt and Nut*

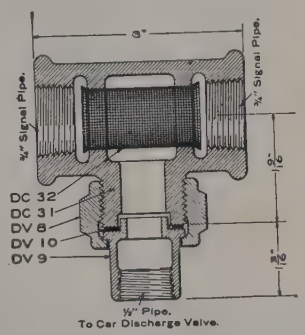


Fig. 1943—Signal Pipe Strainer.

Parts of Strainer, Fig. 1943.

DC 31	*Body*
DC 32	*Strainer*
DV 8	*Union Nut*
DV 9	*Union Swivel*
DV 10	*Union Gasket*

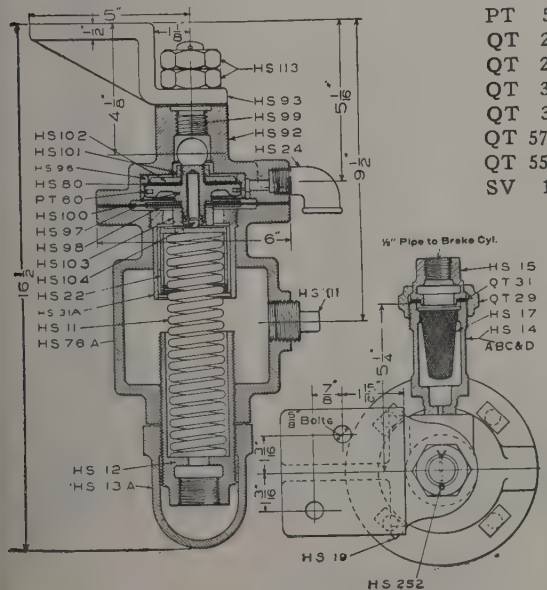
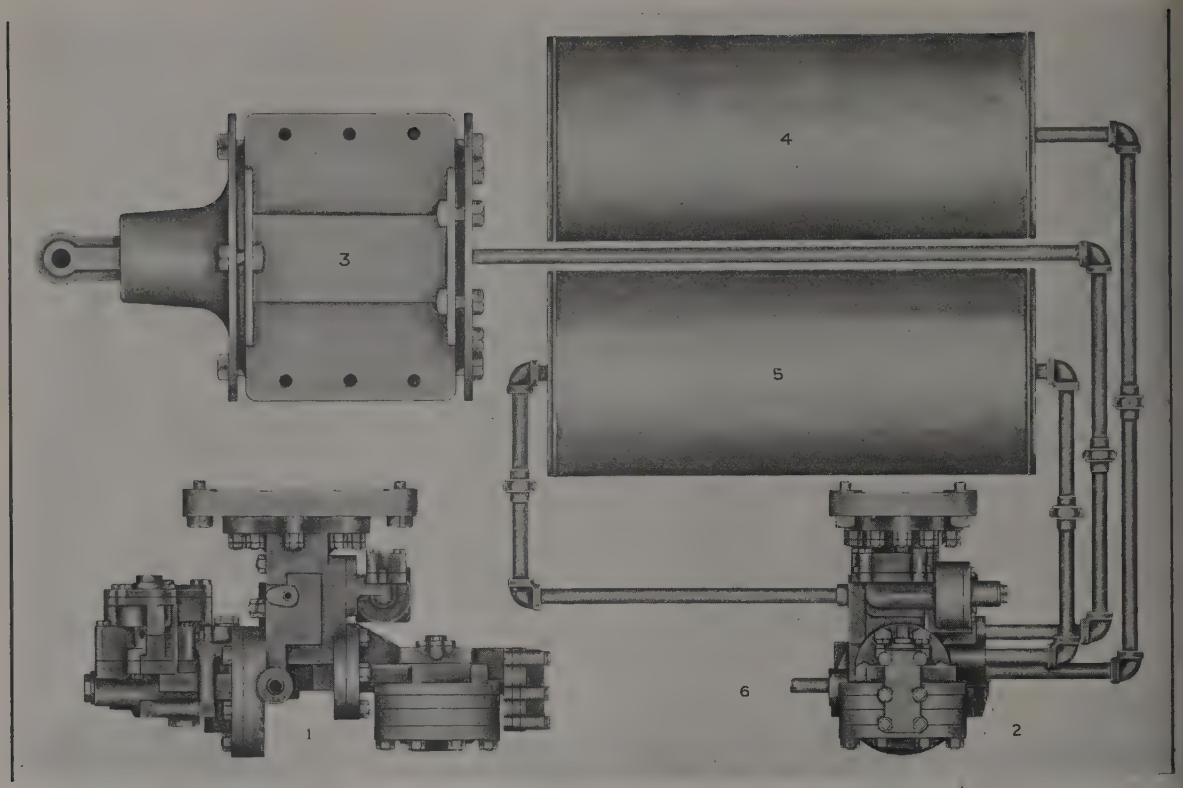


Fig. 1944—Compensating Valve, Style B1.

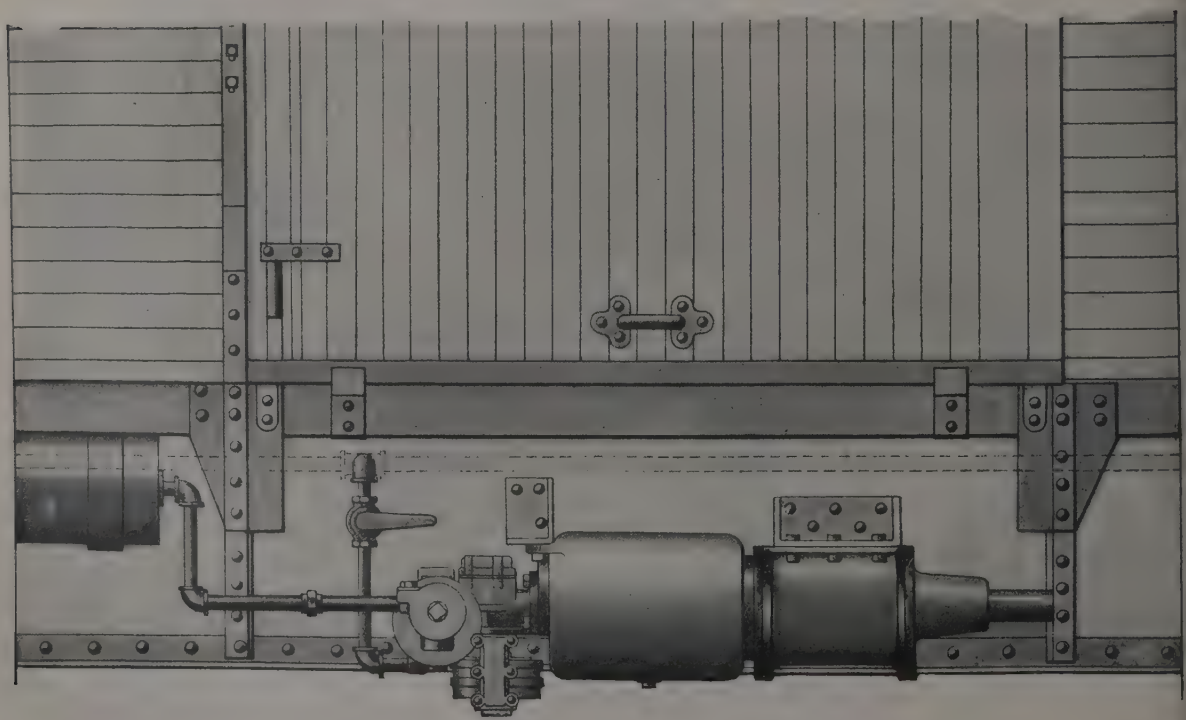
Parts of Compensating Valve, Fig. 1944.

HS 11	*Regulating Spring*	HS 99	*Bracket Stud*
HS 12	*Regulating Nut*	HS 100	*Piston*
HS 13A	*Check Nut*	HS 101	*Top Piston Nut*
HS 14A	*Union Stud*	HS 102	*Piston Disc*
HS 15	*Union Swivel*	HS 103	*Bottom Piston Nut*
HS 17	*Union Strainer*	HS 104	*Rider Pin*
HS 19	*Tee Head Bolt*	HS 111	*Plug*
HS 22	*Spring Abutment*	HS 113	*Holding Nut*
HS 24	*Street Elbow*	HS 252	*Cotter*
HS 76A	*Spring Box*	PT 60	*Packing Ring*
HS 80	*Leather Washer*	QT 29	*Union Nut*
HS 92	*Body*	QT 31	*Union Gasket*
HS 93	*Bracket*	HS 31A	*Spring Box Bush*
HS 97	*Diaphragm*	HS 96	*Piston Bush*
HS 98	*Diaphragm Washer*		



1 *Triple Valve, Side Elevation*
2 *Triple Valve, End Elevation*
3 *Brake Cyclinder*
4 *Emergency Reservoir*
5 *Two Compartment:*
Brake Pipe Reservoir
Quick Action Reservoir
6 *Brake Pipe*

Fig. 1945—All Service Triple Valve for the Automatic Straight Air Brake.



1—*Triple Valve.* 2—*Service Reservoir.*

Fig. 1946—Type S-2 Triple Valve for Automatic Straight Air Brake.

Automatic Straight Air Brake Company, Inc.

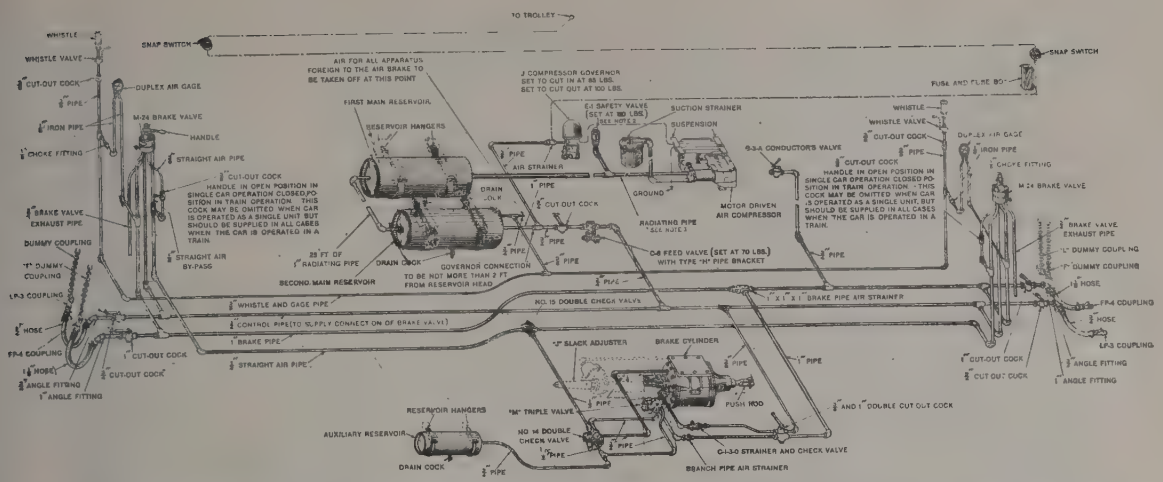


Fig. 1947—Westinghouse Combined Automatic and Straight Air Brake Equipment, Schedule AMM, for Single Car and Train up to Three Cars in Length. City, Suburban and Interurban Service.

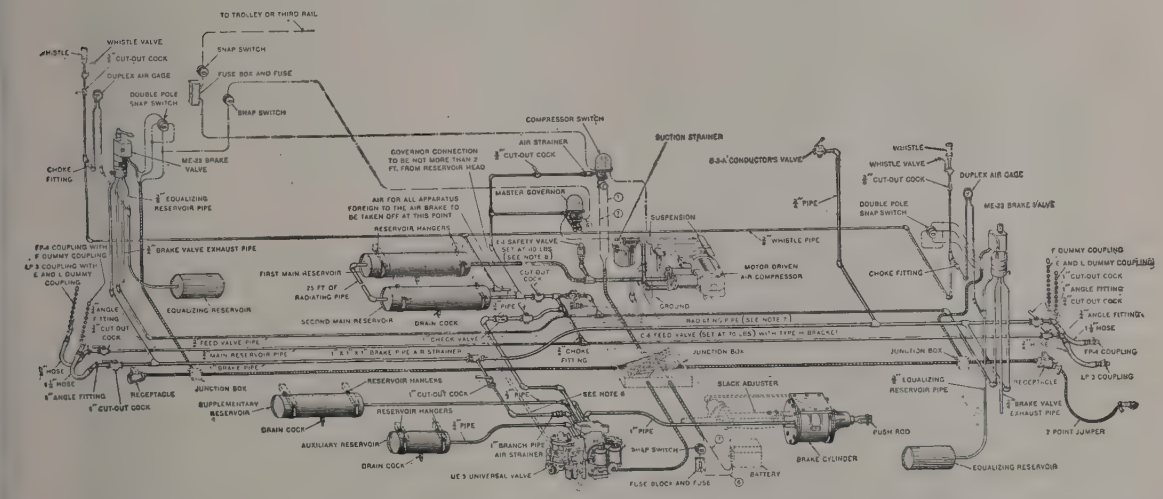


Fig. 1948—Westinghouse Universal Electro-Pneumatic Brake Equipment, Schedule AMUE, with Governor Synchronizing System. For Long Heavy High Speed Train Service Necessitating Fast Schedules, Close Headway, Maximum Deceleration, Reliability, and Safety.

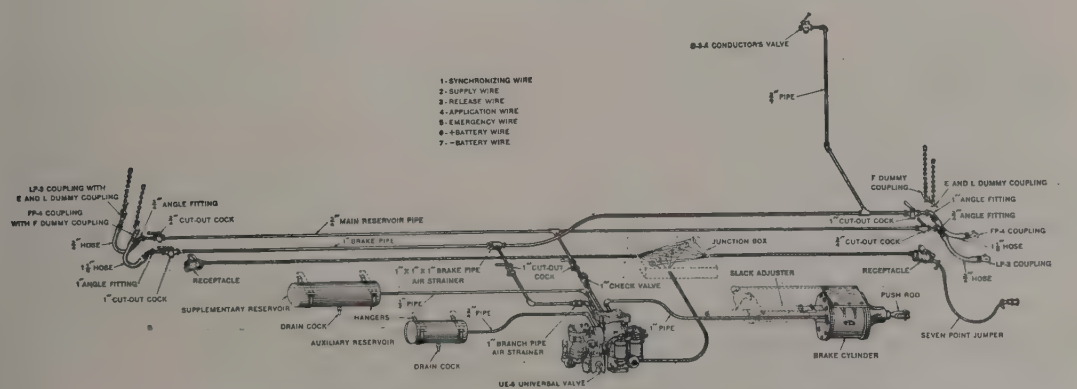


Fig. 1949—Westinghouse Universal Electro-Pneumatic Brake Equipment for Trailer Car, Schedule ATUE, as Used with Motor Car Having the AMUE Equipment.

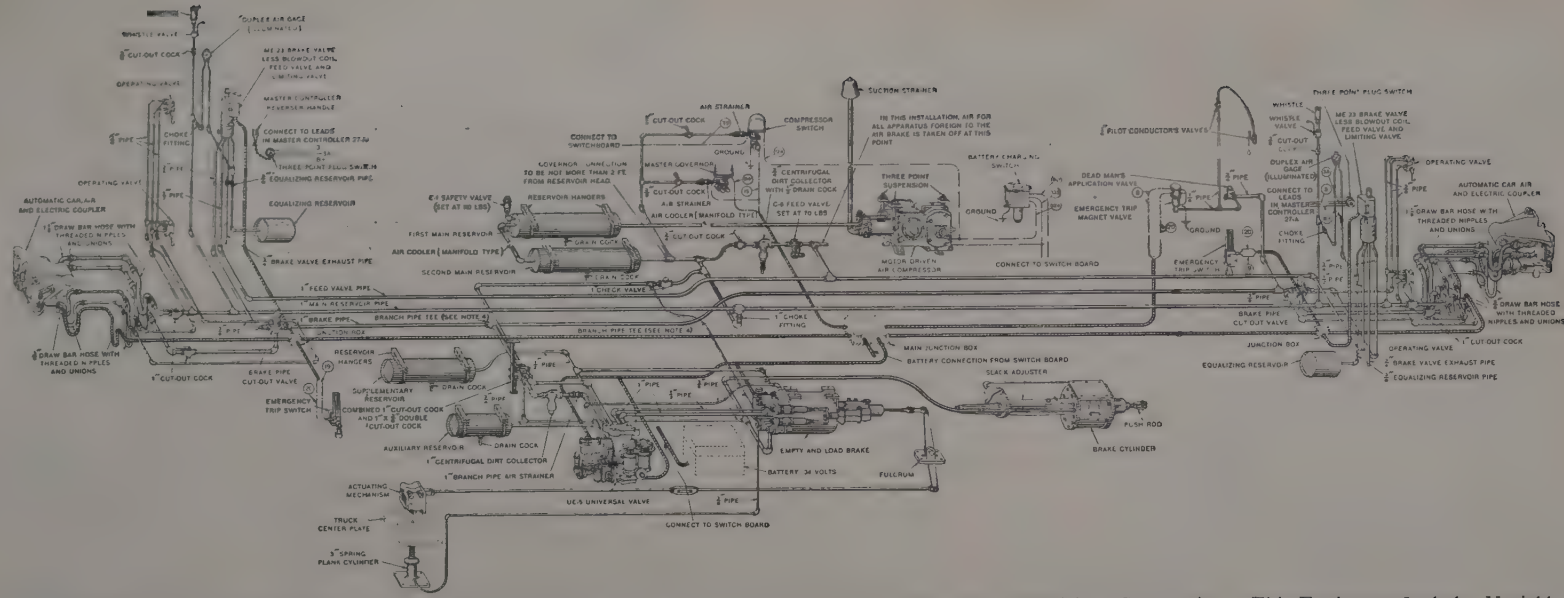


Fig. 1950—Westinghouse Universal Electro-Pneumatic Brake Equipment, Schedule AMUE, as used by New York Municipal Corporation. This Equipment Includes Variable Load Feature, Governor Synchronizing System (Battery Control), and Automatic Car, Air and Electric Coupler.

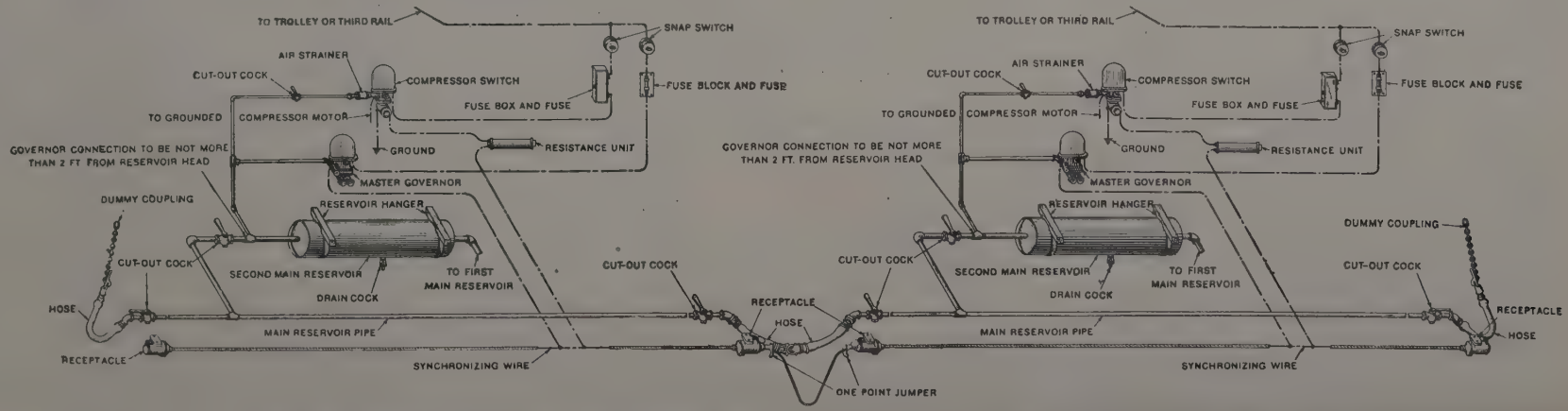


Fig. 1951—Westinghouse Governor Synchronizing System (Trolley Circuit) for Insuring Uniform Compressor Labor.

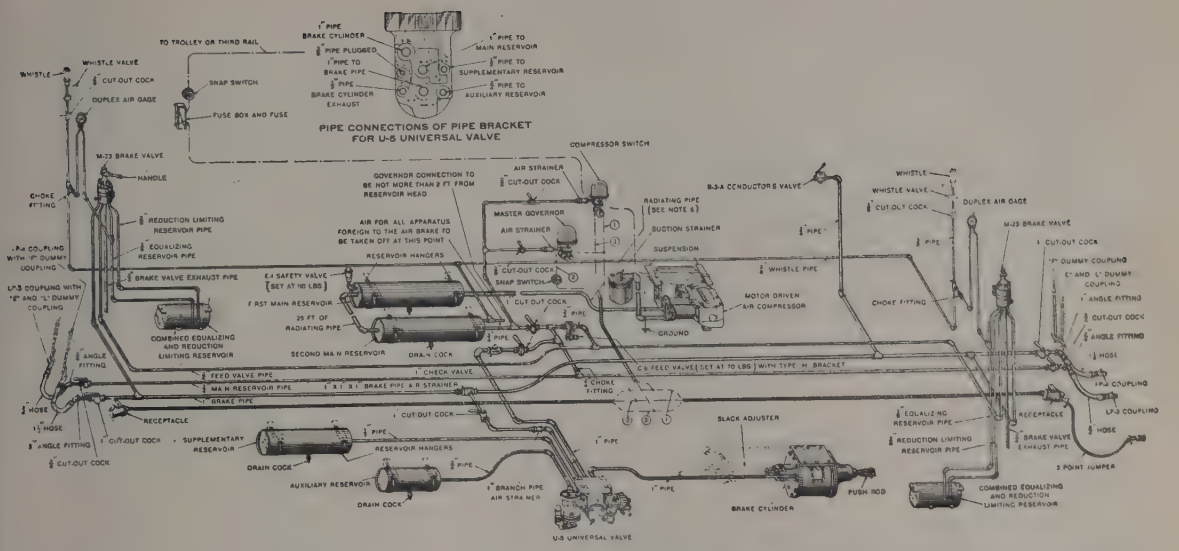


Fig. 1952—Westinghouse Universal Pneumatic Brake Equipment, Schedule AMU, for Long Heavy Trains in Elevated, Subway, and High Speed Surface Line Service.

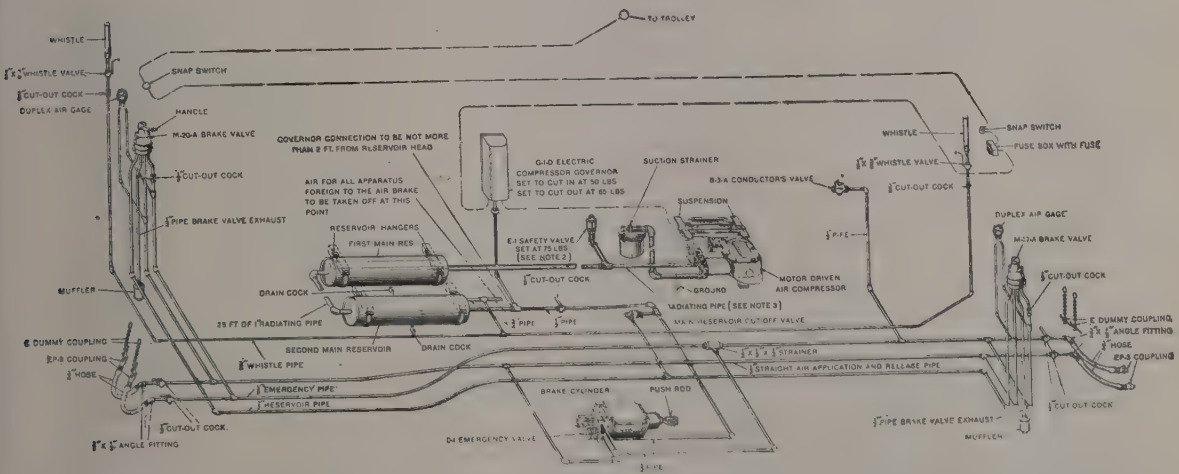


Fig. 1953—Westinghouse Straight-Air Brake with Emergency Feature, Schedule SME (A-Type Emergency Valve), for Light Single Car and Motor Car Trailer Train in Slow Speed City Service.

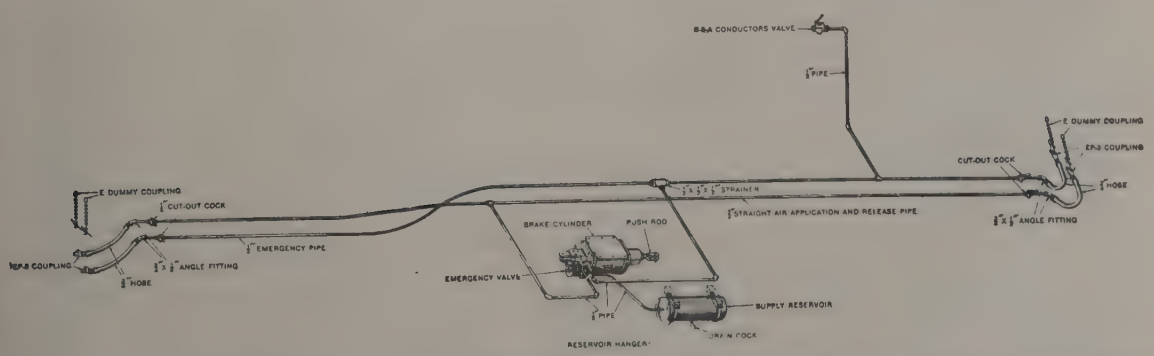


Fig. 1954—Westinghouse Trailer Car Brake Equipment, Schedule STE (A-Type Emergency Valve), for Trailers Used with Motor Cars Having SME Equipment with A-Type Emergency Valve.

Names of Parts of Fig. 1955.

2 *Equalizing Body*
3 *Equalizing Slide Valve*
4 *Equalizing Piston*
5 *Piston Ring*
6 *Slide Valve Spring*
7 *Equalizing Graduating Valve*
8 *Graduating Valve Spring*
9 *Flush Nut*
12 *Equalizing Cylinder Cap*
13 *Ball Check Cap Nut*
14 *Ball Check Valve*
15 *Cylinder Cap Gasket*
16 *Square Head Cap Screw*
17 *Release Piston*
18 *Release Piston Cap Nut*
20 *Gasket*
22 *Gasket*
25 *Graduating Sleeve*
26 *Graduating Spring*
27 *Graduating Sleeve Nut*
28 *Release Piston Ring*
29 *Relay Valve*
30 *Packing Ring*
31 *Seat*
32 *Nut*
33 *Cotter*
34 *Relay Valve Spring*
35 *Relay Valve Cover Gasket*
36 *Relay Valve Cover*
37 *Square Head Cap Screw*
38 *Flush Nut*
39 *Square Head Cap Screw*
75 *Cut Off and Safety Valve Body*
76 *Cut Off Valve Piston*
77 *Piston Ring*
78 *Check Valve Stem*
79 *Cap Nut*
80 *Cut Off Valve Spring*
81 *Cut Off Valve Cap*
82 *Cut Off Valve Cap Gasket*
83 *Square Head Cap Screw*
84 *Air Strainer*
85 *E-6 Safety Valve*
86 *Square Head Cap Screw*
87 *Cut Off Valve Piston Seat*
88 *Cut Off Valve Piston Nut*
89 *Check Valve Head*
90 *Check Valve Seat*
125 *Emergency Slide Valve Case*
126 *Emergency Piston*
127 *Emergency Piston Ring*
128 *Emergency Slide Valve*
129 *Graduating Valve*
130 *Emergency Slide Valve Spring*
131 *Graduating Valve Spring*
133 *Flush Nut*
134 *Quick Action Valve Case*
135 *Quick Action Valve*
136 *Quick Action Valve Seat*
137 *Quick Action Valve Nut*
138 *Quick Action Piston*
139 *Piston Ring*
140 *Cap Nut*
141 *Quick Action Valve Spring*
142 *Valve Case Gasket*
143 *Stud and Nut*
144 *High Pressure Cap Gasket*
145 *Ball Check*
146 *Ball Check Cap Nut*
147 *Gasket*
148 *Spring*
160 *High Pressure Cap Body*
161 *Pilot Piston*
162 *Piston Ring*
163 *Pilot Valve Guide*
164 *Large Pilot Valve Spring*
165 *Cap Nut for Strainer*
166 *Pilot Piston Cover*
167 *High Pressure Valve*
168 *High Pressure Valve Seat*
169 *High Pressure Valve Nut*
170 *Cotter*
171 *High Pressure Valve Spring*
172 *High Pressure Valve Cap Nut*
173 *Protection Valve*
174 *Protection Valve Seat*
175 *Protection Valve Nut*
176 *Cotter*
177 *Protection Valve Spring*
178 *Protection Valve Cap Nut*
179 *Square Head Cap Screw*
181 *Pilot Piston Cover Gasket*
182 *Square Head Cap Screw*
183 *Emergency Piston Spring*
184 *Emergency Piston Stop*
185 *Flush Nut*
186 *Emergency Piston Stop Nut*
187 *High Pressure Valve Ring*
188 *Cap Nut Seat*
189 *Pilot Valve Stem*
190 *Pilot Valve Head*
191 *Pilot Valve Spring*
192 *Strainer for Pilot Valve*
193 *Strainer Plate*
194 *Retainer*
195 *Pilot Valve Seat*
196 *Pilot Piston Seat*
197 *Pilot Piston Seat Nut*
198 *Protection Valve Cap Nut Seat*
235 *Type C Pipe Bracket*
236 *Short Stud and Nut*
237 *Long Stud and Nut*
238 *Stud and Nut*
239 *Stud and Nut*
251 *Magnet Bracket*
252 *Check Valve*
253 *Check Valve Cap Nut*
254 *Cap Nut for Strainer*
255 *Perforated Plate*
256 *Junction Box Cover*
257 *Square Head Cap Screw*
258 *Square Head Cap Screw*
259 *Lock Nut for Conduit*
260 *Terminal Block*
261 *Switch Terminal*
262 *Terminal Block Screw*
263 *Square Head Machine Bolt*
264 *Switch Terminal Insulator*
265 *Hexagon Nut*
266 *Washer*
267 *Terminal Clip*
268 *Magnet Cut Out Cap*
269 *Stud and Nut*
270 *Magnet Cut Out Cap Gasket*
271 *Gasket*
280 *Switch Cylinder*
281 *Switch Piston*
282 *Switch Piston Ring*
283 *Contact*
284 *Piston Spring*
285 *Contact Spring*
286 *Switch Cap Nut*
287 *Contact Washer*
288 *Cotter*
300 *Magnet Core*
301 *Cover*
302 *Lower Valve Seat*
303 *Upper Magnet Valve*
304 *Magnet Coil*
305 *Plunger*
306 *Special Washer*
307 *Armature Stem*
308 *Top Cover*
309 *Magnet Cap*
310 *Gasket for Magnet Cap*
311 *Cotter*
312 *Spring Guide*
313 *Spring*
314 *Bottom Cap Nut*
315 *Sleeve*
316 *Magnet Gasket*
317 *Lower Magnet Valve*
320 *Back Strap*
321 *Cover*
322 *Magnet Core*
323 *Valve*
324 *Magnet Coil*
325 *Plunger*
326 *Special Washer*
327 *Armature Stem*
328 *Top Cover*
329 *Magnet Cap*
330 *Gasket for Magnet Cap*
331 *Cotter*
332 *Spring*
333 *Magnet Valve Cap*
334 *Sleeve*
335 *Magnet Gasket*
340 *Back Strap*
341 *Cover*
342 *Magnet Core*
343 *Valve*
344 *Magnet Coil*
345 *Plunger*
346 *Special Washer*
347 *Armature Stem*
348 *Top Cover*
349 *Magnet Cap*
350 *Gasket for Magnet Cap*
351 *Cotter*
352 *Spring*
353 *Magnet Valve Cap*
354 *Sleeve*
355 *Magnet Gasket*
400 *Exhaust Valve Filling Piece*
401 *Cut Off Valve Body*
402 *Flush Nut*
403 *Flush Nut*
404 *Cylinder Cap Gasket*
405 *Cylinder Cap*
406 *Slide Valve*
407 *Piston*
408 *Piston Ring*
409 *Slide Valve Spring*
413 *Gasket*
414 *Cap Screw*
415 *Gasket*
416 *Relay Valve*
417 *Relay Valve Seal*
418 *Packing Ring*
419 *Relay Valve Spring*
420 *Relay Valve Cap Nut*
421 *⅝" Ball Check*
422 *½" Ball Check*
423 *Square Head Cap Screw*
424 *Piston Spring*

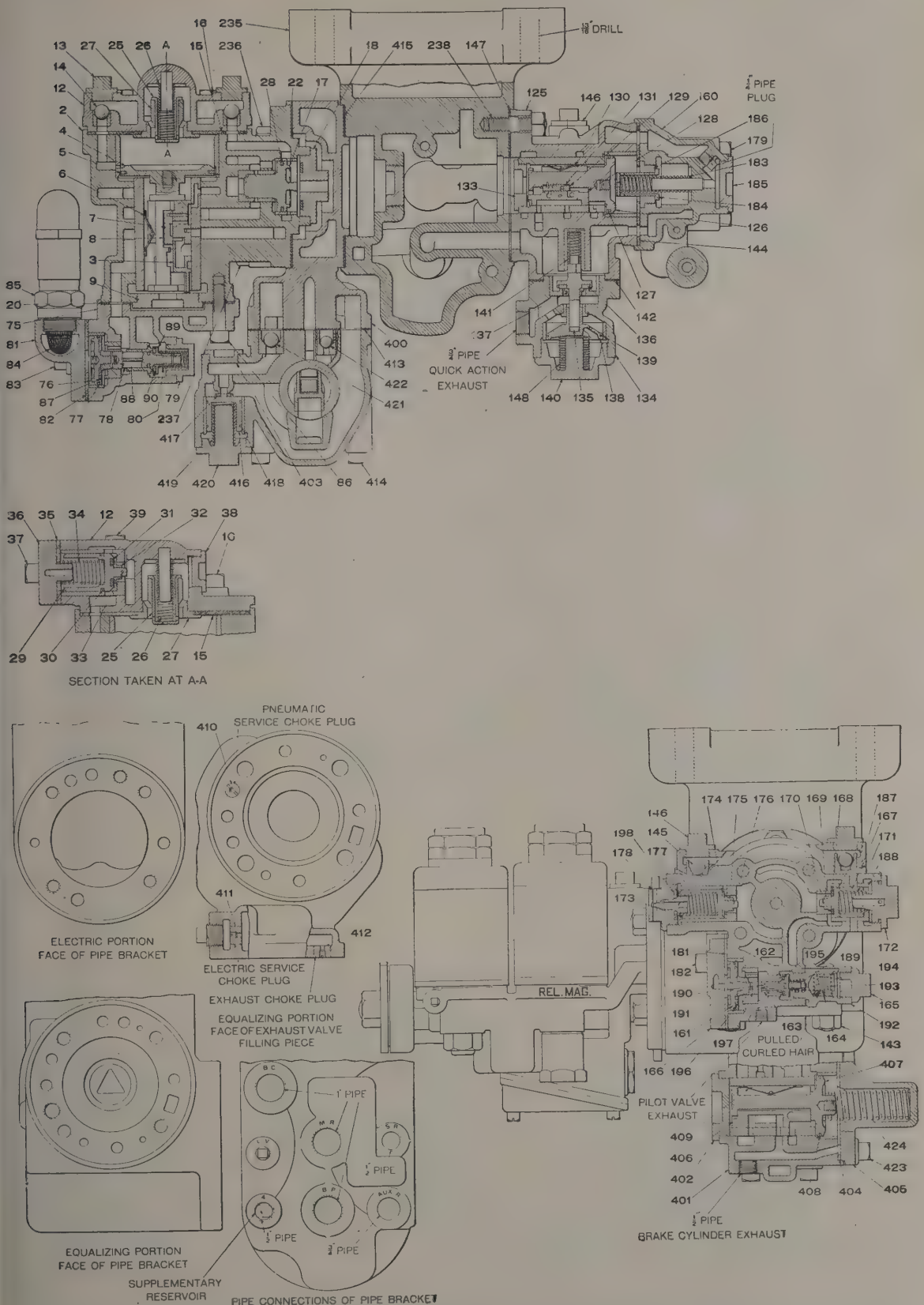


Fig. 1955—Westinghouse UE-5 Universal Valve as used with the AMUE Equipment, Sectional Views of Pneumatic Portions and Pipe Bracket.

Names of Parts of Fig. 1956

2 *Body, bushed*
3 *Cylinder Cap*
4 *Packing Leather*
5 *Piston Follower*
6 *Equalizing Piston Nut*
7 *Equalizing Piston Cotter*
8 *Packing Leather Expander*
9 *Cylinder Cap Gasket*
10 *Bolt and Nut for Cylinder Cap*
11 *Equalizing Piston, complete (includes 6)*
12 *Equalizing Piston Ring*
13 *Exhaust Slide Valve, complete*
14 *Exhaust Slide Valve Spring*
15 *Check Valve Cage*
17 *Check Valve, complete*
18 *Check Valve Spring*
19 *Check Valve Cage Nut*
20 *Emergency Piston Spring*
21 *Emergency Valve Case, bushed*
22 *Emergency Valve Case Gasket*
23 *Emergency Piston Ring*
24 *Emergency Piston, complete*
25 *Emergency Slide Valve*
26 *Emergency Valve Case Cap Nut*
27 *Emergency Slide Valve Spring*
28 *Bolt and Nut for Emergency Valve Case*

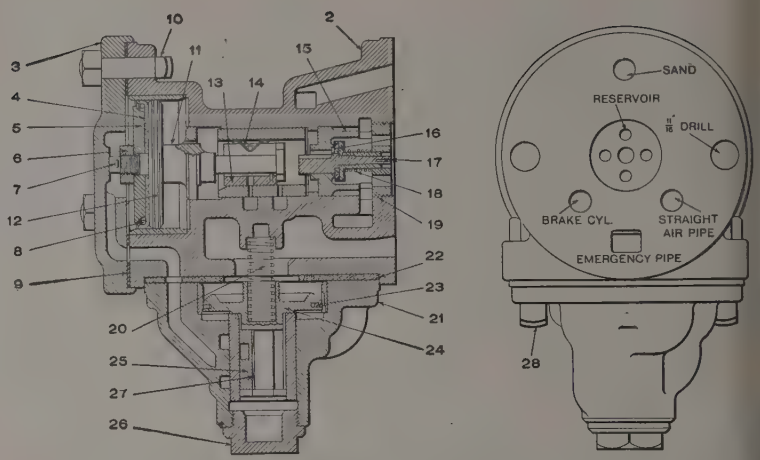
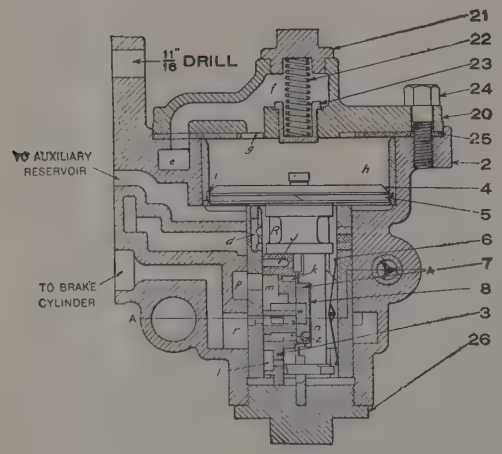
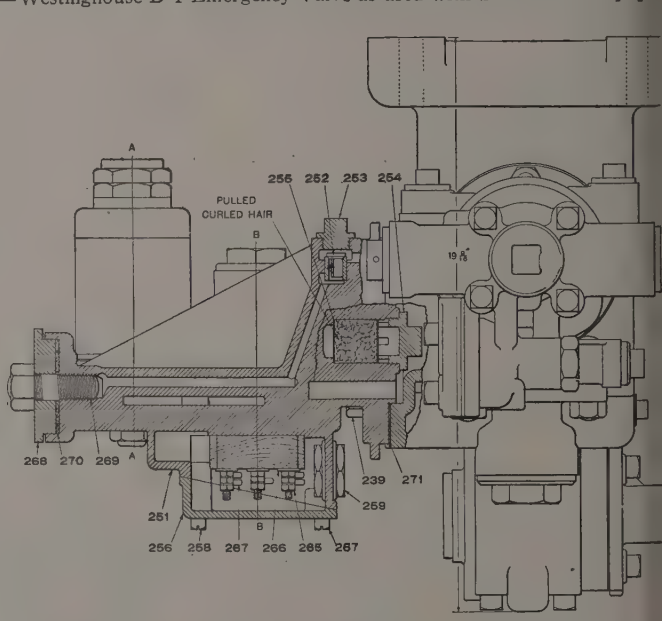
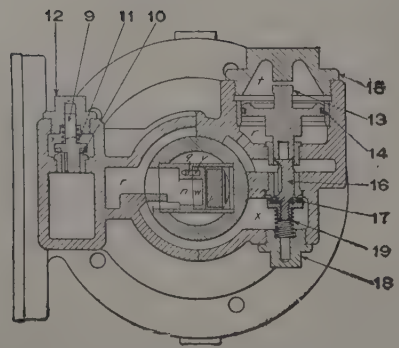


Fig. 1956—Westinghouse D-1 Emergency Valve as used with SME Brake Equipm







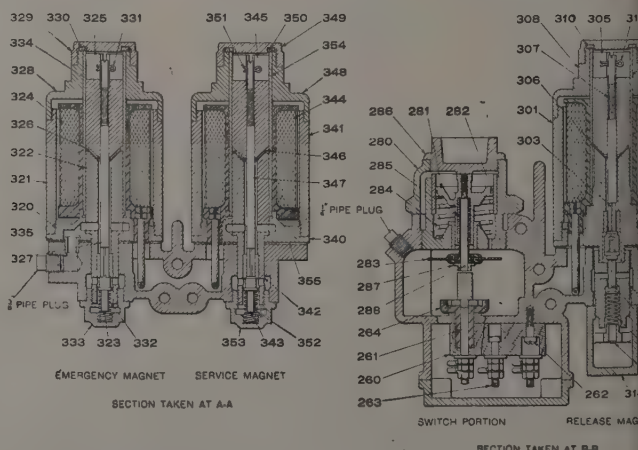
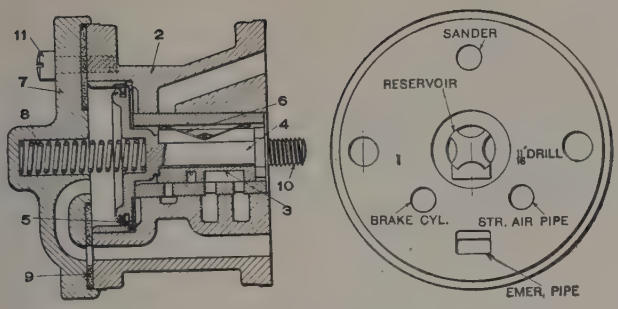


Fig. 1957—Westinghouse Type M Triple Valve as used with the AMM Brake Equipment.

Fig. 1958—Westinghouse UE-5 Universal Valve as used with the A Equipment, Sectional Views of the Electric Portion.



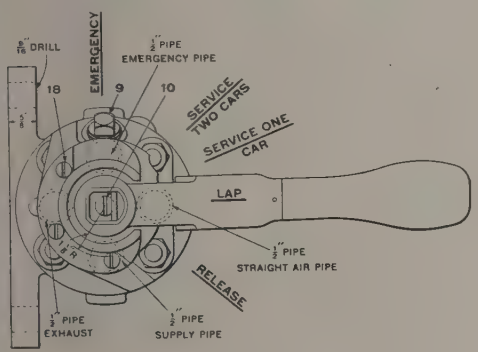
Names of Parts of Fig. 1959

2 *Body, bushed*
3 *Slide Valve*
4 *Piston (includes 5)*
5 *Piston Ring*
6 *Slide Valve Spring*
7 *Cylinder Cap*
8 *Piston Spring*
9 *Cylinder Cap Gasket*
10 *Stud and Nut*
11 *Fillister Head Screw*

Fig. 1959—Westinghouse A-2 Emergency Valve as used with SME Brake Equipment.

Names of Parts of Fig. 1960

2 *Rotary Valve Seat*
3 *Body*
4 *Pipe Bracket*
5 *Rotary Valve*
6 *Rotary Valve Key*
7 *Rotary Valve Spring*
8 *Key Washer*
9 *Oil Plug*
10 *Oil Screw*
11 *Handle*
12 *Handle Latch*
13 *Handle Latch Spring*
14 *Handle Latch Screw*
15 *Handle Grip*
16 *Handle Grip Screw*
17 *Handle Guard*
18 *Handle Guard Screw*
19 *Bolt and Nut*
20 *Fillister Head Screw*
21 *Upper Gasket*
22 *Lower Gasket*
23 *Lock Washer*



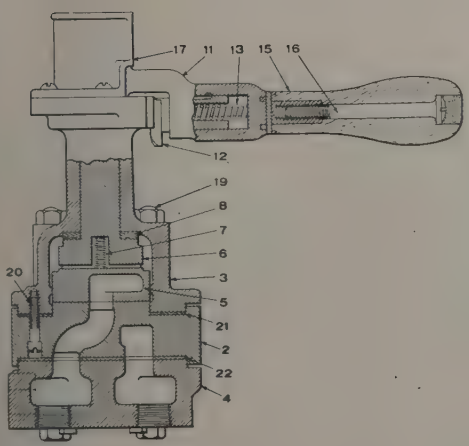
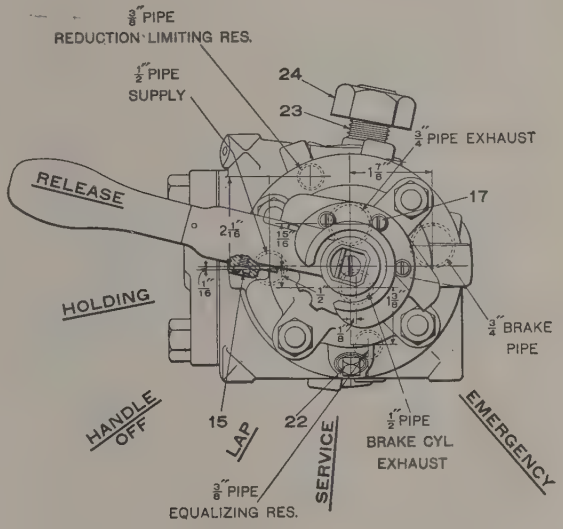


Fig. 1960—Westinghouse M-20-A Brake Valve as used with SME Equipment with the D Type Emergency Valve.



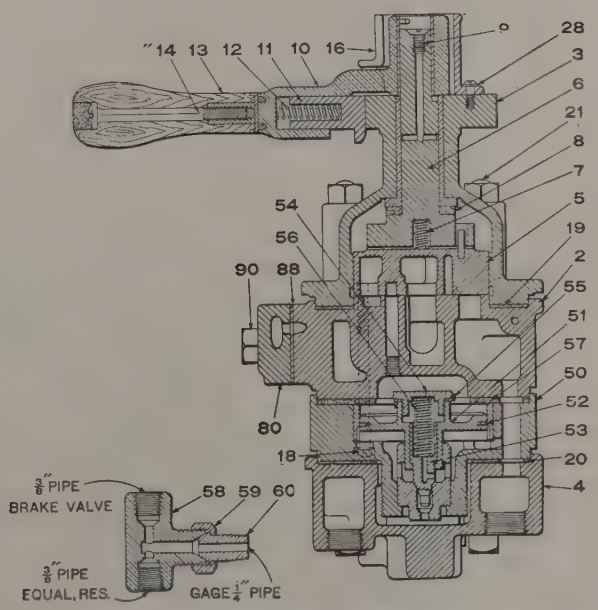
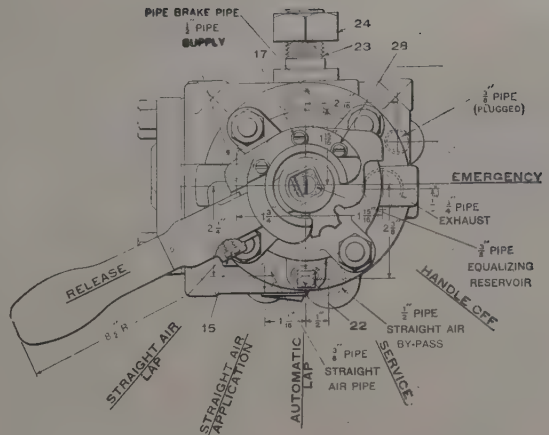
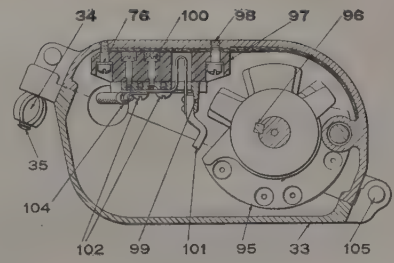
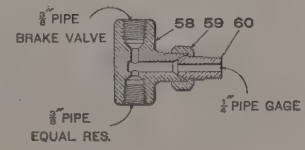
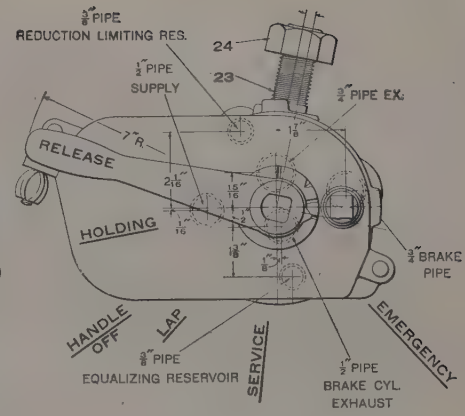


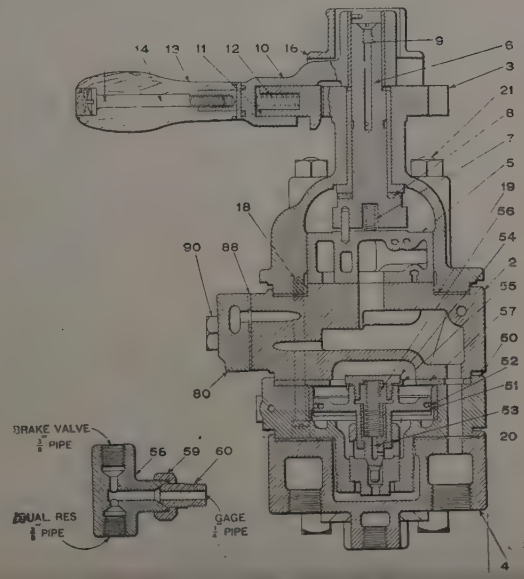
Fig. 1961—Westinghouse M-23 Brake Valve as used with the AMU Brake Equipment.











Names of Parts of Figs. 1962-1963

2 *Rotary Valve Seat*
3 *Body*
4 *Type B Pipe Bracket*
5 *Rotary Valve*
6 *Rotary Valve Key*
7 *Rotary Valve Spring*
8 *Key Washer*
9 *Oil Screw*
10 *Wood rip Handle*
11 *Latch*
12 *Latch Spring*
13 *Handle Grip*
14 *Grip Screw*
15 *Latch Screw*
16 *Handle Guard*
17 *Handle Guard Screw*
18 *Fillister Head Screw*
19 *Upper Gasget*
20 *Lower Gasket*
21 *Bolt and Nut*
22 *Oil Plug*
23 *Holding Stud*
24 *Holding Nut*
28 *Lock Washer*
33 *Cover*
34 *Thumb Nut*
35 *Eye Bolt*
52 *Piston Ring*
53 *Equalizing Piston Valve*
54 *Cap Nut*
55 *Piston Washer*
56 *Equalizing Piston Spring*
57 *Middle Gasket*
58 *Tee*
59 *Union Nut*
60 *Union Swivel*
73 *Spider*
76 *Washer*
80 *Blanking Flange*
88 *Gasket*
90 *Cap Screw*
91 *Blanking Flange*
92 *Pawl*
93 *Pawl Spring*
94 *Cap Nut*
95 *Quadrant*
96 *Feather Key*
97 *Finger Board*
98 *Finger Board Screw*
99 *Finger Base*
100 *Finger Base Screw*
101 *Finger*
102 *Screw for Finger*
104 *Clip for Finger Base Lead*

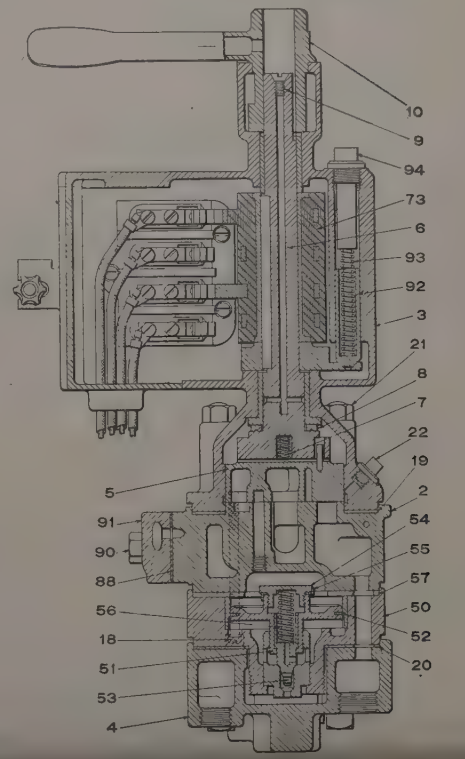


Fig. 1963—Westinghouse ME-23 Brake Valve as

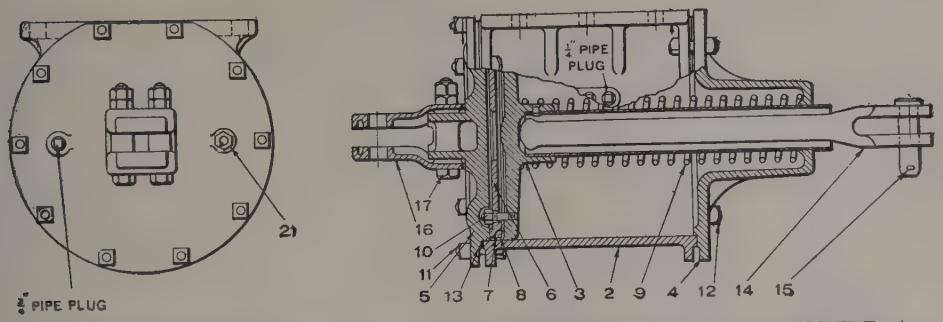


Fig. 1964—Westinghouse Type S Brake Cylinder as used with SM-3, SME, AMU and AMUE Equipments.

Names of Parts of Figs. 1964-1965

2 *Cylinder Body*
3 *Piston and Rod*
4 *Non-Pressure Head*
5 *Pressure Head*
6 *Follower*
7 *Packing Leather*
8 *Packing Expander*
9 *Release Spring*
10 *Follower Stud and Nut*
11 *Pressure Head Bolt and Nut*
12 *Non-Pressure Head Bolt and Nut*
13 *Cylinder Gasket*
14 *Push Rod*
15 *Push Rod Pin*
16 *Detachable Lever Bracket*
17 *Lever Bracket Bolt and Nuts*
21 *Bushing*
23 *Triple Valve Gasket*
24 *Triple Valve Stud and Nut*
25 *Triple Valve Bolt and Nut*

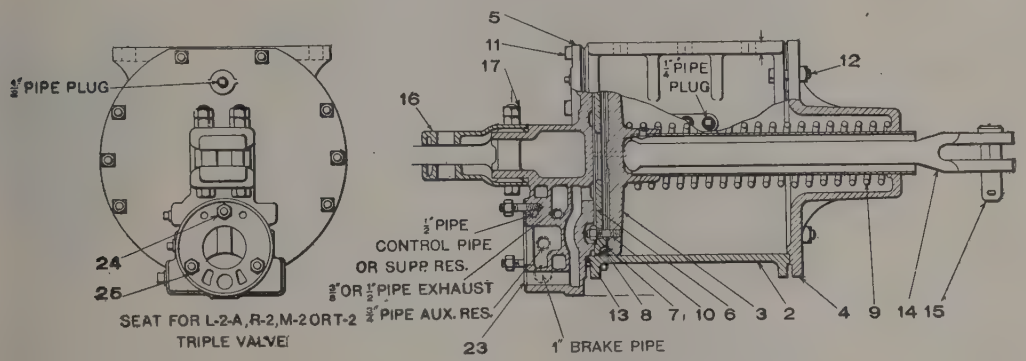


Fig. 1965—Westinghouse Type R Brake Cylinder as used with the AMM Equipment.

Names of Parts of Fig 1966

2 *Body*
3 *Flush Nut*
4 *Flush Nut*
5 *Supply Valve*
6 *Supply Valve Packing Ring*
7 *Supply Valve Seat*
8 *Supply Valve Nut*
9 *Cotter*
10 *Supply Valve Spring*
11 *Supply Valve Cap Nut*
12 *Cap Nut*
13 *Regulating Valve*
14 *Regulating Valve Spring*
15 *Regulating Valve Cap Nut*
16 *Diaphragm*
17 *Diaphragm Ring*
18 *Diaphragm Spindle*
19 *Spring Box*
20 *Regulating Spring*
21 *Regulating Nut*
22 *Jam Nut*
23 *Pipe Bracket*
24 *Pipe Bracket Gasket*
25 *Tee Head Bolt and Nut*

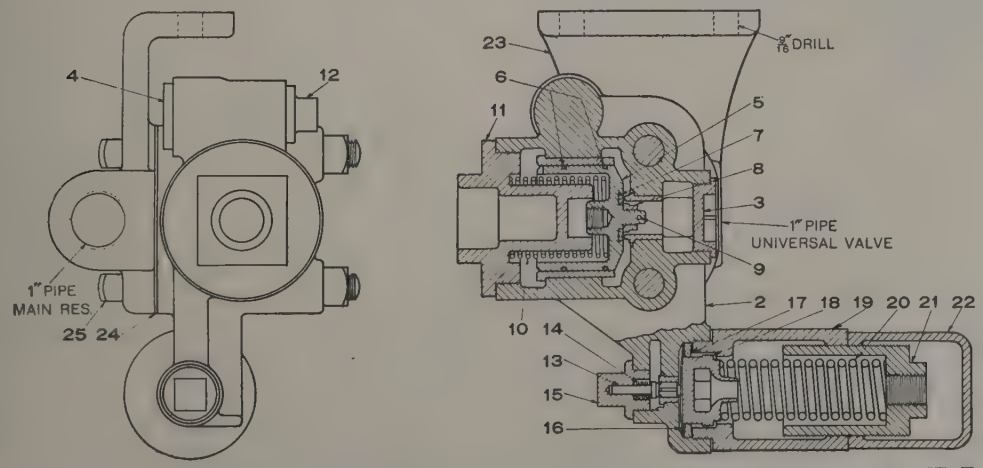


Fig. 1966—Westinghouse Brake Cylinder Pressure Limiting Valve as used with AMU and AMUE Equipment.

Traction Brake Equipments

The Straight Air Brake —Fig. 1953 on page 805 is the simplest form of equipment for traction service. Compressed air from the main reservoir passes through a motorman's brake valve to the pipe leading directly to the brake cylinder. Though possessing extreme simplicity and flexibility it has no automatic feature, i. e., a broken pipe or uncoupled hose will result in the inability to apply the brake. The application is thus limited to single car operation.

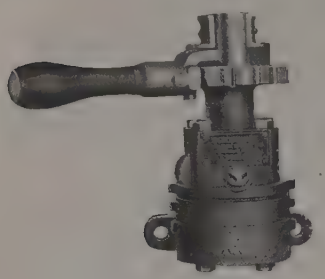


Fig. 1967—Brake Valve Straight Air

The Semi-Automatic Brake retains the simplicity and flexibility of the straight air brake with the safety features of an automatic brake. During the ordinary service application and release of the brakes the air on its way from the motorman's brake valve to the brake cylinder passes through a device called an emergency valve. When an emergency application is made, or a pipe bursts, or a hose becomes uncoupled, this valve operates so as to close the connection from the brake valve to the brake cylinder and admit main reservoir air directly into the brake cylinder.

Two general types of the semi-automatic brakes are in common use, one for single car or motor-trailer service using the "A" emergency valve, the other for motor cars running singly or in two car trains using the "D" emergency valve.

For ordinary motor or motor trailer service, the admission to and exhaust of air from the brake cylinders is directly controlled by the motorman's brake valve. For trains of two motor cars, each car supplying its own compressed air for braking purposes, a relay valve, embodied in the emergency valve structure, is interposed between the brake cylinders and the pipe connecting to the motorman's brake valve. This valve directly admits compressed air from the main reservoir on each car to the brake cylinder during application, and the exhaust from the cylinders during release. The control of the relay valves on each car is from the motorman's brake valve in a manner similar to the system previously described. The brake cylinder pressure is maintained against leakage and is uniform on all cars independent of piston travel. These equipments are also recommended for single car operation.

Fig. 1968—M-2-B Triple Valve

A special form of emergency valve, known as the "H" type has been developed for converting straight air equipments into the semi-automatic type, simply by the addition of this valve. Cars so changed are usually limited to single unit service or occasional motor and trailer operation.

The safety car control equipment was evolved for "Safety Car" or "One-man Car" operating in city service. The brake equipment is of the semi-automatic type, interlocked with the controller, the circuit breaker, the track sanders, the doors, and the motorman himself, so that the critical requirement of safety is fully satisfied.

The operator cannot leave his post without applying the brakes. If he is incapacitated or removes his hand from the controller handle without previously having the car under control, the power is automatically cut off, the track is sanded and the doors are unlatched ready to be opened, the brake is applied in emergency and the car stopped.

The brake valve and controller handles are interlocked indirectly so that while the brakes are held applied during a stop, or while the car remains standing, the removal of the operator's hand from the controller handle does not apply the brakes or throw out the circuit breaker.

Fig. 1969—D-1 Emergency Valve

The control of the doors and of the sanders for ordinary service stops is incorporated in the brake valve. Only two handles—for the brake valve and for the controller—are required for the complete control of the car.

The AMM Equipment is a combined automatic and straight air brake for single car and train service. It provides the simplicity and flexibility of straight air operation on a single car—or on the head car of a train—entirely independent of the automatic features, which are held in reserve.

The automatic brake has such important features as quick service, which insures a prompt and uniform application of all brakes; quick recharge, which makes repeated reapplication possible; graduated release, which makes possible a shorter and smoother stop with a more prompt start again; high emergency brake cylinder pressure, which provides maximum stopping force when necessary, and which is maintained without reduction, up to the compressor capacity. The last three functions are made possible by the use of a supplementary reservoir in addition to the usual auxiliary reservoir. The brake valve is shown in Fig. 1962, the triple valve in Fig. 1957 and double check valve in Fig. 1974.

This equipment is usually limited to three car trains, and includes a plain triple valve. If longer trains are to be run, a brake pipe vent valve—Fig. 1942—is added.

The AMU Equipment is the highest type of

Traction Brake Equipments *Cont'd.*

pneumatic brake for long train service on interurban, elevated or subway lines. The triple valve is displaced by a universal valve, and the unit system of construction permits any combination of operating parts necessary to produce the desired results.

The U-5 universal valve has three main parts; the equalizing or service portion, the emergency portion, and the pipe bracket. The pipe bracket is permanently fastened to the car body, and supports the two operative portions. In addition all pipe connections are made to it. A third face of the pipe bracket is for an electric portion which may be added when service conditions require.

Certainty and uniformity of service action are assured because the feed groove is closed by a movement of the piston only, on the slightest brake pipe reduction.

Maximum service stability and release sensitiveness prevent the brake from creeping on, due to fluctuations of brake pipe pressure, and the motorman from making such light reductions as to render a release difficult; and insure that the valve will be responsive to an increase in brake pipe pressure, making a release more certain under all conditions.

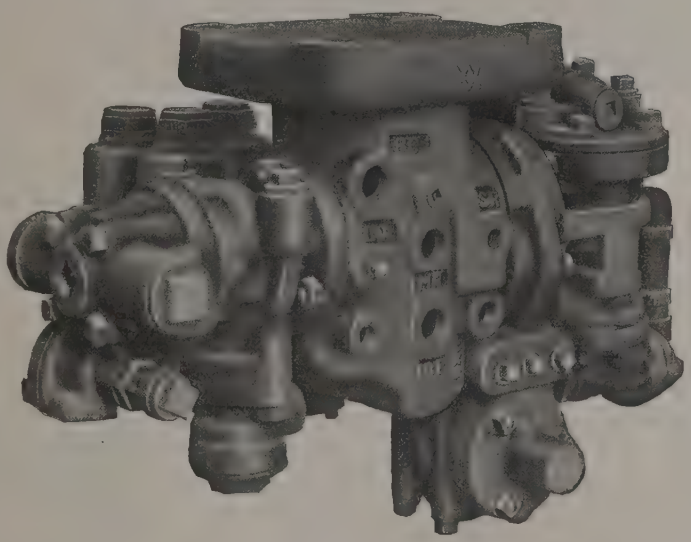


Fig. 1970—UE-5 Universal Valve

Maximum practicable difference between service and emergency braking force is accomplished by limiting the service applications to equalized pressure between the auxiliary reservoir and brake cylinder, and permitting the emergency application to reach the main reservoir pressure. This combined with large and direct passages, insures a high reserve braking force.

Service and emergency functions are controlled by independent valve portions, which insures that the necessary service flexibility and responsiveness will be obtained, and that full emergency braking force can be obtained at any time.

A protection feature insures that the pressure in the system cannot be reduced to such a value that the effectiveness of the brake would thereby be seriously impaired.

A straight air feature for this equipment may be provided by adding a double check valve portion to the universal valve and substituting the brake valve used with the AMM equipment.

The AMUE equipment is an electro-pneumatic brake built up on the AMU equipment by the addition of electrical parts to the universal valve and the brake valve. By actuating the brake electrically, serial action, common to all purely pneumatic systems, is eliminated. There is no time element as far as brake initiation and propagation is concerned, and the retardation of the whole train is as though there were but a single unit, while discomforting shocks do not occur on even the longest train. At the same time the flexibility of the brake is very much improved.

The pneumatic and electric functions are so interlocked that if the electric control should partially or wholly fail, the pneumatic portion of the system will automatically take control.

The use of this equipment makes it possible to run longer trains at higher speeds and on shorter headway than with a purely pneumatic brake, and thus increase the traffic capacity of a rapid transit system.

A variable load feature may be added to the AMUE equipment to provide for a constant braking ratio by the regulation of cylinder pressure to suit the varying load. This is accomplished by changing the effective auxiliary reservoir volume and by the adjustment of limiting valves; this change is automatically effected by the vertical movement of the car body relative to the truck through the medium of an actuating and regulating mechanism as each passenger enters or leaves the train.

This feature is of special value where conditions are such as to demand the highest operating efficiency possible of attainment with a given class of equipment. The variation of pressure in the brake cylinders being automatic, the stopping distance corresponding to a given speed will always be the same regardless of fluctuations, which take place in the car loading under various traffic conditions due to rush-hour and non-rush-hour travel.

To obtain the best results the unit devices should be maintained at their highest practical efficiency. The 3-T Test Rack, which is illustrated in Fig. 1905, and the 3-U are employed to determine promptly and accurately whether the triple valves and universal valves, respectively, are up to the standard of workmanship and general condition before being returned to service, and, after cleaning and repairs, to check the important functions performed by them.

For other products and branch offices, see classified and alphabetical indexes.

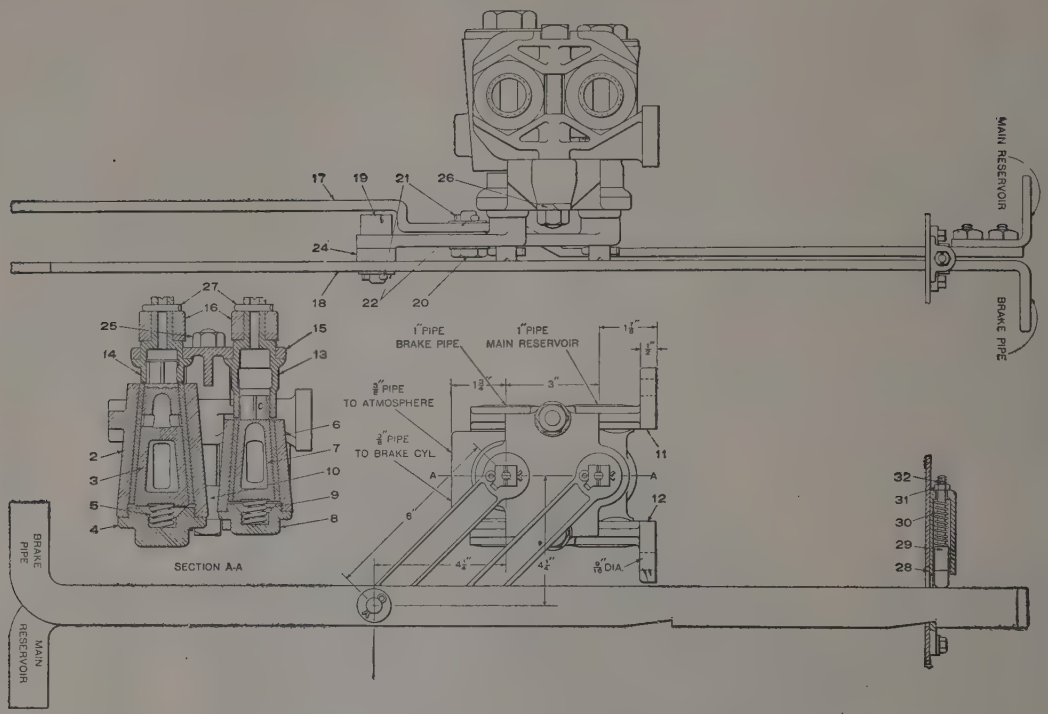


Fig. 1971—Westinghouse Combined Cut-Out Cock as used with AMU and AMUE Equipments.

Names of Parts of Fig. 1971

2 *Body for Double Cut-out Cock*
3 *Key for Double Cut-out Cock*
4 *Cap for Double Cut-out Cock*
5 *Key Spring for Double Cut-out Cock*
6 *Body for 1" Cut-out Cock*
7 *Key for 1" Cut-out Cock*
8 *Cap for 1" Cut-out Cock*
9 *Key Spring for 1" Cut-out Cock*
10 *Top Housing*
11 *Bottom Housing (Left)*
12 *Bottom Housing (Right)*
13 *Long Extension Stem*
14 *Short Extension Stem*
15 *Stem Guide*
16 *Handle*
17 *Offset Operating Lever*
18 *Straight Operating Lever*
19 *Special Cap Screw*
20 *Special Cap Screw*
21 *Steel Cotter*
22 *Wrought Washer*
24 *Special Washer*
25 *Square Head Machine Bolt*
26 *Lock Washer*
27 *Steel Cotter*
28 *Latch Housing*
29 *Latch Bolt*
30 *Spring*
31 *Hexagon Nut*
32 *Steel Cotter*

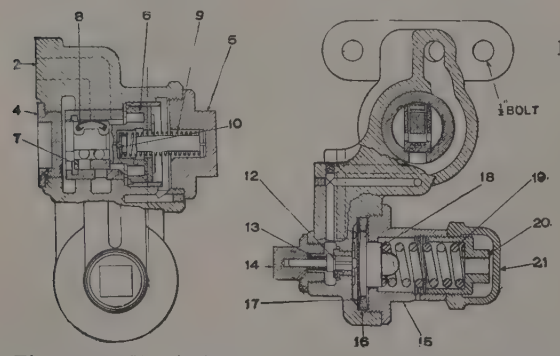


Fig. 1972—Westinghouse C-6 Feed Valve as used with AMM, AMU and AMUE Equipments.

Names of Parts of Fig. 1972

2 *Valve Body, bushed*
4 *Flush Nut*
5 *Cap Nut*
6 *Piston*
7 *Supply Valve*
8 *Supply Valve Spring*
9 *Piston Spring*
10 *Piston Spring Tip*
12 *Regulating Valve*
13 *Regulating Valve Spring*
14 *Regulating Valve Cap Nut*
15 *Spring Box*
16 *Diaphragm Ring*
17 *Diaphragm (2 Req'd)*
18 *Diaphragm Spindle*
19 *Regulating Spring*
20 *Regulating Nut*
21 *Check Nut*

Names of Parts of Figs. 1973-1974

2 *Body*
3 *Cap*
4 *Check Valve*
5 *Gasket*
6 *Union Nut*
7 *Union Swivel*
8 *Union Gasket*
9 *Square Head Bolt and Nut*

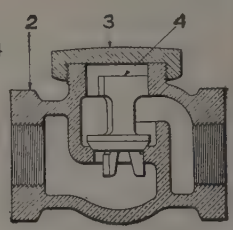


Fig. 1973—Westinghouse Check Valve.

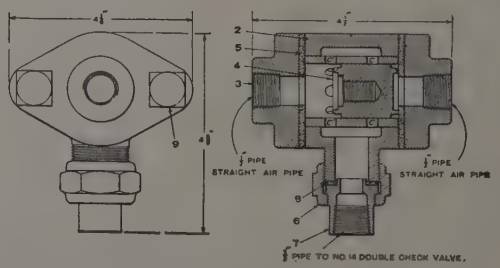


Fig. 1974—Westinghouse No. 15 Double Check Valve as used with AMM Equipment.

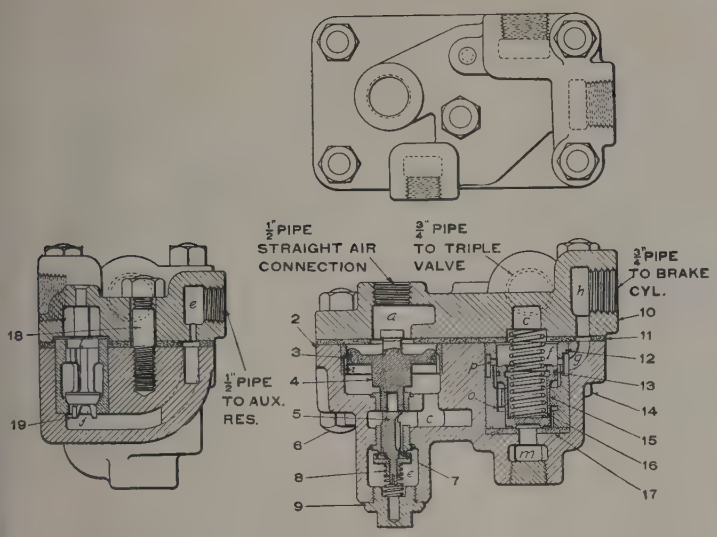


Fig. 1975—Westinghouse No. 14 Double Check Valve as used with the AMM Equipment.

Names of Parts of Fig. 1975

2 *Body*
3 *Supply Valve Piston Ring*
4 *Supply Valve Piston*
5 *Auxiliary Reservoir Check Valve*
6 *Tee Head Bolt*
7 *Rubber Seat*
8 *Check Valve Spring*
9 *Check Valve Cap Nut*
10 *Pipe Bracket*
11 *Pipe Bracket Gasket*
12 *Double Piston Bush*
13 *Double Piston Ring*
14 *Tee Head Bolt*
15 *Double Piston*
16 *Double Piston Spring*
17 *Double Piston Seat*
18 *Stud with Hexagon Nut*
19 *Exhaust Check Valve*

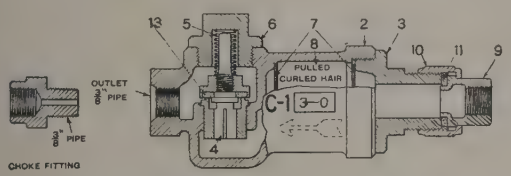


Fig. 1977—Westinghouse Type C Combined Strainer and Check Valve as used with SME (D-1) and AMM Equipment.

Names of Parts of Fig. 1977

2 *Body*
3 *Cap Nut*
4 *Check Valve*
5 *Valve Spring*
6 *Valve Cap*
7 *Strainer*
8 *Curled Hair*
9 *Union Swivel*
10 *Union Nut*
11 *Union Gasket*
12 *Choke Plug*
13 *Leather Seat*

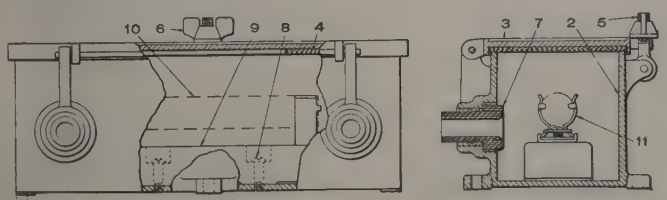


Fig. 1980—Westinghouse C-3 Fuse Box as used in the Compressor Circuit.

Names of Parts of Fig. 1980

2 *Fuse Box*
3 *Cover*
4 *Cover Gasket*
5 *Eye Bolt*
6 *Thumb Nut*
7 *Insulator for Leads*
8 *Fuse Block Screw*
9 *Fuse Block*
10 *Fuse*
11 *Fuse Holder*

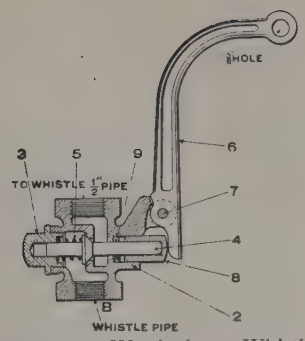


Fig. 1976—Westinghouse Whistle Valve as used with Alarm Whistle Sets.

Names of Parts of Fig. 1976

2 *Valve Body*
3 *Cap Nut*
4 *Valve*
5 *Valve Spring*
6 *Handle*
7 *Screw*
8 *Thimble*
9 *Thimble Seat*

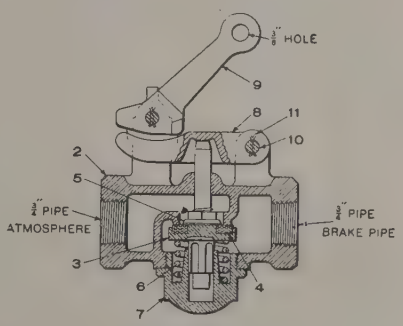


Fig. 1978—Westinghouse B-3-A Conductors Valve.

Names of Parts of Fig. 1979

2 *Cock Body*
3 *Cock Key*
4 *Cap Nut*
5 *Key Spring*
6 *Handle*

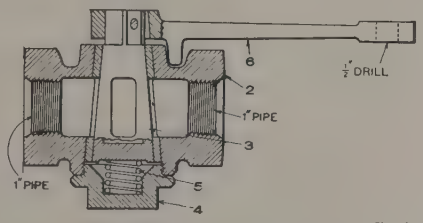


Fig. 1979—Westinghouse Cut-Out Cock with Handle Drilled for Extension.

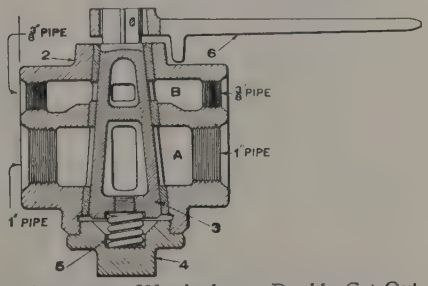


Fig. 1981—Westinghouse Double Cut-Out Cock as used with AMM Equipment.

Names of Parts of Fig. 1982

2 Laminated Field Yoke
3 Front Bearing Housing
6 Armature
7 Field Pole
8 Field Pole Cap Screw
9 ¾" Lock Washer
10 Field Coil
11 Front Bearing Housing Cover
12 Front Bearing Housing Cover Gasket
13 Front Bearing Housing Cover Screw (1" long)
14 Front Bearing Housing Cover Screw (1¼" long)
15 Front Bearing Housing Set Screw
16 Field Yoke M. B. Bolt and Nut
17 Oil Filling Plug
18 Front Bearing Housing Nut
19 Upper Front Bearing Housing Screen
20 Lower Front Bearing Housing Screen
21 Front Bearing Housing Screen Screws
22 ¼" Lock Washer
23 Front Bearing Housing Screen Screw
24 Nut Lock
25 Screen Screw Nut
26 Front Bearing Oil Ring
27 Front Bearing
28 Commutator Door
29 Rear Bearing
30 Rear Bearing Oil Ring
31 Commutator Door Hinge
32 Cottered Hinge Pin
33 1/16" x 1/2" Cotter
34 Commutator Door Latch
35 Upper Carbon Holder
36 Lower Carbon Holder
37 Commutator Door Latch Link
38 Short Latch Link Cottered Rivet
39 Carbon Holder Stud
40 Carbon Holder Lead Screws
41 Carbon Holder Spring
42 Carbon Holder Stud Insulation
43 Carbon Holder Insulating Sleeve
44 Carbon
45 1/16" x 1/2" Cotter
46 Long Latch Link Cottered Rivet
47 Armature Coil
48 Armature Nut
49 Key for Commutator
50 Commutator
51 Commutator Bushing
52 Commutator Taper Ring
53 Commutator Nut
54 Commutator Nut Set Screw
55 Front Insulating "V" Ring
56 Rear Insulating "V" Ring
57 Insulating Sleeve
58 Collared Pinion Nut
59 Motor Shaft Jam Nut
60 Key for Pinion
61 Front Coil Support
62 Rear Coil Support
63 Cleat Screw
64 Lock Washer
65 Cleat for Lead
66 Carbon Holder Lead
67 Knuckle Joint Connector
68 Front Bearing Housing Screw
69 Carbon Holder Insulating Tube
70 Lock Washer
71 ½" Hex. Nut
72 Carbon Holder Bracket
73 Carbon Holder Bracket M. B. Bolt
74 Double Lock Washer
78 Air Spout
79 Air Spout Screen
80 Air Spout Screw
81 Air Spout Gasket
82 Bottom Front Motor Housing Screen Frame
83 Bottom Front Motor Housing Screen
84 Screen Frame Screw
85 ⅜" Lock Washer
86 Blower Frame
87 Blower Frame Screw
88 ⅜" Lock Washer
89 Field Coil Washer
90 Field Coil Spring
91 Lead between Field Coils
92 Lead between Carbon Holder and Field Coil
93 Field Coil Lead
94 Rear Bearing Set Screw
95 Connector for Leads
96 Insulating Plug

Names of Parts of Fig. 1983

102 Field Yoke
103 Field Coil
104 Armature
105 Commutator
106 Right Carbon Holder
107 Left Carbon Holder
108 Front End Bell
109 Salient Pole
111 Lock Washer
112 Salient Pole Cap Screw
113 Hex. Hd. Bolt and Nut
115 Field Coil Spring
116 Armature End plate
117 Ring for Armature End Plate
118 Armature Nut
119 Key for Pinion
120 Key for Commutator
121 Castle Nut
122 Cotter
123 Armature Coil
124 Commutator Bushing
125 Commutator Washer
126 Front Insulating "V" Ring
127 Rear Insulating "V" Ring
128 Insulating Sleeve
129 Taper Ring
130 Commutator Nut
131 Commutator Nut Set Screw
132 Lead Screw
133 Carbon Holder Stud Insulation
134 Carbon Holder Stud
135 Carbon Holder Stud Key
136 Carbon Holder Stud Sleeve
137 Right Carbon Holder Clamp
139 Set Screw for securing Stud to Carbon Holder Clamp
140 Cap Screw for securing Carbon Holder Clamp
141 Carbon Holder Spring
143 Insulating Plug
144 Cleat for Leads
145 Cleat Screw
146 Commutator Door
147 Hinge Pin
148 Latch
149 Latch Eye Bolt
150 Latch Spring
151 Latch Nut
152 Connector for Leads
153 Carbon
154 Field Coil Lead
155 Lead (Field Coil to Carbon Holder)
156 Field Coil Lead (12" long)
157 Left Carbon Holder Clamp
159 Latch Handle
160 Double Lock Washer
161 ¾" Lock Washer
162 No. 10 Lock Washer

Names of Parts of Fig. 1984

2 Combined Motor, Crank and Gear Case
3 Cylinder Cover
4 Cylinder Cover Bolt and Nut
5 Cylinder Cover Bolt and Nut
6 Cylinder Cover Bolt and Nut
7 Front Crank Case Cover
8 Front Crank Case Cover Cap Screws
9 Rear Shaft Bearing Bush
10 Oil Filling Plug
11 Gear Case Cover
12 Gear Case Cover Bolt and Nut
13 Oil Filling Ell
14 Oil Well Cover
15 Oil Well Cover Gasket
16 Oil Well Cover Screw
17 Small Cover for Gear Case
18 Vent Pipe
19 Crank Case Top Cover
20 Crank Case Top Cover Cap Screws
21 Crank Shaft
22 Oil Wheel
23 Oil Wheel Cap Screw
24 ½" Lock Washer
25 Crank Shaft Key
26 Crank Shaft Castle Nut
27 ¼" x 4" Cotter
28 Gear complete
29 Connecting Rod
30 Connecting Rod Cap
31 Connecting Rod Eye Bolt
32 Eye Bolt Nut
33 Eye Bolt Key
34 Eye Bolt Washer
35 Connecting Rod Bush
36 Wrist Pin
37 Wrist Pin Set Screw
38 Piston
39 Piston Ring
40 Inlet Valve
41 Inlet Valve Cap
42 Discharge Valve
43 Discharge Valve Cap
44 Pinion complete
45 Lock for Set Screw
46 Small Gear Case Cover Gasket
47 Small Gear Case Cover Cap Screw
48 Cylinder Bushing
49 Front Crank Case Cover Gasket
50 Crank Case Top Cover Gasket
51 Gear Case Cover Gasket
52 Cylinder Cover Gasket
53 Oil Spout
54 Oil Spout Fl. Hd. Cap Screw
55 Oil Spout Btn. Hd. Cap Screw
56 5/16" Lock Washer
57 ¼" Lock Washer
58 Oil Filling Plug
59 Front Shaft Bearing Bush

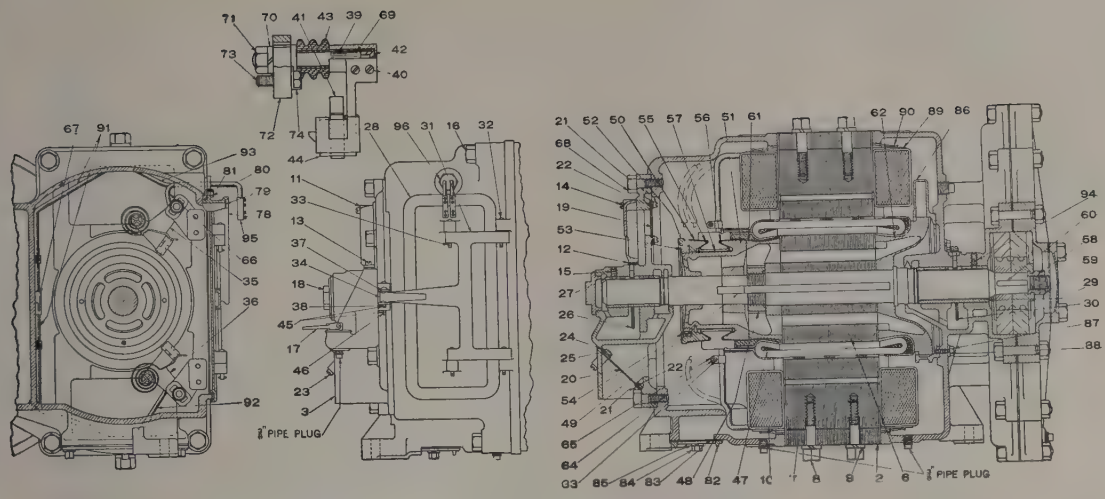


Fig. 1982—Westinghouse Type DF Motor Driven Air Compressor, Motor Portion only.

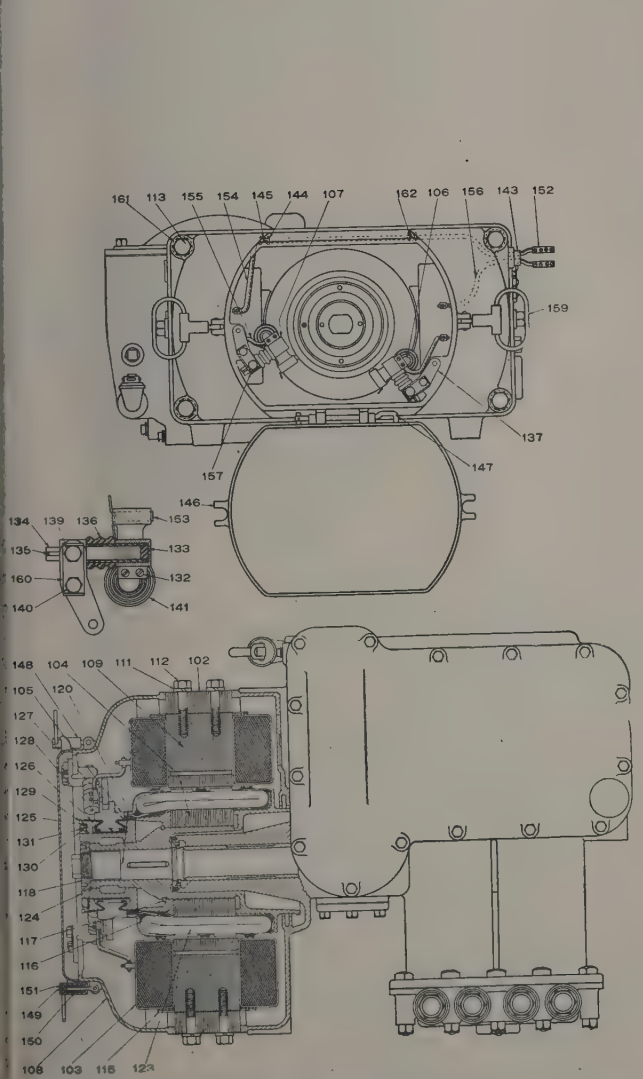


Fig. 1983—Westinghouse Type DH Motor Driven Air Compressor, Motor Portion only.

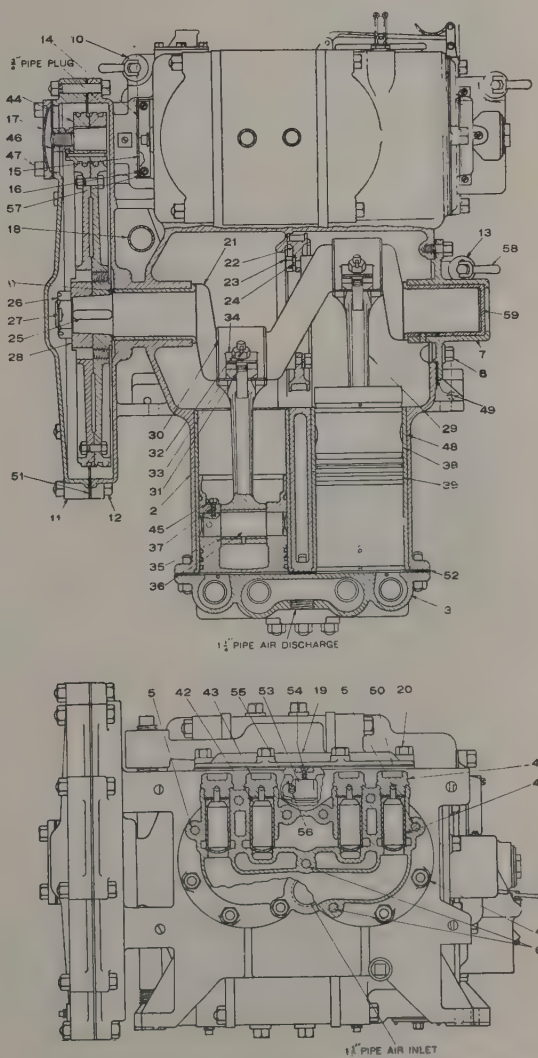


Fig. 1984—Westinghouse Type DF Motor Driven Air Compressor, Compressor Portion Only

Motor Driven Air Compressors

The air compressor, forming a part of every air brake, is of vital importance since upon its proper functioning, depends the integrity of the equipment.

Westinghouse Motor Driven Compressors represent a crystallization of engineering and manufacturing skill combined with practical experience covering an extended period of years. They are possessed of all those characteristics which long association with operating conditions have determined as necessary to insure that they serve their purpose fully.

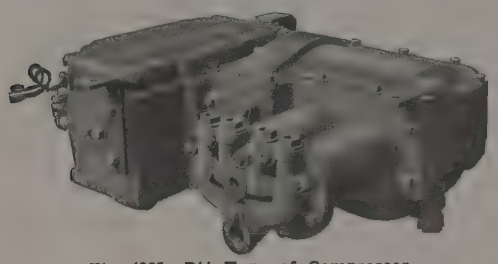


Fig. 1985—DH Type of Compressor

The DEG Compressor is an early design. It is of the duplex, single-acting type, driven through herring-bone gearing, by a series-wound, direct-current, totally-enclosed motor, the complete unit being mounted on a common bed plate and arranged for suspension beneath the car or from the floor. It is made in three sizes: The D-1-EG of 14.5 cu. ft. displacement; the D-2-EG of 25 cu. ft. displacement; and the D-3 EG of 38 cu. ft. displacement.

Fig. 1986—Suction Strainer

The DF Compressor, illustrated in Fig. 1984, is a development of the DEG type and follows the same general lines, but has a number of improvements, made to simplify construction, reduce weight, and permit satisfactory service under more severe operating conditions.

The cylinders, crank case, motor housing, gear case, and shaft bearing are in one integral casting, no bed plate being required. This reduces the number of parts, simplifies machining processes, and assures proper alignment. The motor is of the most modern design, with laminated field yoke, and all parts are designed for severe duty.

Three sizes of this compressor are also made: The D-1-F, of 15.7 cu. ft. displacement; the D-2-F, of 25 cu. ft. displacement; and the D-3-F, of 35 cu. ft. displacement, the latter being provided with a self-ventilated motor. They are designed to permit operation continuously at moderate pressures or for long periods at higher pressures, depending upon the rating of the machine.

The DH Compressor, illustrated in Fig. 1983, was designed particularly to meet the space and weight limitations on low-built, light-weight cars, but it is none the less applicable to all classes of cars. Because of its light weight and low height, it is called the "Bungalow" type.

Simple and compact construction makes for rigidity, quiet running, accessibility, and low maintenance expense. The cylinders, crank case, motor housing, and bearing brackets are in one integral casting. The motor has no outboard bearing but it has a long and liberal bearing extending into the concaved rear end of the armature beyond its center of gravity and a smaller bearing on the inner end of the shaft on the opposite side of the pinion. The field yoke of laminated soft steel of efficient and minimum section, is of the salient pole construction and lies flat at the side of the compressor with the pinion in front of the gear. Thus the compressor occupies the smallest space and has the least weight consistent with the proper operation.

Three sizes of this type of compressor are built: The DH-10, DH-16 and DH-25, the numerals indicating the displacement in cubic feet.

A dynamotor-driven compressor is used on some cars which operate on high voltage lines. The dynamoter runs continuously to supply current at half voltage for lighting and control circuits and to drive the compressor. The desired pressure limits are controlled by a governor acting through a multiple disc clutch between the dynamotor and the compressor. This unit is built in three sizes, having 25, 38 and 50 cu. ft. displacement and called the D-2-LA, D-3-LA and D-4-K respectively.

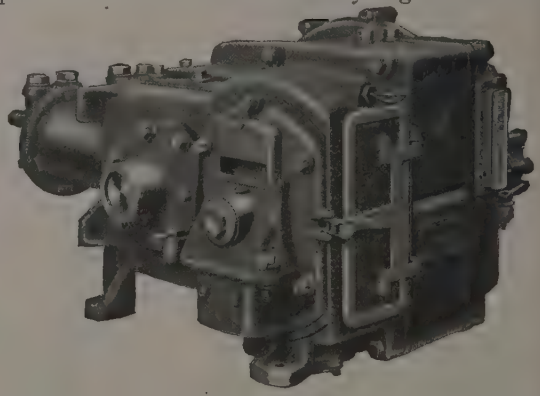
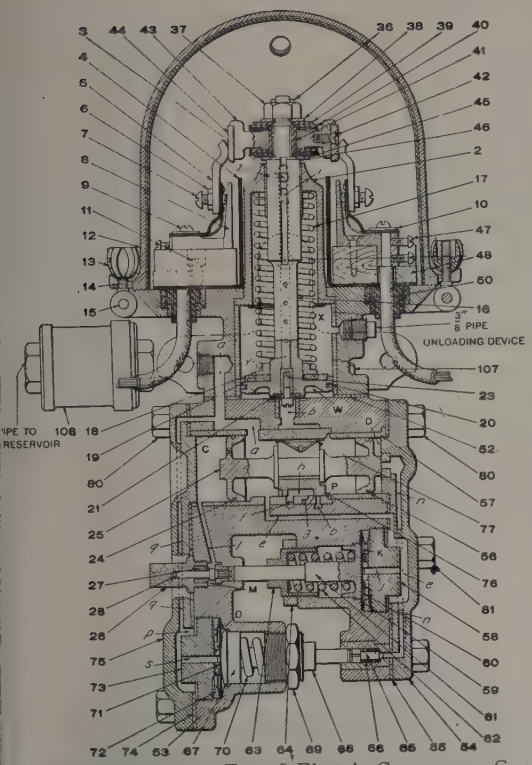


Fig. 1987—D-3-F Compressor

Satisfactory service from Westinghouse compressors is assured because of correct design, high grade materials and careful workmanship. Suction strainers of generous proportions prevent the entrance of dirt into the cylinders with the intake air. Oiling systems are entirely automatic and positive and provide flood lubrication for all wearing parts while preventing the flow of oil to those parts it should not reach.

In general, it may be said of all Westinghouse designs, that they are characterized by mechanical and electrical features of construction which contribute to reliable and economical operation, and to low maintenance cost.

For other products and branch offices, see classified and alphabetical indexes.



Names of Parts of Figs. 1988-1989

2 *Frame*
3 *Guide Pin*
4 *Finger Board Insulation*
5 *Finger*
6 *Adjusting Screw Jam Nut*
7 *Finger Adjusting Screw*
8 *Finger Base*
9 *Screw for securing Finger to Base*
10 *Finger Clamp*
11 *Finger Board Screw*
12 *Switch Cover*
13 *Eye Bolt Thumb Nut*
14 *Cover Eye Bolt*
15 *Eye Bolt Rivet*
16 *Switch Piston and Rod*
17 *Piston Spring*
18 *Piston Spring Seat*
19 *Piston Seal*
20 *Switch Piston Ring*
21 *Piston Seat*
23 *Piston Washer Screw*
24 *Large Ring for Double Piston*
25 *Double Piston with Rings*
26 *Regulating Valve Cap*
27 *Regulating Valve Spring*
28 *Regulating Valve for Cutting Out*
36 *Piston Rod Cotter*
37 *Piston Rod Nut*
38 *Piston Rod Brass Washer*
39 *Piston Rod Fibre Washer*
40 *Piston Rod Fibre Washer*
41 *Square Fibre Bush*
42 *Contact Screw*
43 *Switch Spider*
44 *Switch Spider Contact*
45 *Piston Rod Fibre Washer*
46 *Piston Rod Brass Washer*
47 *Lead Screw*
48 *Finger Board*
50 *Porcelain Bush for Leads*
52 *Frame Gasket*
53 *Valve Case*
54 *Cylinder Head and Diaphragm Cover, for 1 15/32" Cylinder*
55 *Gasket for 1 15/32" Cylinder*
56 *Small Ring for Double Piston*
57 *Piston Bush*
58 *Diaphragm Cap Nut*
59 *Diaphragm Ring*
60 *Diaphragm*
61 *Diaphragm Spindle*
62 *Regulating Spring*
63 *Regulating Nut*
64 *Regulating Check Nut*
65 *Regulating Valve for Cutting In*
66 *Regulating Valve Spring*
67 *Diaphragm Spindle*
68 *Regulating Nut*
69 *Regulating Check Nut*
70 *Regulating Spring*
71 *Diaphragm*
72 *Diaphragm Ring*
73 *Diaphragm Cap Nut*
74 *Gasket for 1¾" Cylinder*
75 *Cylinder Head and Diaphragm Cover for 1¾" Cylinder*
76 *Slide Valve*
77 *Slide Valve Spring*
80 *Short Cap Screw*
81 *Long Cap Screw*
107 *Tee Head Bolt and Nut*

1988—Westinghouse Type J Electric Compressor Governor.

Stringer Filling Piece
Perforated Brass Plate
Cap Nut
Body
Cover
Cap
504 *Armature*
505 *Armature Stem*
506 *Magnet Core*
507 *Core Pole*
508 *Magnet Coil*
510 *Button Head Cap Screw*
511 *Insulator*
512 *Brass Washer*
513 *Terminal*
514 *Exhaust Valve*
515 *Supply Valve*
516 *Supply Valve Spring*
517 *Supply Valve Seat*
518 *Cap Nut*
520 *Terminal Nut*
521 *Rubber Gasket*
522 *Rubber Gasket*

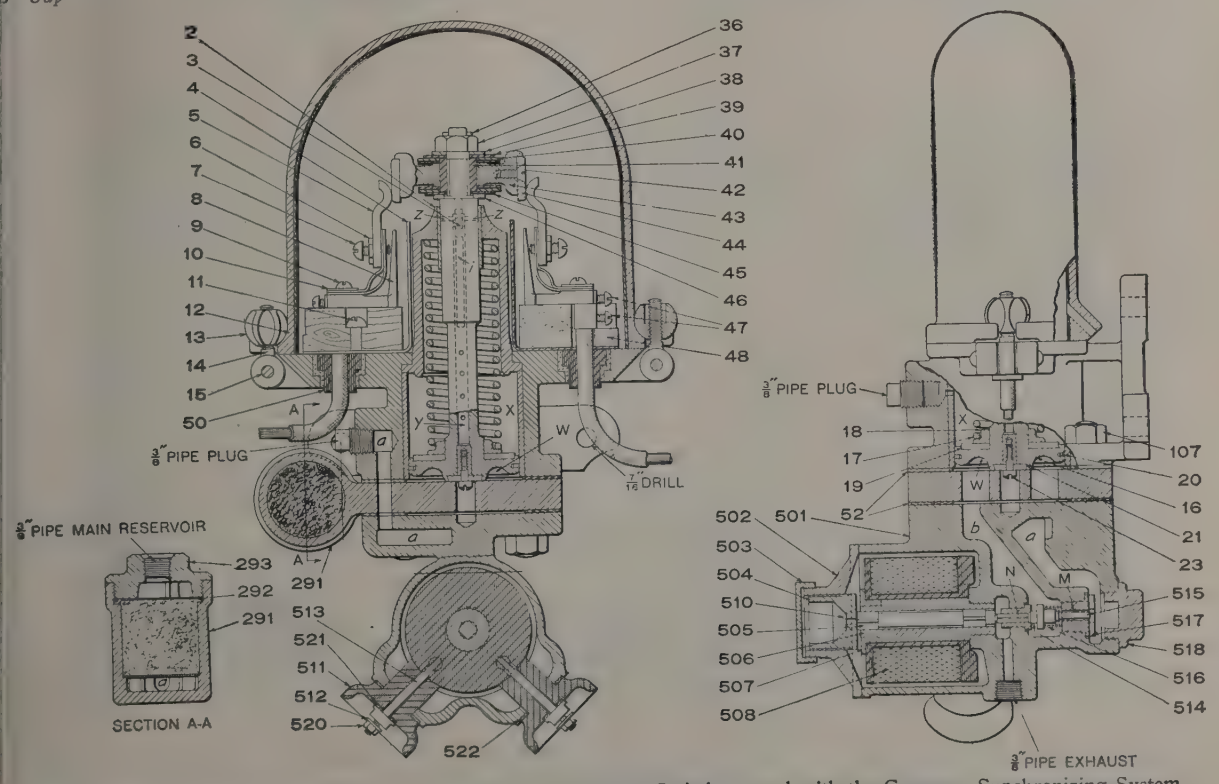


Fig. 1989—Westinghouse A-6 Electro-Pneumatic Compres sor Switch as used with the Governor Synchronizing System.

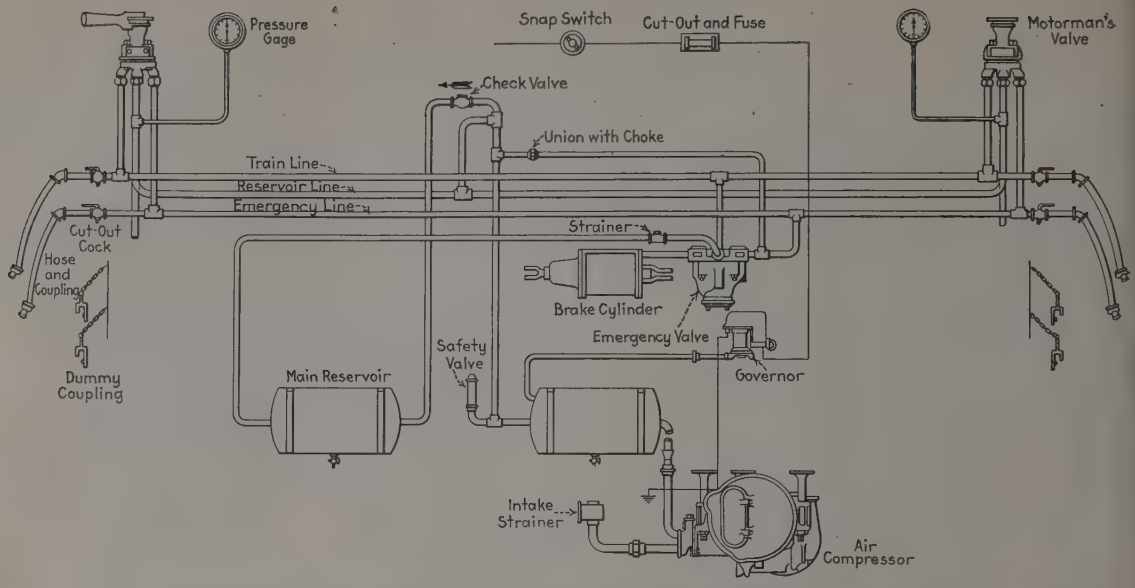


Fig. 1990—Straight Air Brake Equipment with Emergency Feature for Motor Car.

Fig. 1991—Type CP-34-A Air Compressor.

Fig. 1992—Type CP-27-B Air Compressor.

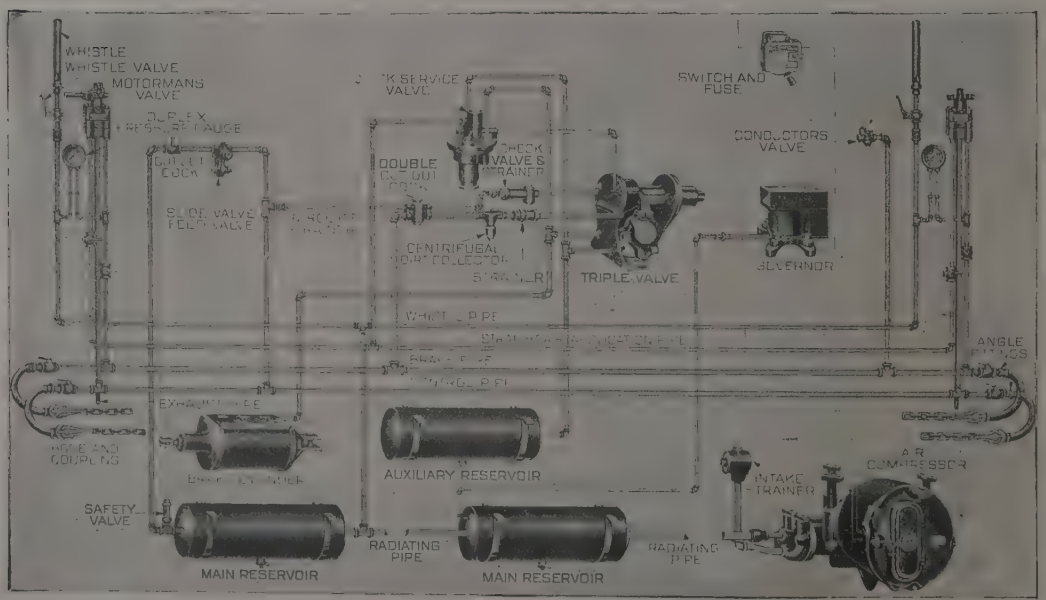


Fig. 1993—Combined Straight and Automatic Air Brake Equipment.
General Electric Company.

Air Brake and Air Signal Instructions

RULES AND INSTRUCTIONS for the maintenance test, and operation of air brakes and air signals have been adopted by the American Railway Association.

In 1895 a code for the guidance of the Committee on Air Brake Tests in testing triple valves was adopted as Recommended Practice for such tests. Revised 1911.

In 1898 the Air Brake and Signal Instructions which had been in use since 1892 were slightly revised and adopted as a Recommended Practice of the Association. Revised in 1904. These instructions were also approved by the American Railway Master Mechanics' Association as originally adopted in 1892 and as revised in 1898 and in 1904.

In 1911 some changes were made in text and illustrations.

In 1914 the Air Brake and Train Air Signal Instructions were revised.

A topical discussion on repairing and cleaning air brakes on such cars as do not get to the repair yards for repairs, will be found in the 1902 M. C. B. Proceedings, page 310.

The report of the committee on Train Brake and Signal Equipment in the 1910 M. C. B. Proceedings, page 83, contains a résumé of the emergency brake tests made on the Lake Shore & Michigan Southern in 1909.

Rules and Instructions on Maintenance of Freight Brakes

Brakes on Cars in Terminal Yards—Test and Repairs

ADOPTED, 1919.

1. Freight cars in terminal yards should have the air brakes tested as follows:

INCOMING TRAINS.

2. Freight trains, on arrival at terminals where inspectors are stationed to make immediate brake inspection and repairs, shall have slack stretched and left with brakes fully applied in service application. Inspection of brakes should be made as soon thereafter as practicable and any needed repairs made; or promptly mark for repair tracks any cars that can not otherwise be repaired.

OUTGOING TRAINS AND YARD TESTS.

3. While the train is being charged, make a visual inspection of retaining valves and retaining valve pipes, position of angle cocks and hose, and examine closely for leaks from the brake pipe and its connections, and make necessary repairs to reduce this leakage to a minimum when the brake system is charged to standard pressure.

4. When the brake is charged to standard pressure, make a 15-lb. service reduction, after which a second examination of the train should be made to determine:

(a) Brake pipe leakage.
(b) If triple valve will operate on service application.
(c) Piston travel.
(d) Brake cylinder leakage.
(e) If the brakes release properly.

5. If, during this test, the brake pipe leakage, as indicated by the brake pipe gage, exceeds 8 lb. per minute, it should be reduced to 8 lb., preferably 5 lb., and if piston travel is less than 6 in. or more than 8 in. it should be adjusted to 7 in. All defects found shall be repaired in the yard or car sent to shop or repair track for necessary attention.

6. In addition to the above terminal tests, at last terminal inspection point prior to descending mountain grades, it must be known that a sufficient number of retaining valves are in good operating condition to control the train.

Brakes on Cars on Shop or Repair Track, With Stencils "In Date"—Test and Repairs

ADOPTED, 1919.

1. All cars on shop and repair tracks (with stencils in date) should be connected to a yard air plant equipped with testing apparatus, and a dummy be connected to a yard plant equipped with testing apparatus, and a dummy coupling attached to hose on the opposite end of car. The pipe, including angle cocks, cut-out cock and hose, to be tested under a pressure of not less than 70 lb., using soapsuds for this test when weather conditions permit. All possible leakage should be eliminated. Any hose found porous or leaking around the fittings, or otherwise defective, and any cocks found leaking at the top of the key should be removed immediately.

2. The brake cylinder must be tested for leakage with a gage attached to the retaining valve exhaust or triple valve exhaust port, and the triple valve tested with a specified testing device to determine whether it will apply and release properly in both service and emergency applications. If the triple valve fails to pass this test or the brake cylinder leakage exceeds 12 lb. per minute, the entire brake equipment must be given the attention specified for cars requiring annual repairs when stencil is out of date. If triple valves and brake cylinder pass the prescribed test, the retaining valve and its pipe must be tested, and the combined leakage from the cylinder, the retaining valve and the retaining valve pipe must not be greater than is specified in the following table:

Type of retaining valve	Position of handle	Initial cylinder pressure	Combined leakage from the cylinder, retaining valve and pipe must not exceed that shown below. Number pounds leakage per minute
15 lb. Single Pressure Spring and Weighted Type	....	10 lb.	7
15-30 Double Pressure Weighted Type	....	20 lb.	10
15-30 lb. Double Pressure Spring Type...	High	20 lb.	10
	Low	10 lb.	7
25-50 lb. Double Pressure Weighted Type	....	40 lb.	14
25-50 lb. Double Pressure Spring Type...	High	40 lb.	14
	Low	15 lb.	9

3. When giving brakes this attention, see that the brake pipe is securely clamped, angle cocks in their proper posi-

tion with suitable clearance—Fig. 1886, page 780—hose and couplings in good condition, reservoirs and cylinders tight on their supports, the supports securely attached to the car, and that the piston travel is adjusted to range from 6 in. to 7 in.

Air Brakes on Freight Cars—Annual Repairs

ADOPTED, 1911; REVISED, 1919.

1. The air brake equipment on freight cars shall receive the following inspection and repairs at least once in 12 months, or if stenciled date is nine months old or over and the car is on the shop or repair track where the work can be done:

CLEANING, LUBRICATING AND INSPECTION OF BRAKE CYLINDERS.

2. First, secure the piston rod firmly to the non-pressure cylinder head, then, after removing the non-pressure head, piston rod, piston head and release spring, scrape off all deposits of gum and dirt with a putty knife or a similar class of tool, and then thoroughly cleanse the removed parts.

3. Packing leathers must be cleaned without the use of oil as same destroys the filler in the leathers, causing them to leak.

4. Thoroughly clean the brake cylinder, including non-pressure head joint, by first using a dull rounded scraper for removal of the heavy grease and dirt, wiping dry with rags or waste. Use no oil unless the substance in the cylinder can not be removed without softening. Rust spots inside of cylinder are to be removed.

5. Particular attention to be paid to cleaning the leakage groove and the auxiliary tube. Triple valve must be removed when the auxiliary tube is being cleaned.

6. The expander ring when applied in the packing leather should be a true circle and fit the entire circumference, having an opening of from 3/16 in. to ¼ in. When removed from the cylinder, the ring opening should be 1½ in. to 1 9/16 in. and with this opening will not be a true circle. It is preferable to exchange packing expanders for others of similar type that have been tested in, and made to conform with a special gage provided at points having triple valve test racks. Send all removed expanders to the same point as the triple valves. Attach to each expander removed from a foreign car a slip or tag showing the car number and the initials of the car from which the expander was removed.

7. A packing leather which is badly worn should be replaced with a new one. If slightly worn on one side, but otherwise in good condition, it should be turned so as to bring the worn side away from the bottom of the cylinder. The packing leather must be placed centrally on the piston head with the flesh side or inside of the leather next to the cylinder.

8. Follower studs to be firmly screwed into the piston heads, and nuts on same to be drawn up tight before replacing the piston.

9. The inside of the cylinder and packing leather to be lightly coated with a suitable lubricant, using 3 to 4 oz. per cylinder.

10. No sharp tools should be used in entering the packing leather into the cylinder.

11. After the piston is entered, and before the cylinder head is replaced, the piston rod should be slightly rotated in all directions, about 3 in. from the center, to be certain that the expander ring is not out of its proper place in the packing.

12. All stencil marks to be scraped off or painted over with a quick-drying black paint. The place of cleaning, the initials of road, day, month and year to be stenciled with white paint on one side of the auxiliary reservoir or brake cylinder, as shown in figure below, or if same is not readily visible, in a convenient location near the handle of the release rod.

13. The bolts and nuts holding the cylinder and reservoir to their respective supports and the latter to the car to be securely tightened.

14. The brake cylinder must be tested, after cleaning, with a gage attached to the exhaust port of the triple valve before connecting the retainer pipe; or where the latest type retainers are used, the gage can be connected to the exhaust port of the retaining valve. In either case, the gage will indicate cylinder leakage on releasing the triple valve after an application, and when attached to the retaining valve it will also test the retainer and retaining valve pipe.

15. Brake cylinder leakage should not exceed 5 lb. per minute, from an initial pressure of 50 lb., with piston travel adjusted to 6 to 7 in.

16. Each time the triple valve and the brake cylinder are cleaned, the brake pipe, brake pipe strainer and branch pipe

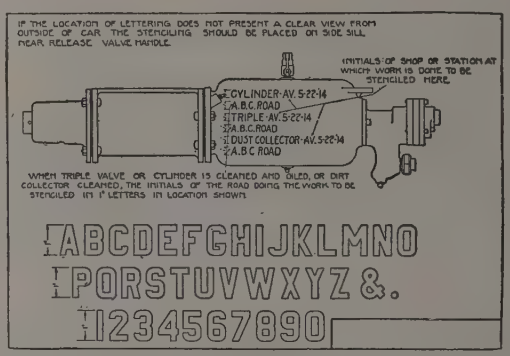

IF THE LOCATION OF LETTERING DOES NOT PRESENT A CLEAR VIEW FROM OUTSIDE OF CAR THE STENCILING SHOULD BE PLACED ON SIDE SILL NEAR RELEASE VALVE HANDLE.
INITIALS OF SHOP OR STATION AT WHICH WORK IS DONE TO BE STENCILED HERE.
CYLINDER AV. 5-22-14
A.B.C. ROAD
TRIPLE AV. 5-22-14
A.B.C. ROAD
DUST COLLECTOR AV. 5-22-14
A.B.C ROAD
WHEN TRIPLE VALVE OR CYLINDER IS CLEANED AND OILED, OR DIRT COLLECTOR CLEANED, THE INITIALS OF THE ROAD DOING THE WORK TO BE STENCILED IN 1" LETTERS IN LOCATION SHOWN
ABCDEFGHIJKLMNO
PQRSTUVWXYZ &.
1234567890

FIG. 1994—STENCILING FOR BRAKE CYLINDER.

should be thoroughly blown out and the triple valve strainer cleaned before recoupling the branch pipe to the triple valve. If a dirt collector is used, the plug should be removed, the accumulation blown out and the threaded portion of the plug shall be coated with oil and graphite before being replaced.

17. All union gaskets should be made of oil-tanned leather. The use of rubber in unions should not be permitted.

18. Piston travel should be adjusted to not less than 6 in. nor more than 7 in.

19. When the brake cylinder and triple valve are cleaned, the following additional work should be performed: Retaining valve cleaned by removing the cap, wiping or blowing out all dirt and seeing that the valve and its seat are in good condition, the retaining position exhaust port open and the valve proper is well secured to the car in a vertical position; pipe clamps applied where missing, and tightened where loose, hose and angle cocks turned to their proper position. Pipe joints, hose, release valve, angle and cut-out cocks should be tested under a pressure of not less than 70 lb. using soapsuds for this test when weather conditions will permit. The retaining valve and its pipe must be tested and the combined leakage from the cylinder, the retaining valve and the retaining valve pipe must not be

greater than the amounts specified by the American Railway Association and given in the following table:

Type of retaining valve	Position of handle	Initial cylinder pressure	Combined leakage from the cylinder, retaining valve and pipe must not exceed that shown below. Number pounds leakage per minute
15 lb. Single Pressure Spring and Weighted Type	....	10 lb.	5
15-30 lb. Double Pressure Weighted Type	....	20 lb.	6
15-30 lb. Double Pressure Spring Type...	High	20 lb.	6
	Low	10 lb.	5
25-50 lb. Double Pressure Weighted Type	....	40 lb.	8
25-50 lb. Double Pressure Spring Type...	High	40 lb.	8
	Low	15 lb.	6

20. Stenciled dates on brake cylinders or auxiliaries should not be changed unless paragraphs 1 to 19, inclusive, have been complied with.

CLEANING, LUBRICATING AND TESTING TRIPLE VALVES.

1. The triple valve shall be removed from the car for cleaning, and replaced by one in good condition. It should be dismantled and all the internal parts, except those with rubber seats and gaskets, cleaned with gasoline or a suitable oil, preferably the former, then blown off with compressed air and wiped dry with a cloth.

2. The slide valve and graduating valve must be removed from the triple piston and retarder-release parts from the body in order that the service ports in the slide valve and other parts may be properly cleaned.

3. No hard metals should be used to remove gum or dirt or to loosen the piston-packing ring in the groove.

4. The feed groove should be cleaned with a piece of wood, pointed similar to a lead pencil. Rags or cloth should be used for cleaning purposes rather than waste, as waste invariably leaves lint on the parts on which it is used.

5. In removing the emergency-valve brass seat, care must be exercised not to bruise or distort it.

6. Particular attention should be given the triple-piston packing ring. It should have a neat fit in its groove in the piston, and also in the triple-piston bushing; once removed from the piston, or distorted in any manner, it should be condemned. The fit of the packing ring in its grove and bushing and the condition of the bushing should be such as to pass the prescribed tests.

7. The graduating stem should work freely in the guide nut. The graduating spring and the retarder-release spring in the retarded-release triple valves must conform to standard requirements and be free from corrosion. The threaded portion of the graduating-stem guide should be coated with oil and graphite before reapplying it to the triple cap.

8. The triple-valve piston and the emergency valve should be tested on centers provided for the purpose to insure same being straight. The emergency-valve rubber seat should invariably be renewed unless it can plainly be seen to be in first-class condition, which is seldom the case. A check-valve case having cast-iron seat should be replaced with a case having a brass seat.

9. The cylinder-cap gasket and check-valve case gasket to be carefully examined and cleaned with a cloth, but should not be scraped; those found hard or cracked to be replaced with gaskets in good condition.

10. Standard gaskets as furnished by the air-brake manufacturers should be used. The use of home-made gaskets should be avoided, as the irregular thickness results in leakage and causes triple-piston stem to bend or break.

11. The tension of the slide-valve spring should be regulated so that the contour of same be such as will bring the outer end ⅛ in. higher than the bore of the bushing

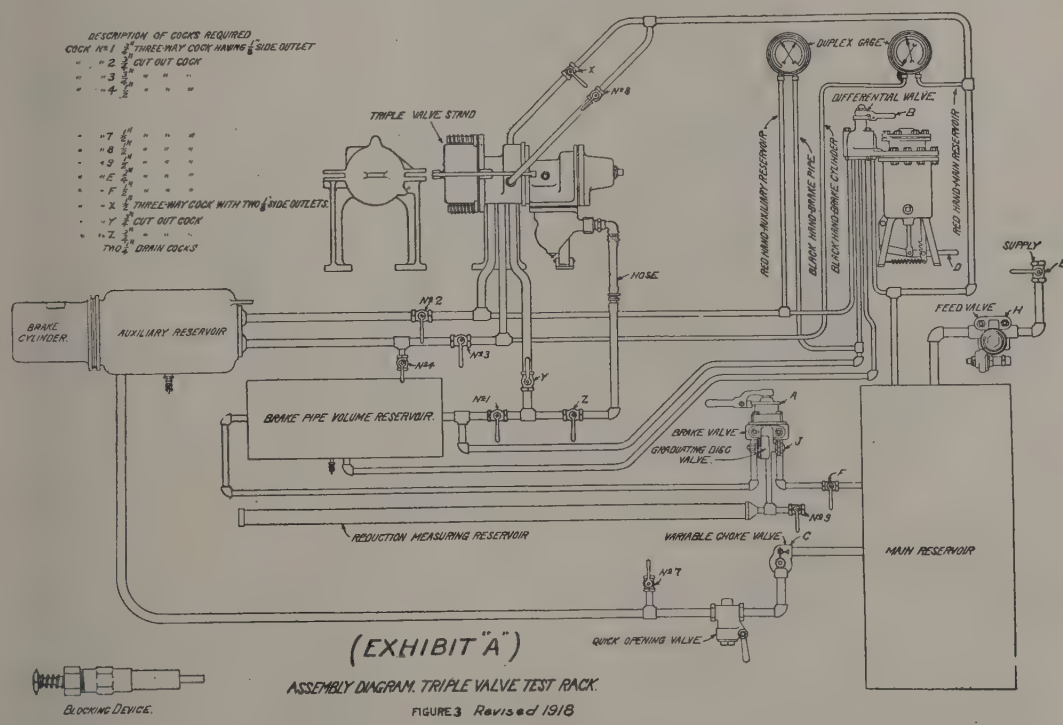

DESCRIPTION OF COCKS REQUIRED
COCK No. 1 ¾" THREE-WAY COCK HAVING ¾" SIDE OUTLET
" " 2 ¾" CUT OUT COCK
" " 3 ¾" " " "
" " 4 ½" " " "
" " 7 ¾" " " "
" " 8 ¾" " " "
" " 9 ¾" " " "
" " E ¾" " " "
" " F ¾" " " "
" " X ¾" THREE-WAY COCK WITH TWO ¾" SIDE OUTLETS
" " Y ¾" CUT OUT COCK
" " Z ¾" " " "
TWO ¾" DRAIN COCKS
TRIPLE VALVE STAND
DUPLEX GAGE
DIFFERENTIAL VALVE
RED HAND-AUXILIARY RESERVOIR
BLACK HAND-BRAKE PIPE
BLACK HAND-BRAKE CYLINDER
RED HAND-MAIN RESERVOIR
SUPPLY
HOSE
FEED VALVE
BRAKE CYLINDER.
AUXILIARY RESERVOIR
BRAKE PIPE VOLUME RESERVOIR.
BRAKE VALVE
GRADUATING DIAG VALVE.
REDUCTION MEASURING RESERVOIR
VARIABLE CHOKE VALVE
MAIN RESERVOIR
QUICK OPENING VALVE
(EXHIBIT "A")
ASSEMBLY DIAGRAM. TRIPLE VALVE TEST RACK.
BLOCKING DEVICE.
FIGURE 3 Revised 1918

FIG. 1995—ASSEMBLY DIAGRAM NO. 1 TRIPLE VALVE TEST RACK.

when the outside end of the spring touches bushing when entering.

12. Before assembling the parts after cleaning, the castings and ports in the body of the triple valve should be thoroughly blown out with compressed air, and all parts of the triple valve not elsewhere provided for known to be in good condition.

13. Lubricate the seat and face of the slide valve and slide-valve graduating valve with high-grade, very fine, dry graphite, rubbing it onto the surface and the upper portion of the bushing where the slide-valve spring bears, with a flat-pointed stick over the end of which a piece of chamois skin has been glued, taking care to work the graphite into the pores of the metal, but leave no loose graphite on the seat.

14. The chamois skin can be dispensed with provided the stick is made of soft wood, such as white pine, which will easily hold all the graphite that can be rubbed into the surfaces of the metal. The parts to be lubricated with graphite must be free from oil or grease.

15. The triple-valve piston-packing ring and its cylinder should be lubricated with either a light anti-friction oil or a suitable grease as follows: Apply a light coating to the packing ring and insert the piston and its valves in the body, leaving them in release position, then lubricate the piston cylinder and move the piston back and forth several times, after which remove the surplus from the outer edge of the cylinder to avoid any lubricant running on the slide valve or seat while the valve is being handled or stored ready for use.

16. No lubricant to be applied to the emergency piston, emergency valve or check valve.

17. All triple valves, after being cleaned or repaired, must be tested on a No. 1 or No. 2 rack as shown in Figs. 1995 and 1996 and pass the prescribed test before being placed in service.

18. Should any of the triple-valve bushings require renewing, work should be done by air-brake manufacturers.

19. Triple valves in which packing rings are to be renewed, slide valve or graduating slide valves renewed or faced, should be sent to a designated point for repairs.

20. When applying the triple valve to the auxiliary reservoir, the gasket should be placed on the triple valve, not the reservoir.

Triple-Valve Tests and Instructions for Operating No. 1 Triple-Valve Test Rack

Mounting Triple Valves for Testing.

With the triple valve gasket applied to the face of the triple-valve flange place the latter against the face of the stand in a vertical position and open cock "X" as shown on attached piping diagram, Fig. 1996. Connect the brake pipe to the triple, then open cock "Z."

Before attaching triple valves suitable for use with 8-in. brake cylinders, insert in the auxiliary reservoir end of the valve the friction-increaser extension piece, suitable for the valve under test.

Two triple-valve stand face plates are required for each test rack to permit the testing of freight triple valves.

Plate No. 1 is for use when testing triple valve for 8-in. cylinders.

Plate No. 2 is for triple valves on 10-in. cylinders.

If it is found necessary to repeat any test which has necessitated a reduction of auxiliary reservoir pressure, valve "B" may be removed to position No. 2, which provides a by-pass around the triple valve from the brake pipe to the auxiliary reservoir, permitting a quick recharge.

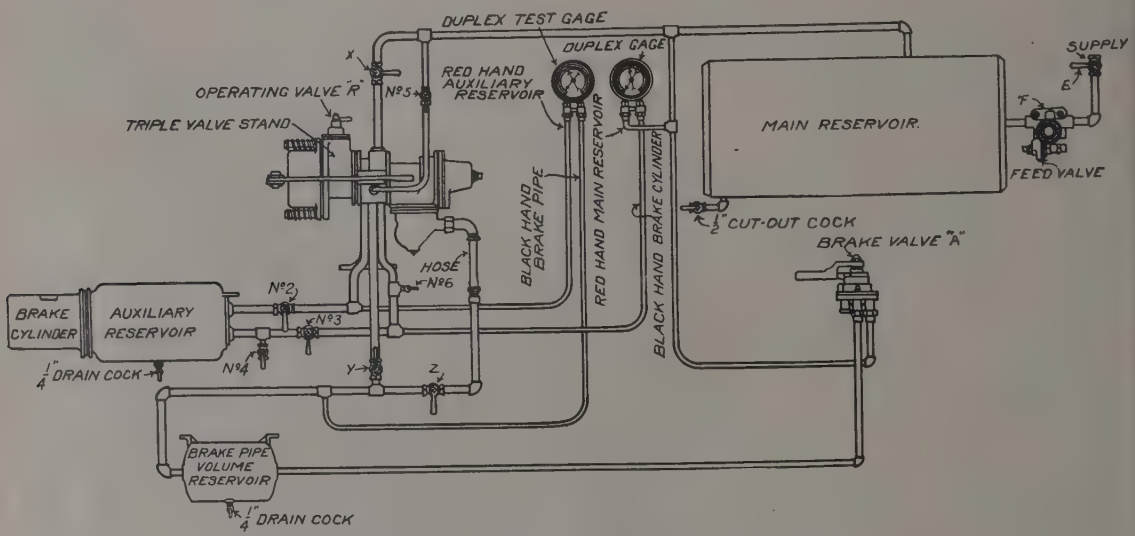


Fig. 1996—Assembly Diagram of No. 2 Triple Valve Test Rack.

Test No. 1.—Charging Test for Triple Valves.

Commencing the tests with cocks 2, 3, 7 and 9 open, all other numbered cocks closed, valve "B" in position No. 3 (lap), valve "A" in position No. 1, auxiliary reservoir empty, main reservoir pressure 80 lb., proceed as follows:

Close cock No. 7 and open No. 1, and with 80 lb. pressure in the brake pipe, note the time required to charge the auxiliary reservoir to specified pressure, as in the table:

Charging Auxiliary Reservoir.

	From 0 to 30 lb. Seconds		From 0 to 70 lb. Seconds	
Type Triple Valve	Min.	Max.	Min.	Max.
8-in. non-quick service	21	28	58	78
10-in. non-quick service	13	17	34	44
8-in. quick service	32	42	100	120
10-in. quick service	19	24	60	72

Note.—If, during this test or Test No. 2 (Leakage Test), any considerable leakage is discovered, the charging test must be repeated.

These tests give practically the same results, and the time of charging from 0 to 30 lb. is given simply to save time in making the test.

TEST No. 2.—LEAKAGE TEST.

Commencing each of the sections of Test No. 2, with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "B" in position No. 3 (lap), valve "A" in position No. 1 and auxiliary reservoir charged to 80 lb., proceed as follows:

SEC. "A," TEST No. 2.—WESTINGHOUSE TRIPLE VALVES AND NEW YORK QUICK-SERVICE TRIPLE VALVES. LEAKAGE AT EXHAUST IN EMERGENCY. CHECK VALVE AND CYLINDER-CAP GASKET LEAKAGE.

Operate the triple valve two or three times in quick action by closing and opening cock No. 1; finally leaving it closed.

Coat the exhaust port of triple valve with soapsuds to ascertain if leakage exists past the slide valve or bushing to the exhaust with the piston and slide valve in emergency position.

Close cocks 2 and 3 and note the rate of fall of pressure indicated by the brake-cylinder gage hand, which is now connected only with the small volume between cocks 2 and 3 and the triple valve. A leakage greater than 5 lb. in 10 seconds indicates either excessive check-valve leakage or that the piston does not seal against the cylinder-cap gasket.

At the completion of this test, open cocks 2 and 3 in the order given.

SEC. "B," TEST No. 2.—LEAKAGE AT EXHAUST IN RELEASE SLIDE VALVE OR EMERGENCY-VALVE LEAKING.

Open cock 1, and after the brake-cylinder pressure is exhausted, close cock 3 and again coat the exhaust port with soapsuds to determine if there is any leakage from the auxiliary reservoir to the brake cylinder past the slide valve when the triple valve is in release position, or from the brake pipe to the brake cylinder past the emergency valve or its seat, when the differential on the emergency valve is high. Open cock 3, then paint the body of the triple valve with soapsuds to determine if leakage exists direct to the atmosphere through castings or gaskets.

If leakage is discovered at the triple exhaust in release position, determine if it is from the auxiliary reservoir or brake pipe in the following manner:

Move valve "A" to position No. 8 and open cock 7 until the brake pipe and auxiliary reservoir are empty; then with the valve "J" in position No. 2 place a soap bubble on the exhaust port and place valve "A" in position No. 3. If no leakage is found at the exhaust, advance valve "J" by stages from position to position until a brake-pipe pressure of 10 lb. is obtained. Any leakage from the exhaust while the auxiliary reservoir is without pressure must be from brake pipe, past the emergency valve. Therefore, if no exhaust leakage is found and leakage did exist while the auxiliary reservoir was charged, it indicates defective slide valve. At the completion of this test, close cock No. 7 and move valve "A" to position No. 1, recharging auxiliary reservoir.

SEC. "C," TEST No. 2.—GRADUATING-VALVE LEAKAGE.

Move valve "A" to position No. 7 until a brake-cylinder pressure of from 20 to 30 lb. is obtained. Then return valve "A" to position No. 3 and close cock 3. If the brake-cylinder pressure then increases without leakage at the exhaust port, it is proper to assume that the graduating valve is leaking, providing it has been determined by the preceding tests that the emergency valve is tight. If leakage at the exhaust occurs during this test, which will be determined by placing a soap bubble on the exhaust, the leakage may be either from slide valve or graduating valve. The rate of rise of pressure on the brake-cylinder gage, resulting from graduating-valve leakage, must not exceed 5 lb. in 20 sec. This comparatively rapid rate of rise is permissible owing to the extremely small volume of the section of brake-cylinder pipe into which the leakage is occurring.

At the completion of test, open cock 3 and move valve "A" to position No. 1.

SEC. "A," TEST No. 2.—NON-QUICK SERVICE. NEW YORK TRIPLE VALVE. LEAKAGE AT EXHAUST IN EMERGENCY. CHECK-VALVE, QUICK-ACTION VALVE AND CYLINDER-CAP GASKET LEAKAGE.

Operate the triple valve two or three times in quick action by closing and opening cock 1, finally leaving it closed.

Coat the exhaust port of triple valve with soapsuds to ascertain if leakage exists past the exhaust valve or bushing, with the piston and slide valve in emergency position. Close cocks 2 and 3. If the brake-cylinder gage now indicates leakage greater than 5 lb. in 10 sec. the leakage is excessive, and is usually due to imperfect seating of the check valve or quick-action valve, or to the main piston not making a tight joint on the main cylinder gasket. To locate the defect, place soap bubbles on the vent ports. No leakage at these points indicates that the leakage is past the main cylinder gasket. If leakage is found at the vent ports, open cocks 1, 2 and 3 and recharge the auxiliary reservoir to 80 lb., then move valve "A" to position No. 7 until the brake-pipe pressure is reduced 10 lb. and return valve "A" to position No. 3. Close cock 2, and if the quick-action valve is leaking, the brake will immediately release. If it does not, the leakage is past the check valve.

At the completion of this test, if no leakage is found, open cocks 1, 2 and 3, and if leakage is discovered, open cock 2 and move valve "A" to position No. 1.

SEC. "B," TEST No. 2.—EXHAUST-VALVE LEAKAGE IN RELEASE; ALSO VENT-VALVE AND QUICK-ACTION VALVE LEAKAGE.

Close cock 3 and coat the exhaust port with soapsuds to determine if there is any leakage from the auxiliary reservoir past the exhaust valve, or graduating valve or triples having this valve tandem with the exhaust valve, when the triple is in release position. If exhaust leakage is found and the triple under test has tandem exhaust and graduating valves, determine which valve is leaking by making graduating-valve leakage test.

SEC. "C." TEST No. 2.—GRADUATING-VALVE LEAKAGE.

Move valve "A" to position No. 7 until a brake-cylinder pressure of from 20 to 30 lb. is obtained. Then return valve "A" to position No. 3 and close cock 3. If the brake-cylinder pressure then increases without leakage at the exhaust port, it is proper to assume that the graduating valve is leaking. The rate of rise of pressure on the brake-cylinder gage, resulting from graduating-valve leakage, must not exceed 5 lb. in 20 sec. This comparatively rapid rise is permissible owing to the extremely small volume of the section of brake-cylinder pipe into which the leakage is occurring.

If leakage at the exhaust occurs during this test, which will be determined by placing a soap bubble on the exhaust, the leakage is by the exhaust valve instead of the graduating valve.

At the completion of the test open cock 3 and move valve "A" to position No. 1.

TEST No. 3.—TEST OF TYPE "K" TRIPLE VALVES FOR RETARDED-RELEASE FEATURE; FOR BOTH WESTINGHOUSE AND NEW YORK TRIPLE VALVES.

Commencing the test with cocks 1, 2, 3 and 9 open, all

other numbered cocks closed, auxiliary reservoir charged to 80 lb., valve "B" in position No. 3 (lap), lever "D" in position No. 2 and valve "A" in position No. 3 (lap), proceed as follows:

Move valve "A" to position No. 7 until brake-pipe pressure is reduced 20 lb., then return it to position No. 3; place valve "J" in position No. 4; valve "B" in position No. 1 and valve "A" in position No. 2. This should move the triple-valve parts to normal (full release) position.

If the triple valve moves to retarded-release position, which is indicated by a contracted exhaust and slow release of brake-cylinder pressure, it indicates a weak or broken retarded-release spring, or undue friction in retarding device.

Following this test, recharge the system to 80 lb. by moving valve "A" to position No. 1 and valve "B" to position No. 2.

When the brake pipe and auxiliary reservoir are charged to 80 lb., move valve "B" to position No. 3 and valve "A" to position No. 7 until brake pipe pressure is reduced 20 lb., then return it to position No. 3. Place valve "J" in notch No. 8, lever "D" in notch No. 4, valve "B" in position No. 1 and valve "A" in position No. 2.

Under these conditions the triple-valve piston and slide valve should be forced to retarded-release position. If this does not occur, it indicates that the retarded-release spring is not standard, or the retarding devices have excessive friction. Completing test, place valve "B" in position No. 3 and valve "A" in position No. 1.

SEC. "A," TEST NO. 4.—APPLICATION TEST FOR BOTH WESTINGHOUSE AND NEW YORK TRIPLE VALVES.

If for any reason it is desired to make this test following an application and release produced by closing and opening cock No. 1, or the auxiliary reservoir has just been charged by opening cock 1, this test should be preceded by an application and release with valve "A," for the purpose of insuring the slide valve being in its normal position.

Commencing the test with cocks 2, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 2 and lever "D" in notch No. 3, then with the auxiliary reservoir charged to 80 lb., proceed as follows:

To test triple valves for 8-in. cylinders, place valve "B" in position No. 4 and valve "A" in position No. 5.

To test triple valves for 10-in. cylinder, place valve "B" in position No. 4 and valve "A" in position No. 6.

In all of these tests the triple valve should move to application position without causing a discharge of air from the vent port of valve "B."

A failure to apply under the conditions specified indicates either excessive friction, which will be shown by an exhaust from the vent port of valve "B"; a leaky packing ring, which will be discovered later by the packing-ring leakage test; too large a feed groove in the cylinder, or a combination of two or more of these defects. Should the triple valve fail to apply and no exhaust occur from valve "B," the indications are that the back flow of air from the auxiliary reservoir to the brake pipe is too rapid to permit the required differential.

At the completion of this test, move valve "B" to position No. 3 and valve "A" to position No. 1.

SEC. "B."—QUICK-SERVICE TEST (FOR QUICK-SERVICE TRIPLE VALVES ONLY) FOR BOTH WESTINGHOUSE AND NEW YORK TRIPLE VALVES.

Commencing the test with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3 and auxiliary reservoir charged to 80 lb., proceed as follows:

Close cock 9 and move valve "A" to postion No. 7 for all 8-in. and 10-in. triple valves. The brake-cylinder pressure obtained should not be less than 5 lb. greater than that which will be obtained by subjecting to the same test triple valves which do not contain the quick-service features.

At the completion of this test, move valve "A" to position No, 1 and open cock 9.

TEST NO. 5.—PACKING-RING LEAKAGE TEST FOR BOTH WESTINGHOUSE AND NEW YORK TRIPLES.

Release Test, Sec. 1.—Commencing with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3 and the auxiliary reservoir charged to 80 lb., proceed as follows:

Place the valve "A" in position No. 7 until the brake-pipe pressure is reduced 15 lb., then return to position No. 3 (lap). Place valve "J" in position No. 2, lever "B" in notch No. 1 and valve "B" in position No. 1; close cocks 2 and 3 and move valve "A" to position No. 2. If the discharge does not occur promptly from the vent port of valve "B," advance valve "J" from position to position until the discharge begins, then note the rate of increase of pressure on the auxiliary reservoir gage, which must not exceed 5 lb. in 30 seconds.

During this test there must be a steady exhaust of air from the vent port of valve "B" to insure the proper differential being maintained on the triple-valve piston. If, in making this test, the triple valve for the 8-in. cylinder releases or indicates excessive ring leakage, make another test after blocking triple-valve piston in service lap position.

Should it occur that the friction of the triple valves is so low as to continue to permit the triple to release, the reduction for the application may be changed from 15 to 10 lb. When this is done, special attention should be given to determine if the graduating valve is right, as it must be to permit an accurate test.

At the completion of this test, place valve "B" in position No. 3, open cocks 2 and 3; place valve "A" in position No. 1.

TEST NO. 6, SEC. 2.—FRICTION TEST. RELEASE TEST FOR BOTH WESTINGHOUSE AND NEW YORK VALVES.

Commencing the test with cocks 1, 2, 3 and 9 open, and all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3, auxiliary reservoir charged to 80 lb.

Place lever "D" in notch No. 3 for triple valves undergoing the test; proceed as follows:

Place valve "A" in position No. 7 until the brake-pipe pressure is reduced 10 lb., then return it to position No. 3. Place valve "J" in position No. 1, valve "B" in position No. 1, and move valve "A" to position No. 2. Under these conditions the triple valve should release. A failure to release should be accompanied by a discharge at the vent port of valve "B," which indicates that frictional resistance to movement of packing ring and slide valve is excessive.

If the triple valve does not release and valve "B" fails to open its exhaust, leakage is occurring from the brake pipe, which will necessitate advancing valve "J" from position to position, remaining in each position 30 seconds, until the triple valve releases or the exhaust in valve "B" opens.

At the completion of the test, place valve "B" in position No. 3 and valve "A" in position No. 1.

TEST NO. 7, SEC. "A."—SERVICE-PORT CAPACITY TEST FOR WESTINGHOUSE TRIPLE VALVES AND QUICK-SERVICE NEW YORK TRIPLE VALVES.

Commencing with cocks 1, 2, 3 and 9 open, valve "A" in position No. 1, valve "B" in position No. 3, place valve "C" in position required for the triple valve under test, as indicated.

Notch No. 1.—For 8-in. triple valves.

Notch No. 2.—For 10-in. triple valves.

During this test the brake-pipe pressure should not drop, except that in the case of the quick-service triple valves

there will, of necessity, be a slight drop, which must not exceed 2 lb.

Place valve "B" in position No. 2 and move valve "A" to position No. 3, open cock 7 until brake-pipe and auxiliary reservoir pressure are reduced to 50 lb., then close cock 7. Move valve "B" to position No. 3 and open combination cock 6 and quick-opening valve, leaving it open 3 seconds. This test should not produce quick-action. If it does, it indicates a service port restriction, or a weak spring.

Sec. "B."—Duplicate the tests specified under Sec. "A," placing the wheel of valve "C" in the position as indicated.

Notch No. 3.—For 8-in. triple valves.

Notch No. 5.—For 10-in. triple valves, excepting Westinghouse non-quick service, with which use notch No. 7.

This should result in the triple valve moving to emergency position. Failure indicates too close fit of emergency piston.

At the completion of the test, close cock 4 and combination cock 6 and quick-opening valve, move valve "A" to position No. 1.

Test No. 7, Sec. "A."—Service-port Capacity Test for New York Non-quick Service Triple Valves.

Commencing with cocks 1, 2, 3, 4 and 9 open, valve "A" in position No. 1, valve "B" in position No. 3, place valve "C" in position required for the triple valve under test.

Notch No. 1.—For 8-in. No. 2.—For 10-in. triple valves.

Place valve "B" in position No. 2 and move valve "A" to position No. 3. Open cock 7, until brake pipe and auxiliary reservoir pressure are reduced to 50 lb., then move valve "B" to position No. 3 and open cock 6 quickly.

Note.—During this test the triple valve should move to service position, the brake-pipe pressure must not drop and there must be no discharge of air from the vent ports. Should the triple valve move to emergency position, it indicates a restriction in the service ports or weak vent-valve spring.

Sec. "B."—Duplicate the test specified under Sec. "A," placing the wheel of valve "C" in the position as indicated for the triple valve under test.

Notch No. 3.—For 8-in. No. 5—For 10-in.triple valves.

This should result in the triple valve moving to emergency position, causing a strong blast of air from the vent ports and a brake-pipe reduction of at least 3 lb. Failure to do so indicates too loose fit of vent-valve piston packing.

Triple-valve Test and Instructions for Operating No. 2 Triple-valve Test Rack.

ADOPTED, 1919.

Repaired work should pass test specified for new work.

Valves failing to pass the cleaner's test are to be repaired before returning them to service.

Where only one test limit is given, the same limit applies to new, repaired and cleaned valves.

The brake-pipe pressure to be carried is 80 lb.

Note.—If it is found necessary to repeat any test which has necessitated a reduction of auxiliary reservoir pressure, valve "R" may be moved to position No. 7, which provides a by-pass from the main reservoir to the auxiliary reservoir, thereby permitting a quick recharge.

The instructions are complete for each specified test without reference to any other test. The sequence of the tests, however, should be followed as given, so that each test may reveal one thing, unobscured by several variables.

Test No. 1.

RESISTANCE TEST.

The resistance to movement of the triple-valve piston and slide valve is measured before the triple valve is clamped on the stand, with the standard measuring device. At the start of this test, the triple-valve piston and slide valve must be in release position. To insure that these parts are in release position, bump the triple valve lightly against the bench a few times with the bolting face downwards. Then with the triple valve in position so that the piston moves horizontally with the slide valve resting on its seat, place the measuring device against the spider of the piston and force the handle inward. The force required to overcome the resistance of the piston and slide valve will be registered by the indicator, which is graduated in pounds.

The resistance should not exceed 6 lb. for all triple valves with slide valve in place, or 5 lb. for the piston and ring alone in the bush.

This resistance can best be measured before the triple valve is completely assembled, especially for type "K" triple valve, where retarded release device obscured observation.

APPLYING PISTON STOPS.

Before placing the triple valve on the stand, the proper piston stop spindle should be screwed in up to the shoulder in the small piston within the triple-valve stand.

MOUNTING TRIPLE VALVES FOR TESTING.

When mounting triple valves on stand, apply gasket to the triple-valve flange, place the latter against the testing stand in a vertical position, and open cock "X," connect the brake pipe to the triple valve with the union hose and open cock "Z." Cock "Y" should always be closed and cock "Z" open, while the triple valve is on the stand for test.

Test No. 2.

CHARGING TEST FOR ALL TRIPLE VALVES.

Commencing the test with cocks 2 and 3 open, all other numbered cocks closed, valve "A" in position No. 8, valve "R" in position No. 1, auxiliary reservoir empty and main reservoir pressure 80 lb., proceed as follows:

Move valve "R" to position No. 2 and valve "A" to position No. 1 and with brake-pipe pressure maintained at 80 lb., note time required by various triple valves to charge auxiliary reservoir to the pressure specified in table.

	Time in Sec. to Charge Aux. Rec. from 0 to 30 lbs. New and Repaired Valves	from 0 to 70 lb. New and Repaired Valves	from 0 to 30 lb. Cleaned Valves	from 0 to 70 lb. Cleaned Valves
Type of Triple Valve				
K-1	35 to 50	90 to 130	30 to 60	80 to 155
K-2	20 to 30	55 to 85	18 to 35	50 to 95
+H-1	21 to 28	58 to 78	19 to 30	50 to 80
+H-2	13 to 17	40 to 52	11 to 19	34 to 58
°F-1-B	20 to 28	58 to 78	.....	.....
°H-1-B	13 to 17	40 to 52	.....	.....

+ Westinghouse triple valves.
°New York triple valves.

Test No. 3.

LEAKAGE TEST.

Commencing each of the sections of Test No. 3 with cocks 2 and 3 open, all other numbered cocks closed, valve "A" in position No. 1, valve "R" in position No. 2, and auxiliary reservoir charged to 80 lb., proceed as follows:

SECTION "A."

LEAKAGE IN EMERGENCY POSITON.

CHECK VALVE AND CYLINDER CAP GASKET LEAKAGE.

Operate the triple valve two or three times in quick succession by moving valve "A" between positions No. 1 and

Note.—The charging times given, from 0 to 30 lb. and from 0 to 70 lb., are equivalent, and either may be used, the former is to save time in making the test.

Note.—If, during the test, or Test No. 3 (Leakage Test), any considerable leakage is discovered, the charging test must be repeated, after the leakage is eliminated.

No. 8 several times, finally leaving valve "A" in position No. 8.

Coat the brake cylinder exhaust port of the triple valve with soapsuds to ascertain whether leakage exists past the slide valve, or bushing to the exhaust.

For new and repaired valves, close 2 and 3; for cleaned valves, not new, and not repaired, close cock 2 only. Then note the rate of fall of pressure on brake-cylinder gage. Check valve and cylinder cap gasket leakage will produce a drop in brake-cylinder pressure, and individual check valve or cylinder cap gasket leakage should not exceed 5 lb. in 10 seconds. If the cylinder cap and check valve leakage combined is greater than 5 lb. in 10 seconds, it should be ascertained that the individual leakage is not greater than 5 lb. in 10 seconds, by applying a new cylinder cap gasket known to be free from leakage in place of the one under test, and repeating the test with the new gasket. Check valve leakage only will then be indicated, which should not exceed 5 lb. in 10 seconds. Deducting check valve leakage from the combined leakage gives the cylinders gasket leakage, which also should not exceed 5 lb. in 10 seconds.

Screw pipe plug in exhaust connection, move valve "A" to position No. 1 and soap valve all over to locate leakage through the body, or at the gaskets.

At the completion of this test, open cocks 2 and 3 in the order given, and remove pipe plug from triple valve exhaust.

SECTION "B."

LEAKAGE IN RELEASE POSITION.

SLIDE VALVE, EMERGENCY CHECK AND VENT VALVE LEAKAGE.

Move valve "A" to position No. 1, and after the brake-cylinder pressure is exhausted, close cock 3, and again coat the exhaust port with soapsuds to determine leakage by the slide valve in release position from the auxiliary reservoir to the brake cylinder, or leakage by the emergency valve from the brake pipe to the brake cylinder. At the conclusion of the test, open cock 3.

Leakage at the triple valve exhaust in release position indicates leakage of the emergency valve of a Westinghouse or K triple valve, the check valve of a New York F-1-B, and H-1-B, or the slide valve of any of these triple valves.

To separate these leakages, in order that the defect may be located and remedied, it is necessary to have available for a Westinghouse or K triple a complete triple valve check case with all its parts in good condition. Substituting this good check case for the one on the defective triple valve and repeating the test will enable locating the source of leakage.

If leakage is discovered at the triple valve exhaust of New York F-1-B or H-1-B triple valve in release position, determine if it is from the auxiliary reservoir past the seat of the slide valve or from the auxiliary reservoir past the emergency check valve by making a 10-lb. brake pipe reduction with valve "A," then return valve "A" to position No. 3 and observe the pressure indication on the duplex gages for 30 seconds. If the auxiliary reservoir pressure falls or the triple valve releases, it indicates emergency check valve leakage.

At the completion of the test, move valve "A" to position No. 1.

SECTION "C."

LEAKAGE IN SERVICE LAP POSITION.

GRADUATING VALVE LEAKAGE.

Move valve "A" to position No. 4 until a brake cylinder pressure of 30 lb. is obtained. Then return valve "A" to position No. 3 and close cock 3.

Observe the pressure on brake cylinder gage. An increase in pressure indicates graduating valve leakage (and in rare instances slide valve leakage, emergency valve leakage or emergency check valve leakage). The rate of increase in brake cylinder pressure should not exceed 5 lb. in 20 seconds for new and repaired valve, or 10 lb. in 20 seconds for cleaned valves.

Upon the completion of the test, open cock 3 and move valve "A" to position No. 1.

Test No. 4.

(A) RELEASE TEST FOR ALL TRIPLE VALVES.

Commencing the test with cocks 2 and 3 open, other numbered cocks closed, auxiliary reservoir charged to 80 lb. valve "A" in position No. 1, valve "R" in position No. 2, proceed as follows:

Move valve "A" to position No. 4 and make sufficient reduction to produce 30-lb. brake cylinder pressure, then return valve "A" to position No. 2. This should move the triple valve piston and slide valve to full release position.

The time of release of brake cylinder pressure from 30 lb. to 5 lb. for the respective triple valves should not exceed:

4 seconds for K-1, K-2, H-1 and F-1-B.

3 seconds for H-2 and H-1-B.

Longer release times than the above indicate a restriction in the exhaust passage.

A longer release time than 4 seconds for the K-1 and K-2 triple valves may indicate that the retarding device spring is broken, or that the retarding device has excessive friction and is sticking in retarded release position.

Following this test, recharge the system to 80 lb. by moving valve "A" to position No. 1.

(B) RETARDED RELEASE TEST FOR TYPE K TRIPLE VALVES.

With brake pipe and auxiliary reservoir charged to 80 lb. move valve "A" to position No. 4 and make sufficient reduction to produce 30-lb. brake cylinder pressure, then return valve "A" to position No. 1.

The triple valve piston and slide valve should be forced to retarded release position, indicated by a slow release of brake cylinder pressure. The time of release of cylinder pressure from 30 lb. to 5 lb. should be:

8 to 12 seconds for K-2.

14 to 20 seconds for K-1.

If in this test the time is shorter than specified, the piston and slide valve are stopping short of retarded release position, and it indicates that the retarding device is offering excessive resistance, which is most likely to be caused by the retarding device sticking in the cap.

Test No. 5.

QUICK SERVICE PORT TEST FOR TYPE K TRIPLE VALVES.

Commencing with cocks 2, 3 and 4 open, all other numbered cocks closed, valve "A" in position No. 1, valve "R" in position No. 2, proceed as follows:

Place valve "A" in position No. 3 and move valve "R" to position No. 1, reducing both auxiliary and brake pipe pressure to 60 lb.

Then place valve "R" in position No. 5. Brake pipe pressure should drop 5 lb. in not more than 4 seconds. If, however, the triple valve piston moves to full service position before the 4 seconds time has elapsed, the triple valve should be passed, provided the brake pipe pressure has been reduced 2½ lb. or more.

NOTE.—In making this test it will be noticed that a slight rise occurs in brake pipe pressure, due to the displacement of the triple valve piston as it moves toward service position. *The measurement of time and pressure should start with the attainment of the maximum pressure in the brake pipe.*

If the requirements of this test are not met, the quick service port must not be unduly restricted.

At the completion of this test, place valve "R" in position No. 2 and valve "A" in position No. 1.

Test No. 6.

PACKING RING LEAKAGE TEST.

Commencing the test with cocks 2 and 4 open, other numbered cocks closed, valve "A" in position No. 1, place valve "R" in position No. 3. Move valve "A" to position No. 8 for H-1, H-2, K-1 and K-2 triple valves and position No. 5 for F-1-B and H-1-B triple valves and reduce brake pipe pressure to 62 lb., returning valve "A" to position No. 3. Open cock 6 and reduce auxiliary reservoir pressure to 60 lb., using valve "R" in position No. 4 if necessary to reach this point. With type "K" triple valves leave cock 6 open —for all other types, close it. Reduce brake pipe pressure to 60 lb. with valve "A" in position No. 4. Both auxiliary and brake pipe pressures should now be just the same at 60 lb.

Move valve "R" to position No. 4, noting the rate of brake pipe pressure drop.

For new and newly repaired triple valves, this drop should not exceed 5 lb. in one minute. The test may be ended and the packing ring approved if the differential between brake pipe and auxiliary reservoir pressure has become 6 lb. in 35 seconds or less, but in case of doubt the brake pipe drop limit will always govern. It is permissible to repeat this test once or twice if the ring has failed on a margin of 1 lb. or less, and if it passes any single test the ring should be approved.

When the brake pipe pressure drop exceeds 7 lb. in 1 minute, the triple valve can not be expected to operate satisfactorily under the conditions characteristic of service; therefore, to provide a suitable margin to insure satisfactory operation, a triple valve removed from service for test should not be returned to service without making proper repairs when this drop in brake pipe pressure exceeds 6 lb. in one minute.

NOTE.—Rubber seated valve leakage, if any exists, will be indicated on this test as ring leakage. To prevent condemning the ring on account of rubber seated valve leakage, after completing the ring tests, increase brake pipe pressure 5 lb. above the auxiliary using valve "A," leaving valve "R" in position No. 3. Then open cock No. 6. Rubber seated valve leakage will be indicated by a continuous blow at cock No. 6 with H-1, H-2, K-1 and K-2 valves, or at the vent port in the F-1-B or H-1-B.

Upon the completion of this test, place valve "R" in position No. 2, valve "A" in position No. 1 and open the cock designated No. 3.

Test No. 7.

SERVICE STABILITY TEST.

With cocks 2, 3 and 4 open, other numbered cocks closed, and valve "R" in position No. 2, move valve "A" from position No. 1 to the position listed for the triple valve undergoing test.

Position No. 4 for H-1, K-1 (H-2 with 3/16-in. service ports).

Position No. 5 for F-1-B and H-1-B.

Position No. 6 for H-2, K-2.

The triple valve must not go to emergency before the brake pipe pressure is reduced 20 lb. If it does, it indicates a restricted service port, or weak graduating spring in the H-1, H-2, K-1 and K-2 triple valves, or too close a fit of the vent valve piston ring, or restriction in the vent port in the vent valve piston of the F-1-B and H-1-B triple valves.

At the completion of this test, place valve "A" in position No. 1 and place valve "R" in position No. 2.

Test No. 8.

EMERGENCY TEST.

H-1, H-2, K-1 AND K-2 TRIPLE VALVE.

With cocks 2, 3 and 4 open, other numbered cocks closed, and vavle "R" in position No. 2, move valve "A" from position No. 1 to position listed for the triple valve under test.

Position No. 7 for H-1, K-1 (H-2 with 3/16-in. service port). Position No. 8 for K-2.

For the H-2 triple valves, open cocks 2, 3 and 4, place valve "R" in position No. 7, close cock "E" and move valve "A" to position listed for the valve undergoing test.

This test should produce emergency before the brake pipe pressure has dropped 20 lb. Failure to produce emergency indicates improper fitting or assembly of emrgency parts.

To determine if emergency valve seats properly when releasing, open cock "E" (if closed for this test), place valve "R" in position No. 2 and place valve "A" in position No. 2. Triple valve should release promptly. If blow continues at exhaust, emergency valve is leaking, due either to its seating improperly, dirt, etc.

EMERGENCY TEST F-1-B AND H-1-B TRIPLE VALVE.

With cocks 2, 3 and 4 open, other numbered cocks closed, and valve "R" in position No. 2, move valve "A" quickly from position No. 1 to position No. 8. When the triple valve vents, move valve "A" to position No. 3 so as to determine the amount of brake pipe reduction caused by the venting of the triple valve.

This should cause the triple valve to produce emergency, venting the brake pipe pressure from 80 lb. to 20 lb., or under. If the brake pipe pressure is not vented to 20 lb. it indicates too poor a fit of the vent piston ring. If it vents the brake pipe pressure to zero it indicates too tight a fit of the vent piston ring in the bushing.

NOTE.—If it becomes necessary to improve the fit of the vent piston ring to meet the emergency test it will be necessary to again repeat Test No. 7, Service Stability Test.

Triple Valve Test Requirements for Freight Service

Recommended Practice—ADOPTED, 1895; REVISED, 1911.

CONDITION OF TESTS.

Construction of Rack.—Triple valves will be tested on a rack representing the piping of a one-hundred (100) car train. All cocks, angles and connections will be as nearly as possible identical with those in train service. The rack shall conform to blue-print No. C-11379 (Rev. 3-9-09) in the hands of the committee, which gives the proper fittings, piping, cylinders, auxiliary reservoirs, main reservoirs, automatic brake valves, etc.

Reservoir Capacity.—The main reservoir capacity shall be approximately 57,000 cubic inches.

The capacity of each auxiliary reservoir shall be such as will, with a pressure of 70 pounds, produce 50 pounds pressure in its brake cylinder when fully equalized in service application with 8 in. piston travel.

Air Supply.—The air supply for the test rack shall be obtained from a locomotive type of air compressor having a capacity of from 80 to 120 cu. ft. of free air per minute. The compressor to be controlled by a single top-pump governor adjusted to maintain 110 lbs. main reservoir pressure.

Brake-pipe Pressure.—Tests will be made with a brake-pipe pressure of 70 lbs., except when otherwise specified.

Brake-pipe Leakage.—With brake-pipe and auxiliary reservoirs charged to 70 lbs., the section of branch pipe between the cut-out cocks and triple valves, also the triple valves, should be tested with soapsuds and leakage eliminated.

Branch pipe cut-out cocks should then be closed and brake valve placed in lap position; brake-pipe leakage should then not exceed 2 pounds per minute.

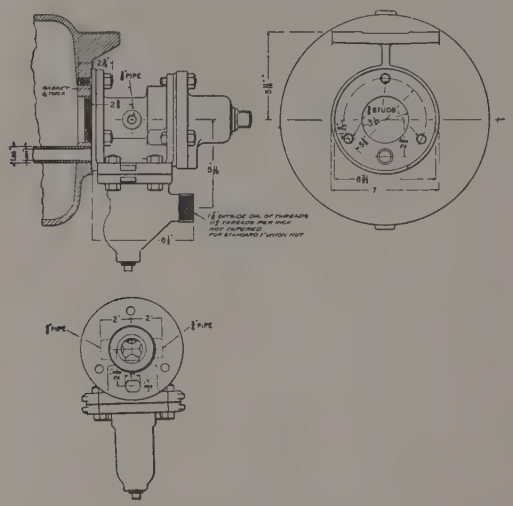


FIG. 1997—TRIPLE VALVE.

Brake Cylinders.—Brake-cylinder packing leathers must always be maintained in good condition and be free from air leakage.

Piston Travel.—All tests shall be made with 8-inch piston travel, except when otherwise specified.

Construction of Triple Valves.—Triples must be so constructed that they can be secured and operated on apparatus conforming to Fig. 1997, A. R. A., Diagram No. D-15611 (which shows triple-valve end of auxiliary reservoir, branch-pipe union and location of bosses for retaining-

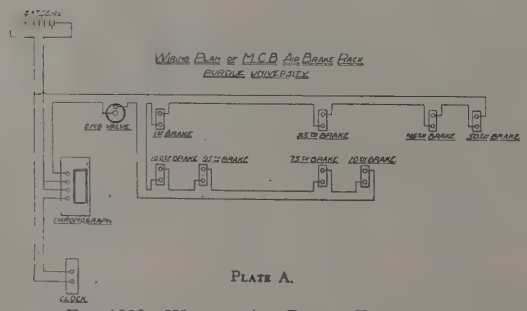


FIG. 1998—WIRING, AIR BRAKE TEST RACK.

valve pipe, with detail dimensions of each, as well as detail dimensions between these parts when in the relative position they would occupy if triple valve were in place).

Gages and Recording Instruments.—The auxiliary reservoirs, brake pipe and brake cylinder of the 1st, 25th, 50th, 75th and 100th brakes shall be fitted with test gages. All gages must be calibrated and maintained in good condition.

Brake No. 1 shall be fitted with two recording pressure gages, one to be connected to the brake-pipe branch pipe, the other to the brake-cylinder, and brake No. 100 shall

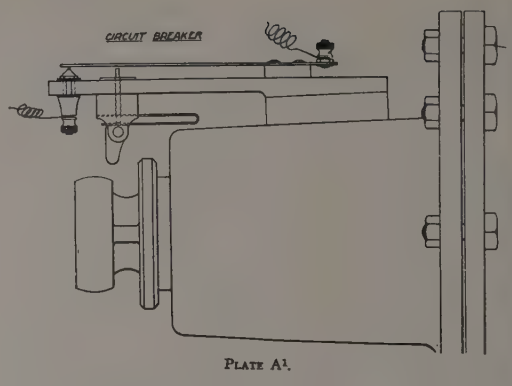


FIG. 1999—ELECTRIC CIRCUIT BREAKER, AIR BRAKE TEST RACK.

be fitted with a test gage connected to the brake cylinder.

The attachments of electric circuit closers, also the general arrangement of the electric circuit wiring, shall be as shown on Figs. 1998 and 1999, A. R. A. Plate A and Plate A-1.

Repetition of Tests.—Tests shall be repeated three times under the same general condition, a record being taken of each test, also the average result of each three tests. The room temperature at the time of the tests shall be recorded, also humidity.

Triple-valve Essentials.—The essentials of a quick-action triple valve are: first, charging; second, service application; third, graduation; fourth, release; fifth, quick action.

INDIVIDUAL TRIPLE-VALVE TESTS.

No. 1.—CHARGING TESTS.

(Time to charge auxiliary reservoir.)

Not less than three triples, selected at random, shall be tested, as follows:

With the triple valve cut out at the branch pipe cut-out cock, the auxiliary reservoir empty, and 90-pound brake-pipe pressure maintained, the triple valve should be cut in.

A. Under these conditions the auxiliary reservoir should be charged from 0 to 70 lbs., in not more than 90 seconds nor less than 70 seconds.

B. When triple is in normal release position, the auxiliary reservoir should be charged from 0 to 70 lbs., in not more than 60 seconds and not less than 40 seconds.

No. 2.—SERVICE APPLICATION TESTS.

Section "A."—(To determine sensitiveness to Service Application.)

1. Three valves, selected at random, shall be taken for this test and each tried separately. They will be tested on the first brake of the rack using the brake pipe only of the first car and locomotive, having the engine and tender brakes cut out.

2. These triple valves should apply in service when the brake-pipe pressure is reduced by direct discharge to the atmosphere through an orifice which will reduce brake-pipe pressure from 70 to 60 lbs., in 16 to 18 seconds, with brake valve and triple valves on locomotive and first brake cut out.

3. In preparing for this test, insert the required disk in union shown on Plate B with all cocks closed, after which open the cock marked C and start the test by opening the cock marked B.

Section "B"—(Graduating Test.)

1. Three valves, selected at random, shall be taken for

this test and each tried separately. They will be tested on the first brake of the rack, using the brake pipe only of the first car and locomotive having the engine and tender brakes cut out.

2. The first admission to the cylinder should be made with a reduction of brake-pipe pressure not exceeding 5 lbs.; each succeeding reduction should reduce the pressure in the auxiliary reservoir not to exceed 3 pounds, until equalization takes place. The pressure in the brake pipe should not be more than 3 pounds lower than the equalized pressure in the brake cylinder and reservoir at equalization.

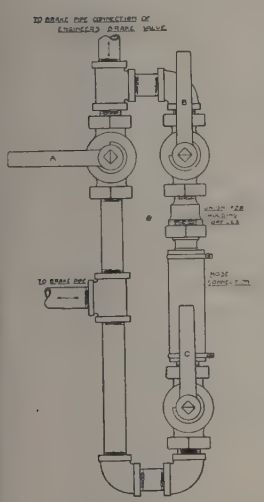


PLATE B.

FIG. 2000—CONNECTION, AIR BRAKE TEST RACK.

Section "C."—(Holding test.)

Three valves, selected at random, will be taken for this test and each tried separately on the first brake on the rack, using the brake pipe only of the locomotive and the first car, having the triple valves cut out on engine and tender. The one brake will be applied, admitting as nearly as may be 15 lbs., into the brake cylinder following a service application. Record of pressure in the auxiliary reservoir cylinder and brake pipe will be taken as follows:

First. At completion of application.
Second. In five minutes.
Third. In ten minutes.
Fourth. In fifteen minutes.

In this test, when a constant brake-pipe pressure is maintained, the brake-cylinder pressure must not be increased more than 5 lbs., in 5 minutes.

Section "D."—(Release Test.)

Three triple valves, selected at random, shall be taken for this test and each tried separately. They will be tried on the first brake of the rack, using the brake pipe only of the first car and locomotive having the engine and tender brakes cut out. When the triple goes to normal release position it must exhaust the air from the brake cylinder from 50 to 0 pounds in not more than 15 seconds.

When the triple goes to retarded-release position it must exhaust the air from the brake cylinder from 50 pounds to 0 pounds in not more than 40 seconds.

No. 3.—EMERGENCY APPLICATION TESTS.

(To determine sensitiveness to quick action.)

Three triple valves, selected at random, shall be taken for this test and tried separately on the first brake of the rack. During this test the locomotive and tender triples are to be cut out.

Section "A."—These triple valves must give a quick-action application when the brake-pipe pressure is reduced by direct discharge to the atmosphere through disk with a 14/64-in. orifice.

Section "B."—These triple valves must not give a quick action application when the brake-pipe pressure is reduced by direct discharge to the atmosphere through a disk with a 10/64-in. orifice.

Section "C."—(Holding Test.) Three triple valves, selected at random, shall be taken for this test and tried separately on the first brake on the rack.

The brake will be applied in quick action by moving the brake-valve handle to emergency position, where it must remain until completion of test for the purpose of insuring the discharge of all brake-pipe pressure. Record of pressure in auxiliary reservoir and brake cylinder will be taken as follows:

First.—At completion of application.
Second.—In five minutes.
Third.—In ten minutes.
Fourth.—In fifteen minutes.

In this test, the auxiliary reservoir and brake-cylinder pressure must not show a reduction of more than 5 lbs. in 5 minutes.

RACK TESTS.

No. 4.—SERVICE APPLICATION TESTS.

Section "A."—(Service Equalization.)

With a service reduction of 25 lbs. from brake-pipe pressure, a brake-cylinder pressure of not less than 48 lbs., nor more than 52 lbs., must be obtained.

Section "B."—(Graduating Test.)

1. A reduction of 5 pounds in brake-pipe pressure should apply lightly the 100 brakes. However, the brake-cylinder pressure may not be sufficient to show on all test gages.

2. A further reduction of 4 lbs. to 6 lbs. should increase the cylinder pressure of all brakes.

3. A further reduction, making a total of 25 lbs., should equalize the pressure between the auxiliary reservoirs and brake cylinders.

Section "C."—(Service application time.)

Brakes will be applied by reducing brake-pipe pressure 10 lbs.

There shall not be more than 25 seconds difference in the time of obtaining 10 lbs. pressure in the cylinders of the 1st and 100th brakes.

No. 5.—EMERGENCY APPLICATION TESTS.

Section "A."—(Quick action, time and pressure.)

The 100th brake must be applied with at least 45 lbs. pressure in 6¼ seconds from the movement of the brake-valve handle to emergency position and at least 55 lbs. in 7 seconds. The final maximum pressure in this test must not be less than 15 per cent nor more than 20 per cent above the pressure given by the same brake in full service application.

This test will also be made to determine that quick action is obtained with:

First—Four inches piston travel.
Second.—Twelve inches piston travel.

Note—The object of this test is to secure, as nearly as possible, uniformity of pressures in brake cylinders in an emergency application and uniformity of time required to obtain the pressures; to secure a minimum length of stop and a minimum of shock, and of trains parting.

Section "B."—(To determine whether quick action will follow a service application.)

Using the 100 brakes, make a service reduction such as will give 20 lbs. cylinder pressure on the first brake. Then place the brake-valve handle in emergency position, which should cause quick-action operation of all triple valves.

The pressure in the first cylinder will be increased or decreased by steps of about 5 lbs. until the point at which quick action commences or ceases is determined.

Section "C."—(Quick-action jumping test.)

With brakes Nos. 1, 2 and 3 cut out, quick action should be obtained with the remainder of the brakes by an emergency reduction, and the time, from the movement of the brake-valve handle to emergency position to obtain 45 and 55 lbs. cylinder pressure on the 100th brake, should not be increased more than one second over that required to obtain the same pressures with all brakes cut in.

This test should be repeated with groups of three brakes

cut out, consisting of Nos. 2-3-4, 3-4-5, 4-5-6 and 5-6-7, and the time from the movement of the brake-valve handle to emergency position to obtain 45 and 55 lbs. cylinder pressure in the 100th brake should be the same as with all brakes cut in.

These tests will also be made with piston travel of 4 in.

No. 6.—Holding Tests.

Section "A."—(Following a service application.)

The 100 brakes will be applied, admitting, as nearly as may be, 15 lbs. into the cylinder of the first brake. Record of pressures in the auxiliary reservoirs and cylinders will be taken at all record points as follows:

First—At completion of application.

Second.—In five minutes.

Third.—In ten minutes.

Fourth.—In fifteen minutes.

In this test any increase of brake-cylinder pressure should be in proportion to the reduction in brake-pipe pressure due to leakage.

Section "B."—(Following a quick-action application.)

The 100 brakes will be applied in quick action by placing the brake-valve handle in emergency position, where it will be left until completion of test, for the purpose of insuring the discharge of all brake-pipe pressure. Record of pressures in auxiliary reservoirs and cylinders will be taken at all record points as follows:

First.—At completion of application.

Second.—In five minutes.

Third.—In ten minutes.

Fourth.—In fifteen minutes.

The results of this test must not indicate an excessive amount of back leakage into brake pipe.

No. 7.—Release Tests.

Section "A."—(Release Time.)

The 100 brakes shall be applied with an 18-lb. service reduction of brake-pipe pressure and brake valve then placed in release position. Time will be taken from the movement of the brake valve into release position until pressure is reduced to 5 lbs. in the cylinder of the first brake.

The pressure in the cylinder of the first brake should not reduce to 5 lbs. in less than 18 seconds nor more than 25 seconds.

Note—Main reservoir pressure must be 110 lbs. at time of release.

Air-Brake and Train-Air-Signal Instructions

Recommended Practice—adopted, 1898; revised, 1914.

"A"—General Instructions.

1. The following rules and instructions are issued for the government of all employees of this rialroad whose duties bring them in contact with the maintenance and operation of the air brake and train air signal apparatus. They must be obeyed in all respects, as employees will be held strictly responsible for the observance of same.

Every employee whose duties are connected in any way with the maintenance and operation of the air brake will be examined from time to time as to his qualifications for such duties by the Inspector of Air Brakes or other person appointed by the proper authority, and a record will be kept of such examination.

Any employee whose work indicates an apparent lack of the requisite brake knowledge will be required to pass an examination at any time following such indications.

"B"—Instructions to Enginemen.

2. Enginemen when taking charge of locomotives must see that the air brake and train air signal apparatus on engine and tender is in good working order and that the air compressor and lubricator work properly; that the devices used for regulating all pressures are adjusted to the authorized amount; that brake valves work properly in all positions of the handle, and that, when brakes are fully applied, with cam type of driver brake, the pistons do not travel less than 2 in., nor more than 3½ in., and with other forms of driver brakes from 4 to 6 in.; that the engine truck and trailer brake piston travel be not less than 4, nor more than 6 in.; that the tender brake piston does not travel less than 6 nor more than 8 in.

Enginemen must report to roundhouse foreman, in writing, at the end of the run, any defects in the air brake or train air signal apparatus.

3. *Making Up Trains. Testing Brakes at Terminal Points and Before Starting Down Such Grades as May Be Designated by Special Instruction.*—The brake pipe on the engine and under the tender must always be blown out and maximum pressure obtained in main reservoir before coupling engine to train.

After the train has been coupled, stretched and fully charged, the engineman shall, at the request of the inspector or trainmen, apply the brakes with full service application and leave them so applied until all brakes operated from the engine have been inspected and the signal given to release. The engineman must then release the brakes and he must not leave the station until it has been ascertained that all brakes are released and he has been informed by the inspector, or the trainmen, of the number of brakes in service and of their condition. If any defect is discovered during this test same must be corrected and the brakes again tested, and the operation repeated until the brakes are known to be in good condition.

In testing passenger train brakes, signal for releasing must be given from the air signal discharge valve on rear car.

Following the separation of couplings for local switching, or when engine is parted from train, or train has been parted for any purpose, the above test need not be complied with further than to ascertain, by test, that the rear brakes are responsive to brake valve on engine and that all brakes have been properly released. However, the above test need not be complied with further than to ascertain, by test, that the rear brakes are responsive to brake valve on engine and that all brakes have been properly released.

4. *Service Application.—Passenger Trains.*—In making service stops from high speed, two applications should be used. The first application should be derived from two or more brake-pipe reductions, and when the speed has reduced to about 15 miles per hour, release all brakes, and complete the stop with a moderate service application.

In making service stops with trains of less than seven cars, the brakes should be released about the time the drivers make the last revolution, except on heavy grades. Even on moderate grades and when stopping at water stations, coaling chutes, short platforms, etc., this should be done, and after releasing re-apply the brakes, either automatic or independent, as required, to prevent the train from starting. To avoid shocks and train parting the brakes must not be released on trains of seven or more cars while moving at a speed of less than 10 miles per hour.

If *undesired quick action* has taken place during a service application on trains of more than five cars, the brakes must

not be released until the train has come to a full stop.

5. *Service Application.—Freight Trains.*—In applying the brakes to steady the train on descending grades, or for reducing speed for any purposes, an initial brake-pipe reduction of not less than 7 lb. must be made. Releasing brakes at low speeds must not be attempted unless local conditions are favorable for same.

Ample time should always be allowed for making stop, first permitting the slack of train to become adjusted before commencing to use the brake. After this the first brake-pipe reduction should be made and it should be sufficiently heavy to make the stop, being not less than 7 or more than 12 lb., according to the length of the train. Then when not more than a car length (40 ft.) short of the completion of the stop, a second reduction sufficiently heavy should be made to cause the brake valve to be blowing when stop is completed. After a reduction to apply brakes, no attempt must be made to release, until air ceases to discharge from the brake-valve pipe exhaust.

When backing freight trains and it is desired to stop, apply the brake in service, and when conditions permit, keep the engine brake from applying and the throttle open until stop is complete, the idea of keeping the engine brake released and using steam while train brake is applying being to keep the slack of the train bunched and thus prevent train parting.

6. *Emergency Applications.*—The emergency application of the brakes must be used only in actual emergencies. Under such conditions the brake-valve handle must be left in emergency position until train has come to a stop.

ENGINEMEN'S STRAIGHT AIR OR INDEPENDENT BRAKE VALVES.

(A) Always keep both brakes cut in and ready for operation, unless failure of some part requires cutting out.

(B) Always carry an excess pressure of 20 lb., or more, in the main reservoir, as this is necessary to insure a uniformly satisfactory operation.

(C) The straight air or the independent brake valve should not be used for bunching the slack of the train previous to an automatic application; neither should it be used alone for making ordinary stops with a train.

(D) The reducing valves for the straight air and the independent brake and the safety valves for the locomotive brakes should be kept adjusted at the authorized pressures.

When a full application of the straight air or of the independent brake causes any of the safety valves to operate. it indicates that same is out of order, or too high adjustment of the reducing valve or too low adjustment of the safety valve, or leakage of same. Have the reducing and safety valves tested and adjusted.

7. *Brakes Applied from an Unknown Cause.*—If it is found that the train is dragging as though the brakes were applied without rapid falling of the pointer on the brake pipe air gage, the engineman must make an effort to release the brakes, which may be done as follows: First, if brake-pipe pressure is less than authorized amount and the required excess pressure is carried in the main reservoir, move the handle of the brake valve to release position for an instant and then return it to running position; second, should the brake pipe be fully charged, apply the brakes with a heavy service reduction, and release them in the usual way. In case the brakes can not be released in this manner, the train must be stopped and the train men notified.

If, however, the brakes go on suddenly with a rapid fall of brake-pipe pressure, it is evident that (A) a conductor's valve has been opened (B) a hose has burst or other serious leak has occurred, or (C) the train has parted. In such an event the engine throttle should be closed and the brake-valve handle immediately placed on lap or in emergency position, to prevent the escape of air from the main reservoir, and left there until the train has stopped and the signal to release has been given.

8. *Braking by Hand.*—Hand brakes must not be used, except in emergency.

9. *Cutting Out Brakes.—The engine and tender brakes must always be used automatically at every application of the train brake,* unless defective, except upon such grades as shall be designated by special instructions.

When necessary to cut out either the engine or the tender brake, it shall be done by closing the cut-out cock, located between the brake pipe and triple valve, and opening the drain cock in the auxiliary reservoir, on locomotives so equipped. On locomotives having the ET or the LT equipment close the cut-out cock in the pipe leading to the respective brake cylinder.

10. *Double Headers.*—When two or more engines are coupled in the same train, the brakes must be connected through to and operated from the leading engine. Engineman of each engine, except the leading one, must close the double-heading cock below the automatic brake valve and carry the handle of brake valve in running position. He will run the compressor for the purpose of maintaining pressure on his engine, and of enabling him to assume charge of the train brakes should occasion require.

11. *Dead Engine Feature.*—Its purpose is to supply air to the main reservoir for operating brakes and other devices on engines where pump has failed, or on dead engines en route. In both cases the cut-out cock in this device must be kept open and handle of both brake valves on such engines left in running position, and the double heading cock below automatic brake valve kept closed.

The dead engine cut-out cock must be kept closed on all engines whose compressors are running.

"C"—INSTRUCTIONS TO TRAINMEN.

12. *Making Up Trains and Testing Air Brakes.*—After the locomotive has been coupled to the train, or after two or more sections have been coupled together, the brake and signal couplings must be united, the cocks in the brake and signal pipes must all be open, except those at the rear end of the last car, which must be closed, and the rear hose hung up in the dummy couplings, when the cars are so equipped.

After the train has been coupled, stretched, and fully charged, the engineman must be requested to apply the brakes. When he has done so, the brakes of each car must be examined to see if they are properly applied. When it has been ascertained that each brake is so applied the engine-man should be signaled to release.

In testing passenger-train brakes the train air signal whistle code for releasing must be used, and the signals to release must be given from the air signal apparatus on the rear car. The brakes of each car must then be examined to see that each is released, and the engineman informed as to the number of brakes in service and of their condition.

If any defect is discovered it must be remedied and the brakes tested again—the operation being repeated until it is ascertained that everything is right. The conductor and engineman must then be notified that the brakes are all right. Following the separation of couplings for local switching or when engine or train has been parted for any purpose, the above test need not be complied with other than to ascertain, by test, that the rear brakes are responsive to brake valve on engine, and that all brakes have properly released.

No passenger train must be started out from its terminal with the brakes upon any car cut out or in a defective condition. The air brakes must be relied upon to control all trains.

13. *Detaching Locomotive or Cars.*—First close the

cocks in the brake and signal pipes at the point of separation, and then part the couplings by hand.

Couplings Frozen.—If the couplings are found to be frozen together or covered with ice, the ice must first be removed and then the couplings thawed to prevent injury to the gaskets.

14. *Brakes Sticking.*—If brakes are found sticking and cannot be released from the engine, or if the brakes are applied to detached cars, the release may be effected by opening the release valve in the auxiliary reservoir until the air begins to release through the triple valve, when the valve must be closed.

15. *Train Breaking in Two or More Parts.*—First close the cock in the brake pipe at the rear of the first section, and then signal the engineman to release the brakes. Having coupled to the second section, observe the rules for making up trains—first be sure that the cock in the brake pipe at the rear of second section has been closed, if the train has broken in more than two sections. When the engineman has released the brakes on the second section, the same method must be employed with reference to the third section, and so on. When the train has been once more entirely united the brakes must be inspected on each car to see that all are released before proceeding.

16. *Cutting Out Brakes on a Car.*—When necessary to cut out the brake upon any car, close the cut-out cock in the cross-over pipe near the triple valve, and open the drain cock in the auxiliary reservoir, leaving it open on passenger cars.

On freight cars the release valve must be held open until all of the air has escaped the reservoir, when an air-brake defect card must be applied. The conductor must notify the engineman of brake cut-out.

17. *Conductor's Valve.*—Should it become necessary to apply the brakes from the train, it may be done by opening the conductor's valve in any car so equipped. *The valve must be held open until the train comes to a stop, and then must be closed.*

This method of stopping the train must not be used except in case of emergency.

18. *Burst Hose.*—In the event of the bursting of a brake hose, it must be replaced and the brakes tested before proceeding, so as to ascertain that the rear brakes are responsive to the brake valve on engine. At least one extra air-brake hose complete should be carried by all crews, and in addition one extra signal hose complete carried by passenger crews.

19. *Brakes Not in Use.*—When the air brakes are not in use, hose should be kept coupled between the cars or hung to the dummy couplings when cars are so equipped.

20. *Pressure Retaining Valve.*—When this valve is to be used, the trainmen must, at the top of the grade, at the point authorized, test the brakes upon the whole train, and must then pass over the train and turn the handles of the pressure retaining valves upon all or upon a part of the cars, as may be directed, to proper position for retaining pressure. At the foot of the grade, the handles must be turned downward (lengthwise with pipe) again. Special instructions will be issued as to the grades upon which these valves are to be used.

21. *Train Air Signal.*—In making up trains, all couplings and car discharge valves on the cars must be examined to see if they are tight. Should the car discharge valve upon any car be found defective it may be cut out by closing the cock in the branch pipe leading to it. The conductor must be notified when the signal has been cut out upon any car, and he must report the same for repairs.

In using the signal, pull down upon the cord during one full second for each intended blast of the signal whistle, and allow three seconds to elapse between pulls.

22. *Reporting Defects to Inspectors.*—Any defect in either the air brake or the train air signal apparatus must be reported to the inspector on arrival at terminal; or, if the defect be a serious one in passenger service, it must be reported to the nearest inspector, and such defect must be remedied before the car proceeds.

"D"—Instructions to Engine-house Foremen.

23. *General.*—It is the duty of the engine-house foreman to know that the air brake and train air signal equipment is properly inspected upon each locomotive after each run, and that necessary repairs are made before leaving the engine house. Air gages must be tested at least once every thirty days, and date of testing shown.

24. *Air Compressors.*—The air compressors must be tested for efficiency by orifice test, and their condition determined.

Compressors must be started slowly with drain cocks open, these cocks to be left open until compressor is free from all condensation. They must also be left open while compressor is not working.

25. *Compressor Governor.*—The compressor governor should cut off the steam supply when the air pressure for which it is adjusted has been obtained, and promptly admit steam to the compressor when air pressure falls slightly below the authorized amount.

26. *Brake Valves.*—These valves must be kept clean and be known to be in working order in all positions of the handle before the engine leaves the engine house.

27. *Adjustment of Brakes.*—Engine brake piston travel should not be less than 4 nor more than 6 in.; for tender brake not less than 6 in. nor more than 8 in. When cam driver brake is in use piston travel should be not less than 2 in. nor more than 3½ in., and care must be taken to adjust both cams alike, so that the point of contact of the cams will be in line with the piston rod; the brake shoes should be correctly adjusted at equal distances from the wheel at the top and bottom of the shoe and in line with the tires.

28. *Brake Cylinders and Triple Valves.*—Engine and tender brake cylinders, plain triple valves and high-speed reducing valves should be cleaned, lubricated and tested, at least once in six months; when locomotive is equipped with distributing valve or control valve, or the tender has a quick action triple valve, these parts should be cleaned and tested at least once in three months. Time and place of cleaning to be stenciled according to standard drawings.

29. *Draining.*—The main reservoir, and also the drain cup and dirt collector in the brake pipe under the tender, must be drained of any accumulation after each trip. The auxiliary reservoirs and triple valves must also be drained frequently, and daily in cold weather, and the brake pipe under the engine and tender blown out.

30. *Train Air Signal.*—The train air signal apparatus must be examined and tested, both at front of engine and rear of tender, before every trip, by means of a suitable appliance to which is attached an air gage for testing the pressure carried. It must be known that the whistle responds properly, also that the pressure-reducing valve maintains the authorized pressure.

"E"—Instructions to Inspectors.

31. *General.*—It is the duty of all inspectors to see that the couplings, the pipe joints, the triple valves, the high-speed reducing valves, the conductor's valves, the air-signal valves, and all other parts of the brake and signal apparatus

are in good order, of standard size for the car, and free from leaks. For this reason they must be tested under the full air pressure as used in service. No passenger train must be allowed to leave a terminal station with a brake upon any car cut out, or in a defective condition.

If defect is discovered in the brake apparatus of a freight car, which cannot be held long enough to give time to correct such defect, the brake must be cut out and the car properly carded, to call to attention of the next inspector.

Special rules will specify the smallest proportion of the total number of freight cars, with the air brakes in good condition, which may be used in operating the train as an air-brake train.

32. *Making Up Trains and Testing Brakes.*—In making up trains, the couplings must be united and the cocks at the ends of the cars all opened, except at the rear end of the last car, where the cocks must be closed; the inspector must know that the air is passing through the pipes to the rear end, and the hose couplings at the rear are properly attached to the dummy couplings on cars so equipped.

After the train is stretched and fully charged, the engineman must be requested to apply the brakes. After the brakes are applied they must be examined upon each car to see that they have the proper piston travel. This having been ascertained, the inspector must signal the engineman to release the brakes.

In testing passenger-train brakes, the signal to release must be given from the discharge valve on the rear car. He must then again examine the brakes upon each car to note that all have released. If any defect is discovered, it must be corrected and the testing of the brakes repeated, until they are found to work properly. The inspector must then inform both the engineman and conductor of the number of cars with brakes in good order. Examination must be repeated if change is made in train make-up before starting.

33. *Cleaning Cylinders, Triple Valves and Slack Adjusters.*—The brake cylinders and triple valves on freight equipment cars must be cleaned, lubricated and tested, at least once in twelve months, and the method of marking brake apparatus which has been cleaned, lubricated and tested, should be as shown in Rule No. 60, of A. R. A. Rules of Interchange.

On passenger cars, the cylinders and slack adjusters must be cleaned and oiled at least once in twelve months. Triple valves, control valves and high-speed valves must be cleaned and oiled at least once in every six months, and date and place of last cleaning stenciled on these parts with white paint.

The triple valves and auxiliary reservoirs must be frequently drained, especially in cold weather, by removing the plug at the bottom of the triple valve and opening the drain cock in the bottom of reservoir.

34. *Adjustment of Brakes.*—The slack of the brake shoes must be taken up by means of the truck dead levers on cars having four-wheeled trucks and at the turnbuckle nearest the center of the car on cars having six-wheeled trucks. In taking up such slack it must first be ascertained that the hand brakes are released, and the slack is all taken out of the upper connections, so that the truck levers do not go within one in. of the truck timber or other stop, when the piston of the brake cylinder is fully back at release position.

When under a full application the brake piston travel is found to exceed 9 in. upon passenger or freight cars, the brake shoe slack must be taken up and adjustment so made that the piston shall travel not less than 6 in. Brake shoe slack it must never be taken up by means of the hand brakes.

Where automatic slack adjusters are applied to a car, such adjusters must be fully released before the slack is taken up elsewhere, and where cars are equipped with P. C. control apparatus it must be seen that both slack adjusters are evenly adjusted.

35. *Braking Force.*—Where the cylinder lever has more than one hole at the outer end and different holes are for use upon cars of different weights, it must be carefully ascertained that the rods are connected to the proper holes so that correct braking force shall be exerted upon each car.

36. *Repair Parts.*—Inspectors must keep constantly on hand for repairs supply of all parts of the brake and signal equipment that are likely to get out of order.

37. *Hanging Up Hose.*—Inspectors must see that, when cars are being switched or while standing in the yard, the hose is coupled between the cars or properly secured in the dummy coupling, where cars are so equipped.

38. *Responsibility of Inspectors.*—Inspectors will be held strictly responsible for the good condition of all brake and signal apparatus upon cars placed in trains at their stations; they will also make examination of the brakes, and such repairs as may be required.

Operation of Brakes on Engines and Tenders Handled Dead in Trains and Offered in Interchange

Recommended Practice—ADOPTED, 1915.

1. All engines equipped with side rods must have them applied, when handled dead in trains, suitable washers, of wooden blocks clamped together with bolts, being used where necessary on main rod bearings to keep the side rods in place.

2. All engines and tenders hauled dead in trains must have the air brakes cut in and operative on drivers, trailers and on tender trucks.

3. Engines and tenders equipped with the Westinghouse ET, or New York LT brake, must have the safety valve on the distributing valve, or control valve, adjusted to not less than 25 lb. or more than 30 lb.

4. Engines and tenders equipped with the automatic and straight air combined must have the safety valve in brake cylinder pipe adjusted to not less than 25 lb. or more than 30 lb.

5. Engines equipped with Westinghouse ET, or New York LT brakes, or with straight air, must have positive stops applied to handles of automatic and independent valves to secure these handles in running position.

6. Engines and tenders equipped with high speed brake without the straight air must have the high speed reducing valve set to reduce the brake cylinder pressure to not less than 25 lb. or more than 30 lb., or must have a safety valve applied to the brake cylinders or the brake cylinder pipe set to not less than 25 lb. or more than 30 lb.

7. Engines and tenders equipped with only the automatic brake must have a safety valve applied to the brake cylinders or the brake cylinder pipe set to not less than 25 lb. or more than 30 lb.

8. Engines fitted with power brakes other than air must be equipped with an air train line and connections.

9. Delivering line will be held responsible for flat spots on driving tires, trailer tires and tender truck wheels.

10. Owners shall be responsible for any special application of safety valves as required in Section Nos. 3 to 8.

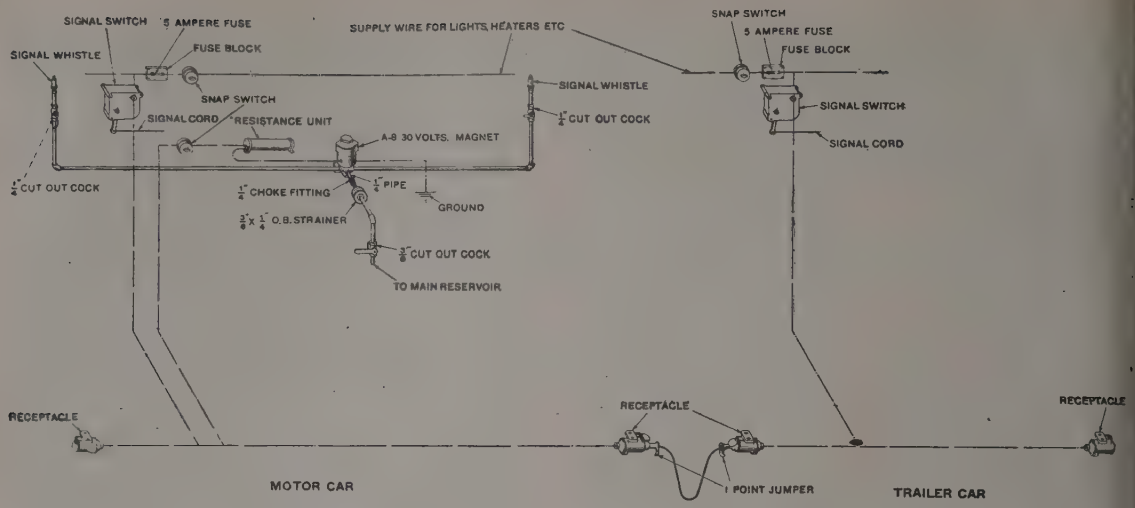


Fig. 2001—Westinghouse Electro-Pneumatic Signal System as used on Motor Car and Trailer.

Names of Parts of Fig. 2002

2 *Frame*
3 *Pin for Cover*
4 *Cover*
5 *Steel Cotter*
6 *Extension Spring*
7 *Handle*
8 *Spider*
9 *Screw for securing Spider to Shaft*
10 *Screw for securing Contact to Spider*
11 *Shaft*
12 *Collar*
13 *Steel Cotter*
14 *Contact*
15 *Contact Finger*
16 *Finger Stop*
17 *Screw*
19 *Double Nut*
20 *Special Nut*
21 *Fillister Head Screw*
22 *Arc Shield*
23 *Round Head Screw*
24 *Back Insulation*
25 *Lead*
26 *Insulating Bushing*
27 *Blowout Coil*
28 *Cap Screw for Blowout Coil*

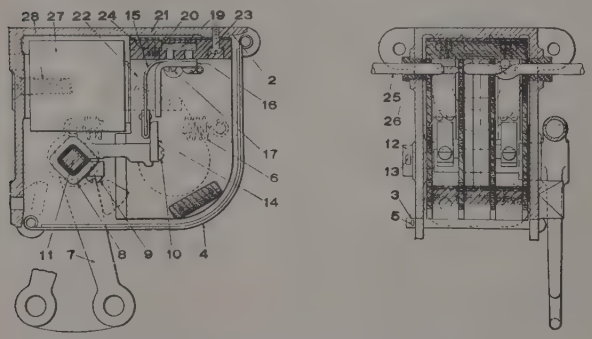


Fig. 2002—Westinghouse Conductors Signal Switch as used with the Electro-Pneumatic Signal System.

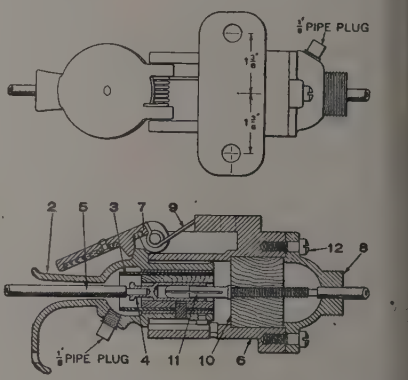


Fig. 2003—Westinghouse Plug Connection as used with the Electro-Pneumatic Signal System.

Names of Parts of Fig. 2003

2 *Plug Body*
3 *Jumper Contact*
4 *Female Contact*
5 *Jumper Cable*
6 *Receptacle Body*
7 *Receptacle Door*
8 *Receptacle Cover*
9 *Spring*
10 *Socket for Male Contact*
11 *Male Contact*
12 *Cap Screw*

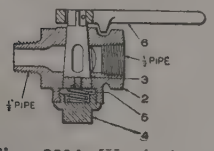


Fig. 2004—Westinghouse Reservoir Drain Cock.

Names of Parts of Fig. 2004

2 *Cock Body*
3 *Cock Key*
4 *Cap Nut*
5 *Key Spring*
6 *Handle*
7 *Handle Socket*

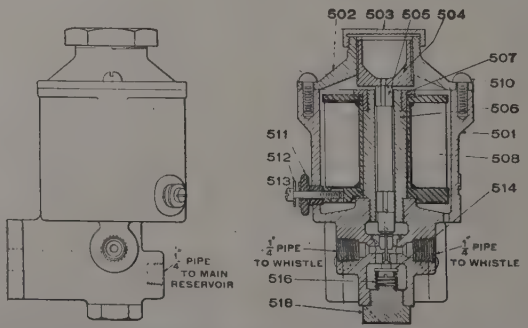


Fig. 2005—Westinghouse Type A Combined Magnet and Bracket for the Electric-Pneumatic Signal System.

Names of Parts of Fig. 2005

501 *Body*
502 *Cover*
503 *Cap*
504 *Armature*
505 *Armature Stem*
506 *Magnet Core*
507 *Core Pole*
508 *Magnet Coil*
510 *Button Head Cap Screw*
511 *Insulator*
512 *Brass Washer*
513 *Contact Screw*
514 *Exhaust Valve*
515 *Supply Valve*
516 *Supply Valve Spring*
517 *Supply Valve Seat*
518 *Cap Nut*

Fig. 2006—Sprague Flexible Steel Armored Air Brake, Signal and Tank, Hose and Nipples. Sprague Electric Works.

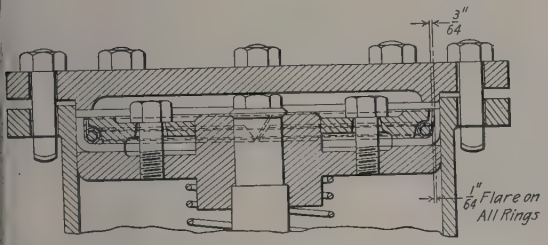


Fig. 2007—J-M Slip Type Expander Ring for Air Brake Cylinder Packing Leathers. H. W. Johns-Manville Company.

Fig. 2009—Air Gage for Caboose The Ashton Valve Company.

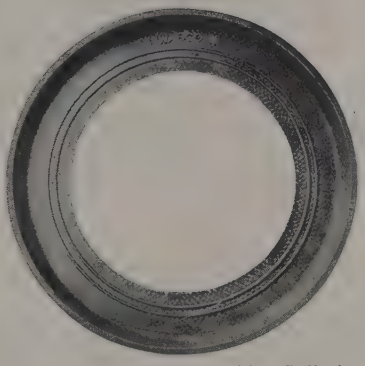


Fig. 2010—"Wabco" Air Cylinder Packing Cup. Westinghouse Air Brake Company.

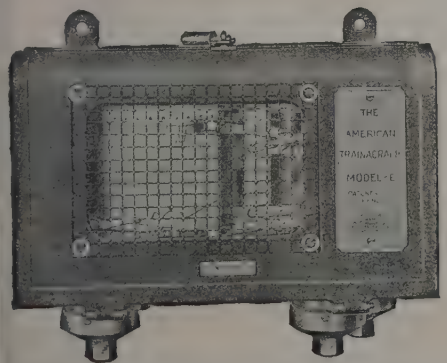


Fig. 2012—"Trainagraph" Air Brake Recording Gage—Closed.

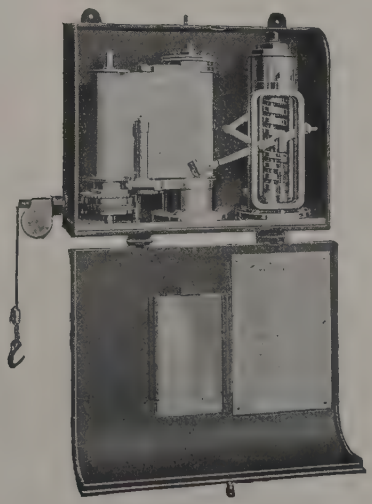


Fig. 2013—"Trainagraph" Air Brake Recording Gage—Open.

American Steam Gage and Valve Company.

Fig. 2008—Universal Hose Protector. McCord & Company.

Fig. 2011—Mulconroy New Process Air Hose; Mulconroy Company.

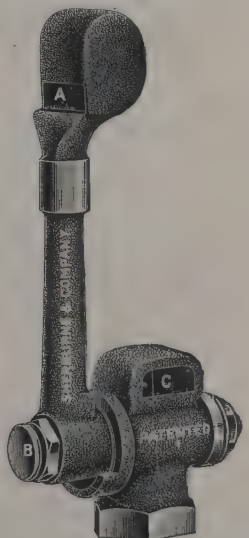


Fig. 2014—Brakeman's Back-Up Air Brake and Signal Valve. Sherburne & Company.

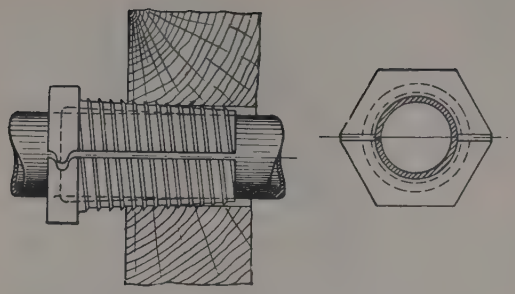


Fig. 2015—Acme Pipe Clamp for Use in Needle Beam. Western Railway Equipment Company.

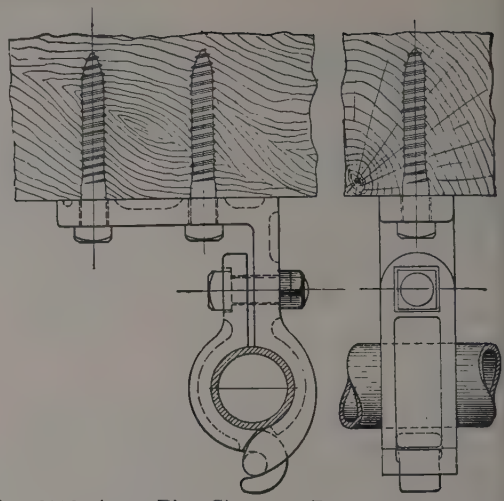


Fig. 2016—Acme Pipe Clamp on Bottom of End Sill. Western Railway Equipment Company.

Fig. 2017. Pipe Clamp.

Fig. 2018. Pipe Clamp.

Fig. 2019. Pipe Hanger.

Fig. 2020. Hose Clamp.

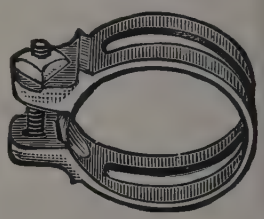


Fig. 2021—Yerdon Hose Band. William Yerdon.

National Malleable Castings Company.

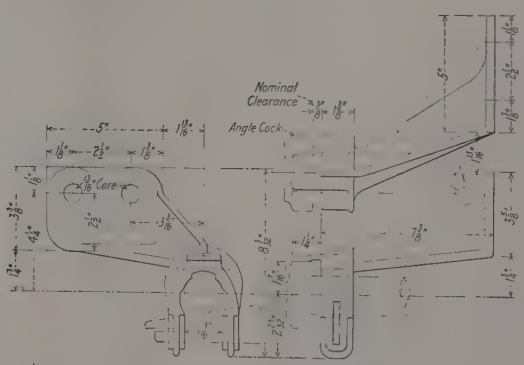


Fig. 2022—Burnett Angle Cock Holder for U. S. R. A. Standard Striking Plate. National Car Equipment Company.

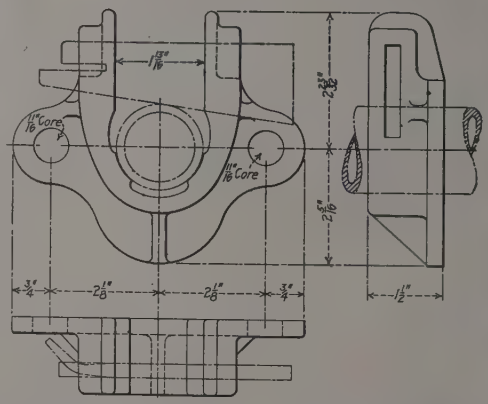


Fig. 2023—Burnett Brake Pipe Anchor. National Car Equipment Company.

Fig. 2024—Application of Burnett Brake Pipe Anchorage and Angle Cock Holder. National Car Equipment Company.

(See also Page 869.)

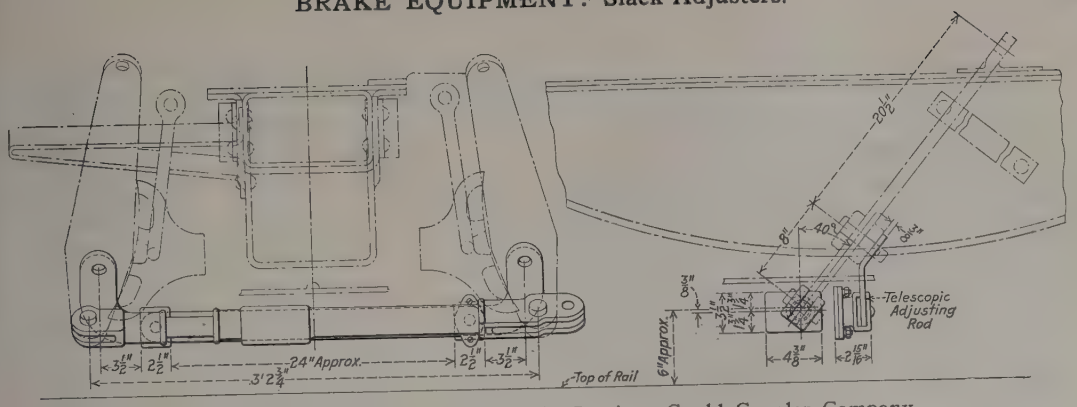


Fig. 2025—Slack Adjuster for Freight Service. Gould Coupler Company.

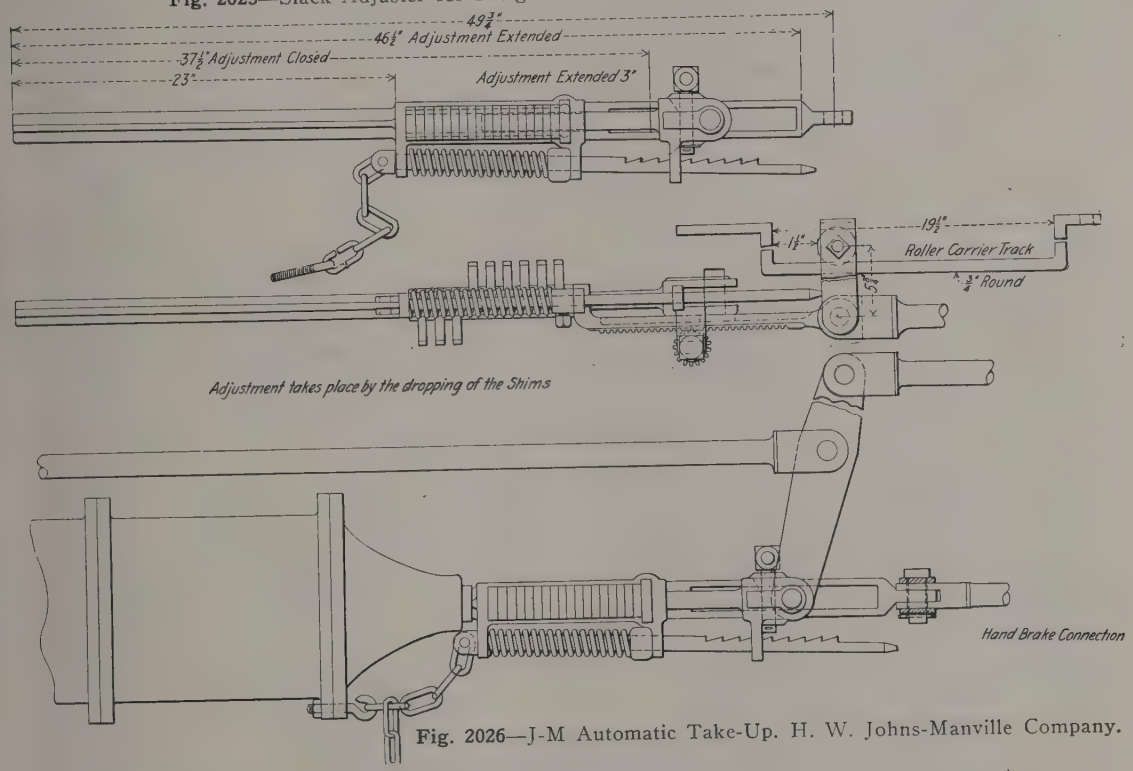


Fig. 2026—J-M Automatic Take-Up. H. W. Johns-Manville Company.

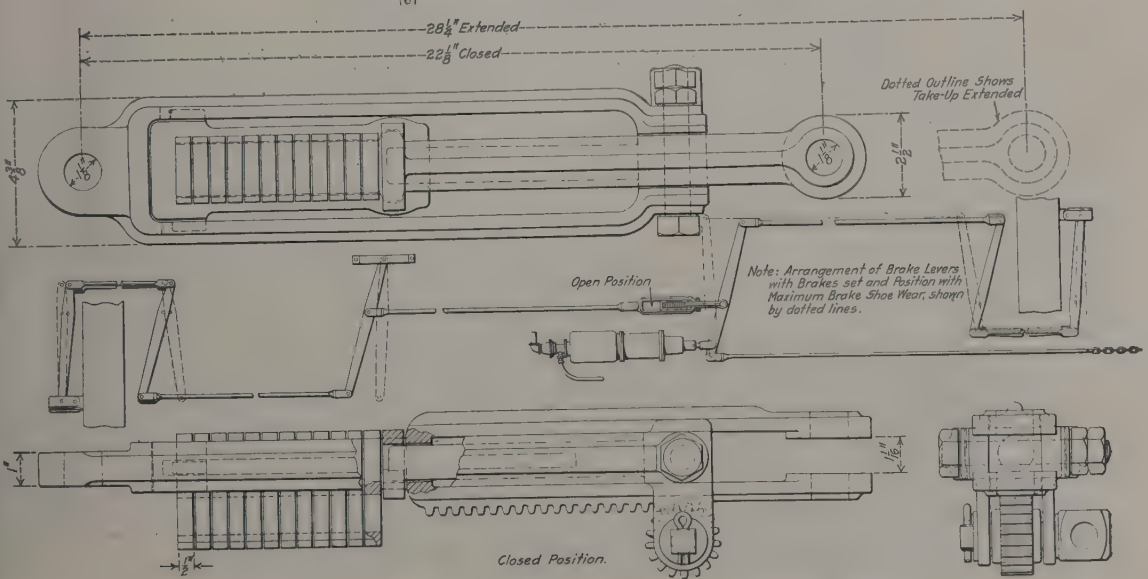

28½" Extended
22⅛" Closed
Dotted Outline Shows Take-Up Extended
Open Position
Note: Arrangement of Brake Levers with Brakes set and Position with Maximum Brake Shoe Wear, shown by dotted lines.
Closed Position.

Fig. 2027—J-M Manual Take-Up. H. W. Johns-Manville Company.

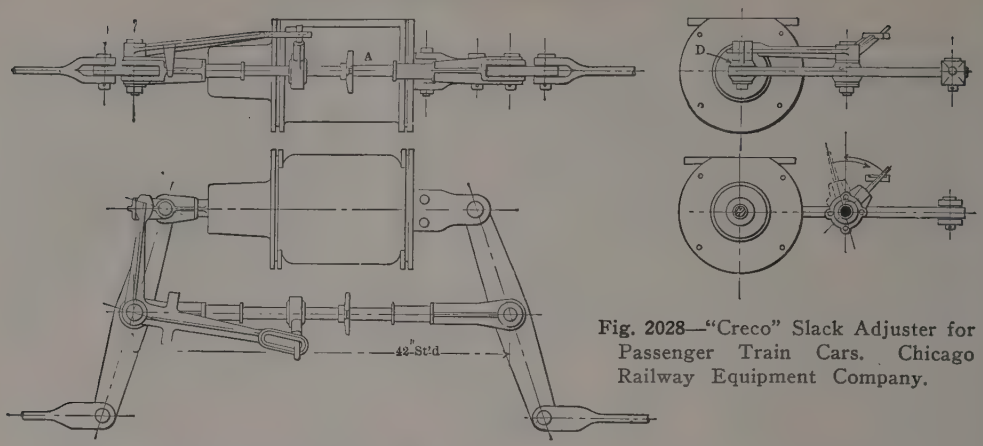


Fig. 2028—"Creco" Slack Adjuster for Passenger Train Cars. Chicago Railway Equipment Company.

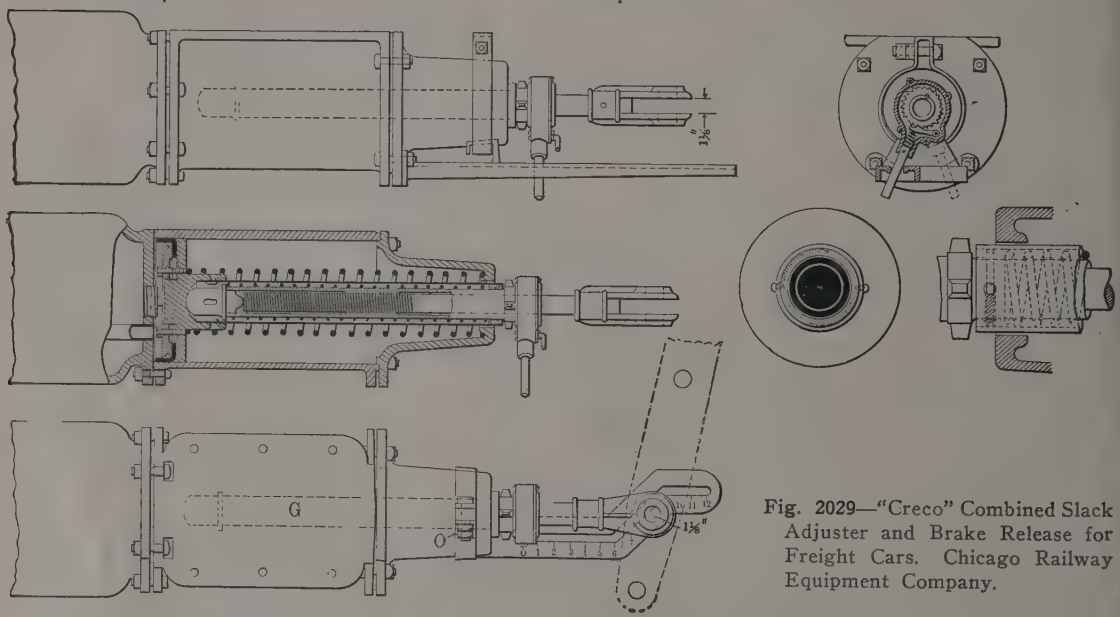


Fig. 2029—"Creco" Combined Slack Adjuster and Brake Release for Freight Cars. Chicago Railway Equipment Company.

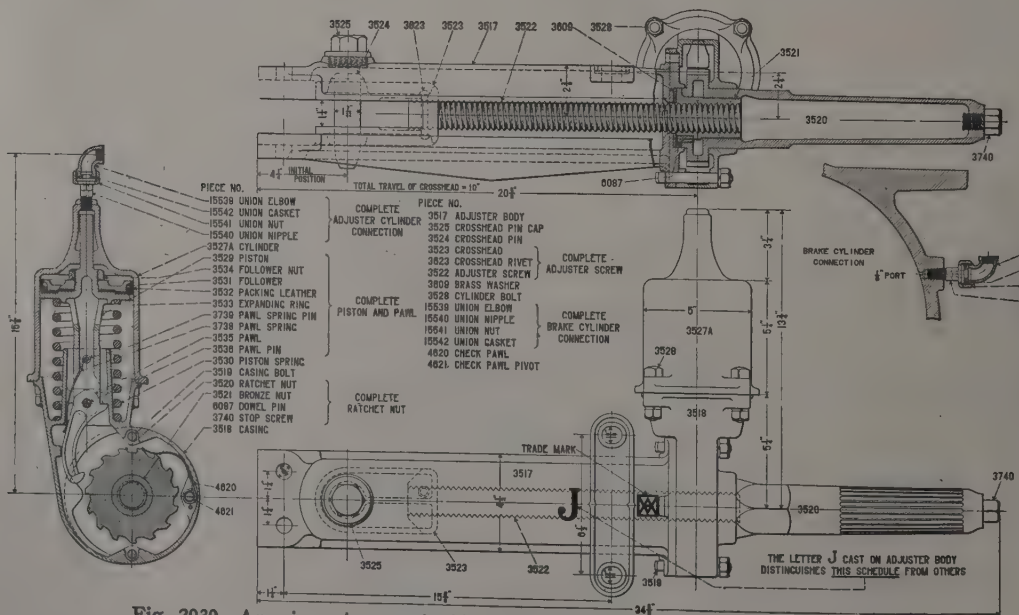


Fig. 2030—American Automatic Slack Adjuster. American Brake Company.

(See also Page 841.)

The American Automatic Slack Adjuster

This device is an efficient mechanism which has been devised for providing correct adjustment of foundation brake gear by maintaining uniform piston travel. It regulates the running travel, gives a fine adjustment—it alters the piston travel only about 1/30 inch at each movement—and operates promptly the moment piston travel exceeds the amount for which it is set. Its construction and operation are very simple and can be understood readily by reference to the accompanying illustrations.

The slack adjuster body is bolted to a lug on the pressure head of the brake cylinder, and contains a movable crosshead which acts as a fulcrum for the cylinder lever. Movement is imparted to this crosshead through a long screw, combined with a ratchet nut and pawl carried at the other end of the body, the pawl being operated by a small air piston and spring. A copper pipe leads from the chamber behind this piston to a small port drilled in the side of the brake cylinder, at a distance from the pressure head equal to the piston travel desired.

All parts of the adjuster remain at rest until the slack in the brake rigging has increased sufficiently to allow the brake piston to travel far enough to uncover the small port drilled in the side of the brake cylinder. When this occurs the air from the brake cylinder passes through the copper pipe and forces out the piston and pawl against the pressure of the coil spring, the pawl passing over two teeth of the ratchet nut.

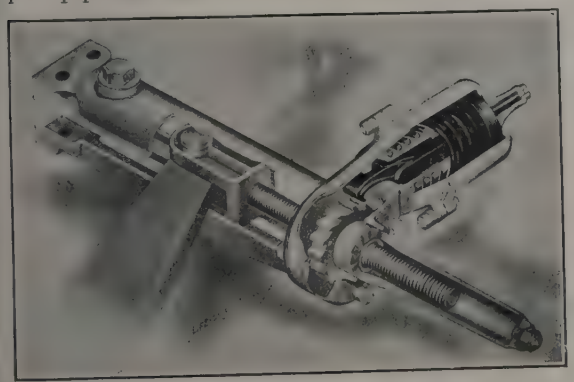


Fig. 2032—Detail of Adjusting Mechanism

Slack is taken up only after release of the brake has been completed. When this occurs the air escapes through the same port by which it entered, and the piston and pawl are forced back by the spring which they previously compressed. The pawl, in returning, rotates the ratchet nut, thus drawing the fulcrum of the cylinder lever 1/30 inch farther away from the brake cylinder, and correspondingly reducing the piston travel.

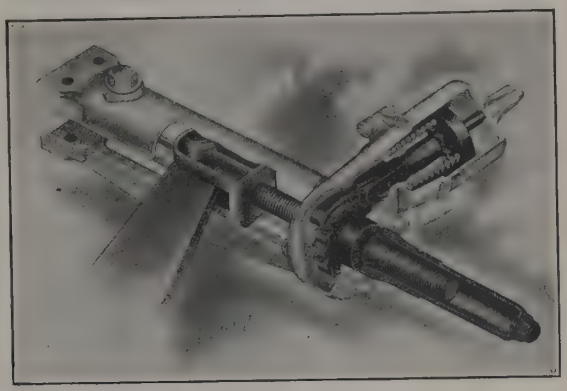


Fig. 2033—Ratchet Engaged, Adjustment About to Take Place

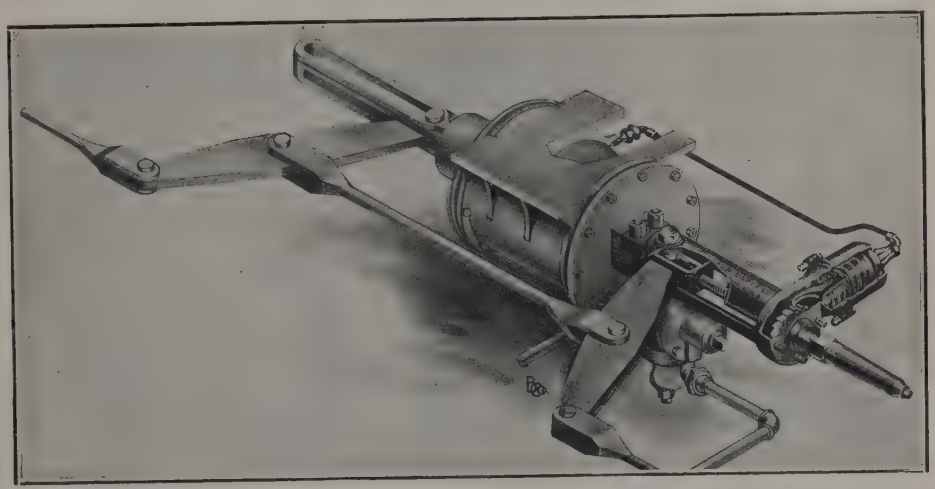


Fig. 2031—General Arrangement of American Automatic Slack Adjuster

Protection from dust and injury is provided for all operating parts of the Adjuster by carefully housing them. The fact that there is no movement whatever in the Adjuster except when the piston has over-traveled, assures long life to the wearing parts.

Quick alteration of the amount of slack in the rigging may be accomplished by turning the ratchet nut either by hand or with a wrench, one turn of the nut producing ¼ inch movement of the crosshead.

The Slack Adjuster has sufficient capacity to take care of changes in piston travel occasioned by brake shoe wear or replacement, it being unnecessary to make any adjustments at other points except when the diameter of the wheels or the lengths of rods or levers have been altered.

For other products and branch offices, see classified and alphabetical indexes.

AMERICAN BRAKE COMPANY, ST. LOUIS, MO.

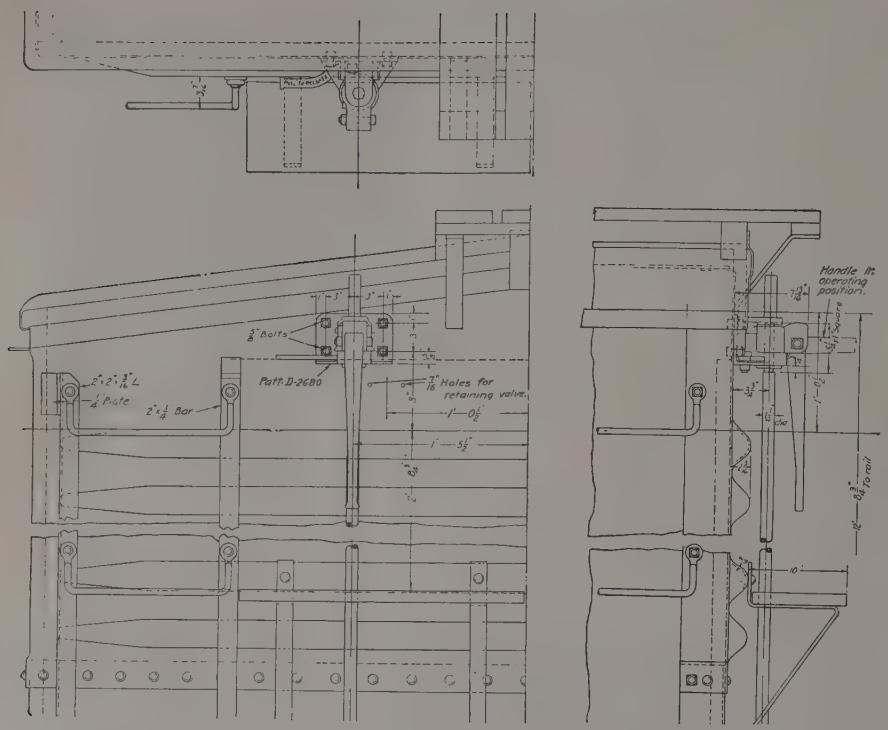


Fig. 2034—Miner Ideal Safety Hand Brake—Staff Type—for Freight Equipment.

Fig. 2035—Miner Ideal Safety Hand Brake as Shown in Fig. 2034.

Fig. 2036—Miner Ideal Safety Hand Brake as Shown in Fig. 2035.

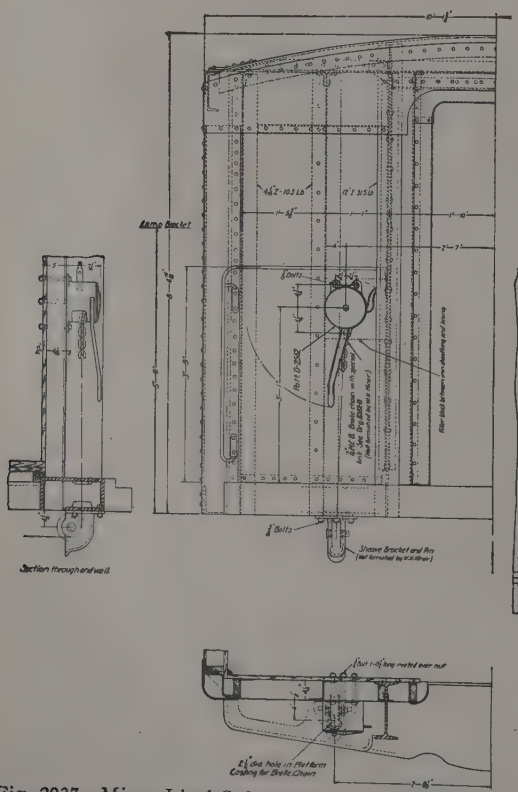


Fig. 2037—Miner Ideal Safety Hand Brake—Chain Type For Freight or Passenger Equipment.

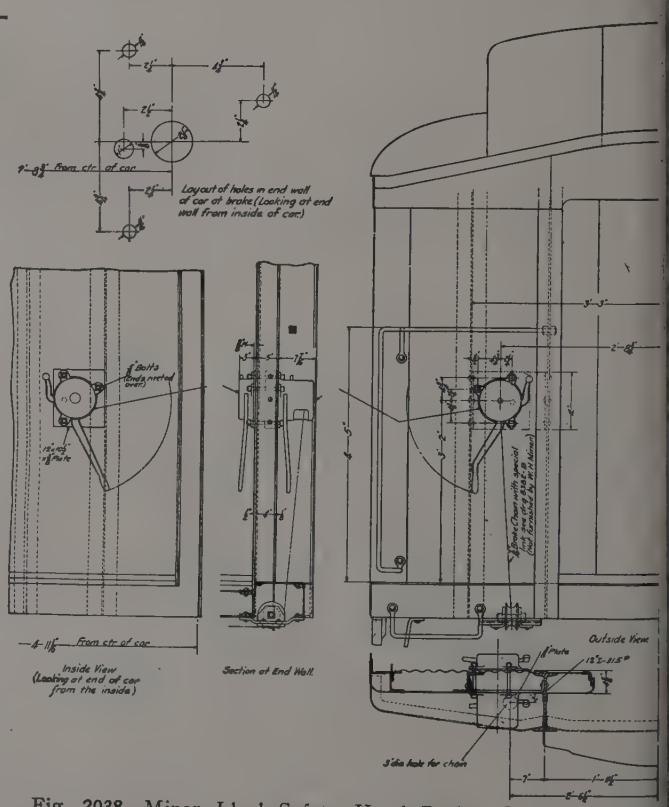

Layout of holes in end wall of car at brake (Looking at end wall from inside of car.)
Inside View (Looking at end of car from the inside)
Section at End Wall
Outside View

Fig. 2038—Miner Ideal Safety Hand Brake—Chain Type—for Inside and Outside Operation on Baggage and Mail Cars.

W. H. Miner.

(*See also Page* 843.)

Miner Ideal Safety Hand Brake Staff Type

The Miner Ideal Safety Hand Brake meets every requirement for the safe and sure control of cars during switching. All types of these brakes provide great leverage and require only one hand for operation. The outstanding feature of the Miner staff brake is its instant ability to develop power adequate to meet any switching emergency. The operator never has to exert such an abnormal pull on the handle as would require his using two hands. Therefore, he instinctively uses his left hand to grasp the grab iron, which is the only safe practice.

The action of the pawl is automatic and the brake can be readily released by simply pulling the handle extension of the pawl. This automatic hand release is provided on all forms of Miner brakes and will positively operate under all conditions. The release handle is always plainly marked so that the inexperienced switchman cannot fail to understand that a simple pull on the release handle will accomplish the desired result.

Switchmen and trainmen are always able to stand on both feet and use their left hand in maintaining a safe operating position, as the right hand only is needed to set or release this brake.

Fig. 2039—Miner Ideal Safety Hand Brake

All parts of the Ideal brakes are made of the best and most suitable material and each device is thoroughly tested and assembled as a complete unit before it is shipped. The operating mechanism is protected from the effect of sleet, cinders, etc.

These brakes are designed to suit various types of freight and passenger car construction, special attention being devoted in every case to properly safeguarding switchmen and trainmen from accidents which are likely to occur when an inefficient braking device is applied. The Miner Ideal Safety Hand Brake of the staff type illustrated in Fig 2035 is designed particularly for vestibule passenger cars and embodies all of the advantages of the freight car brake just described. The passenger design of brake is readily applied to the usual "I" beam end frame construction.

The Chain Type of the Miner Ideal Safety Hand Brake, which is shown in Fig. 2037, is powerful and effective and is doing splendid service on many types of freight and baggage cars. This brake is particularly advantageous for application wherever it is desirable to eliminate the usual brake staff and have the chain wound directly by the brake. It meets the requirements of the United States Safety Appliance Standards in every particular.

The operator applies this brake by gripping the extreme end of the handle, then rotating same until the required power is obtained. Only one hand is required for applying or releasing the brake; therefore the other hand is free to grasp the end hand-hold of the car. There is no foot pawl to operate, hence the brakeman can use both feet to obtain a favorable and safe standing position on the brake step. To release the brake the handle is dropped to normal position and the release pawl is pulled toward the brake.

Figs. 2036 and 2038 show an important modification of the chain brake suitable for operation from either the inside or the outside of the car.

Miner Ideal Safety Hand Brakes are being extensively used by many railroads. They are most effective in preventing personal injuries and are saving large sums of money by protecting equipment and lading from damage.

For other products and branch offices, see classified and alphabetical indexes.

W. H. MINER, CHICAGO, ILL.

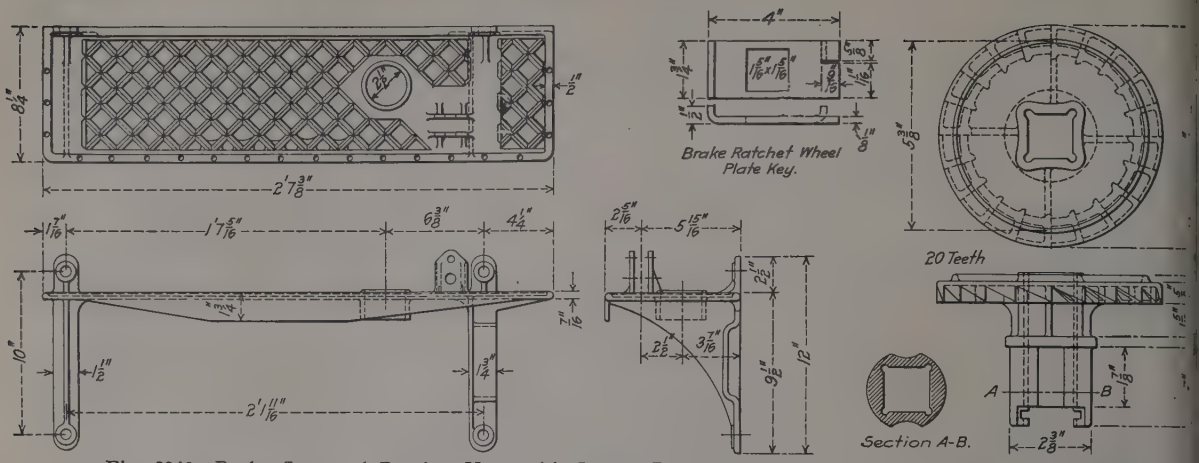


Fig. 2040—Brake Step and Ratchet Used with Square Brake Shaft, Buffalo, Rochester & Pittsburgh.

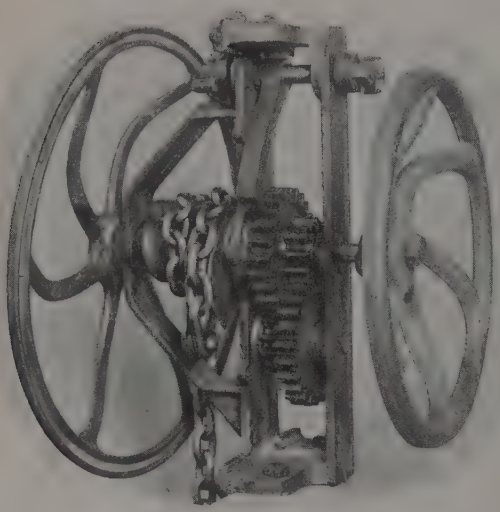


Fig. 2041—Peacock Geared Hand Brake for Blind End Cars. National Brake Company, Inc.

(See also Page 845.)

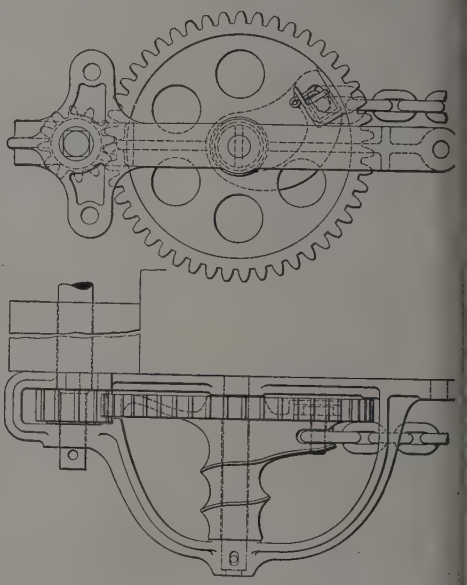


Fig. 2042—Peacock Geared Hand Brake for Fre Cars. National Brake Company, Inc.

(See also Page 845.)

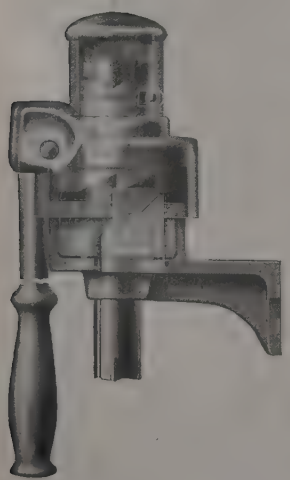


Fig. 2043 — Blackall Drop Handle Government Type Ratchet Brake with Standard No. 59 Cap. Robert H. Blackall.

Fig. 2044—H-R Ratchet Brake Lever Applied to Gondola Car. Robert H. Blackall.

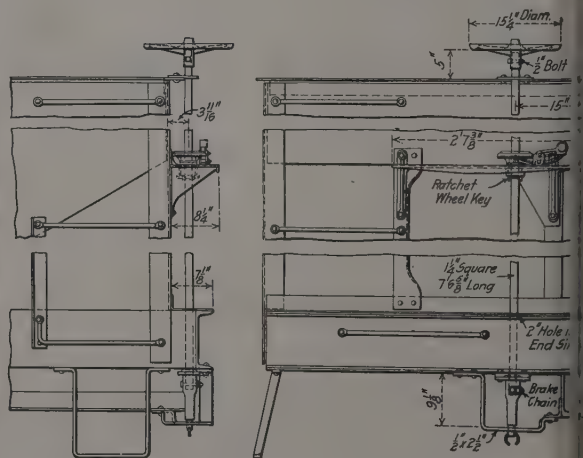


Fig. 2045—Square Brake Shaft Applied to Gondola Car on the Buffalo, Rochester & Pittsburgh.

The Peacock Geared Hand Brake

The Peacock Brake has been designed to provide a reliable means for increasing the effectiveness of hand brake applications. Cars are being built of increasingly greater weight, the loads are constantly becoming heavier and every consideration points to the necessity for a hand brake which will function with increased power and efficiency.

The limit to the amount of leverage which may

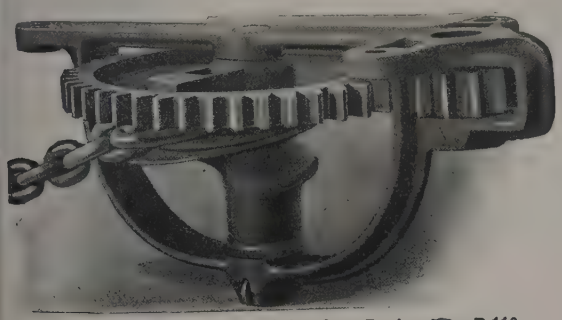


Fig. 2046—Peacock Freight Car Brake B 116

be placed under the car has been reached. The effort which the average brakeman will exert is fairly constant; it seems to be pretty well settled that between the brakeman and the body levers some means must be introduced to supply the increased braking power so urgently demanded.

The Peacock Brake is designed to meet just this requirement. Attached to the lower end of the regular brake staff this brake, by means of a set of gears, multiplies the effort of the brakeman so that he is able to place on the brake chain all the stress that the chain should be called upon to stand.

The Peacock Brake as designed for freight car service—Fig. 2046—consists essentially of a frame drum and pinion. The regular brake staff passes through the front part of the frame and carries the pinion which, as the brake staff is turned, engages the teeth of the large gear or drum about which the chain is wound. This chain-winding drum begins with an eccentric of large radius which tapers gradually to a round of comparatively small diameter. In operation, as the brakeman begins to turn the brake wheel, this eccentric takes up the slack chain quickly and moves the brake levers forward so that the brake shoes are brought in contact with the wheels with the greatest possible speed. Simultaneously the brake chain passes from the large radius of the eccentric to the smaller portion of the drum which increases the braking power at the chain in the exact proportion to the gear ratio.

The gear ratio of the Peacock Brake shown is 4 to 1 so that:

100 lb. on a 16-in. wheel delivers 1,777 lb. at the brake chain.
100 lb. on an 18-in. handle delivers 4,000 lb. at the brake chain.
100 lb. on a 21-in. handle delivers 4,666 lb. at the brake chain.
100 lb. on a 24-in. handle delivers 5,333 lb. at the brake chain.

Any hand brake, to be efficient in freight service, must provide a means for taking up the slack in both chain and brake rigging quickly and must furnish sufficient braking power to handle the loaded car. This should be accomplished without the resort to any device which requires any other than the habitual practice of the brakeman.

No additional instruction of the brakeman is required to operate the Peacock Brake. The brake operates with the same type of wheel or handle that has long been used in ordinary brakes. A reliable control or "a good braking car" is thus provided and good braking cars save both time and damage.

The Peacock Internal Geared Hand Brake for baggage, mail, and all blind-end cars—Fig. 2047—consists, essentially, of a main steel shaft, drum and pinion mounted in a suitable frame with a rachet wheel and pawl for holding the brake when set.

Of these different parts the drum, about which the brake chain is wound, deserves particular attention. This drum begins with an eccentric of large radius and tapers gradually to a round of comparatively small diameter. In operation the eccentric takes up the slack chain quickly and moves the brake levers forward, bringing the shoes in contact with the wheels with the greatest possible speed. Simultaneously the brake chain passes from the large radius of the eccentric to the smaller diameter of the drum, which increases the

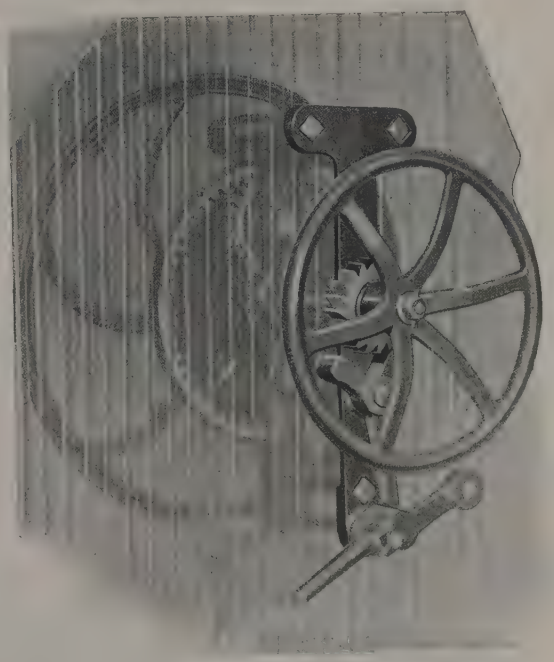


Fig. 2047—Peacock Hand Brake for Blind End Cars

braking power at the chain in exact proportion to the gear ratio.

With the combination of this eccentric and a high gear ratio the effort of the average brakeman will develop at the brake chain all the stress which the chain can safely be called upon to stand. By this method very high braking power may be applied quickly and effectively.

Fig. 2048—Ratchet Wheel Pawl and Plate for Square Shaft — Assembled.

Section of Above.

Fig. 2049—Square Shaft Castings.

Fig. 2050—Ratchet Wheel, Pawl and Plate for Round Shaft — Assembled.

Fig. 2051—Application of Square Shaft Castings to Brake Step.

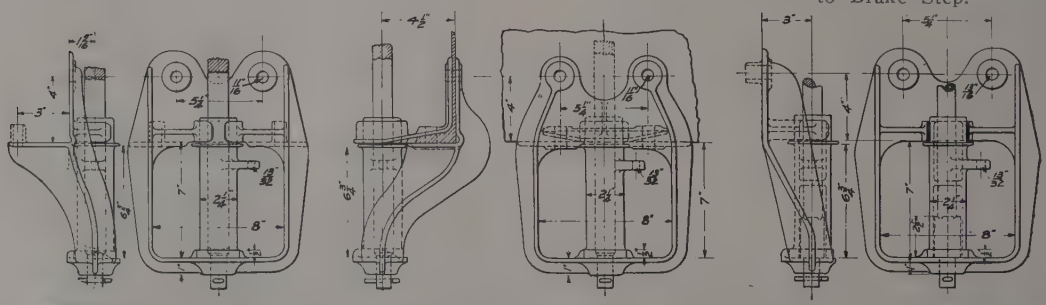


Fig. 2052—Brake Shaft Steps for Square and Round Shafts.

Fig. 2053—5-Spoke Hand Brake Wheel.

Fig. 2054—Square Shaft Roof Bracket.

Fig. 2055—Round Shaft Roof Bracket.

Fig. 2056—Six-Spoke Hand Brake Wheel.

Fig. 2057—Square Drop Shaft in Raised Position.

Fig. 2058—Square Drop Shaft Step Sleeve and Seat.

Fig. 2059—Square Drop Shaft in Lowered Position.

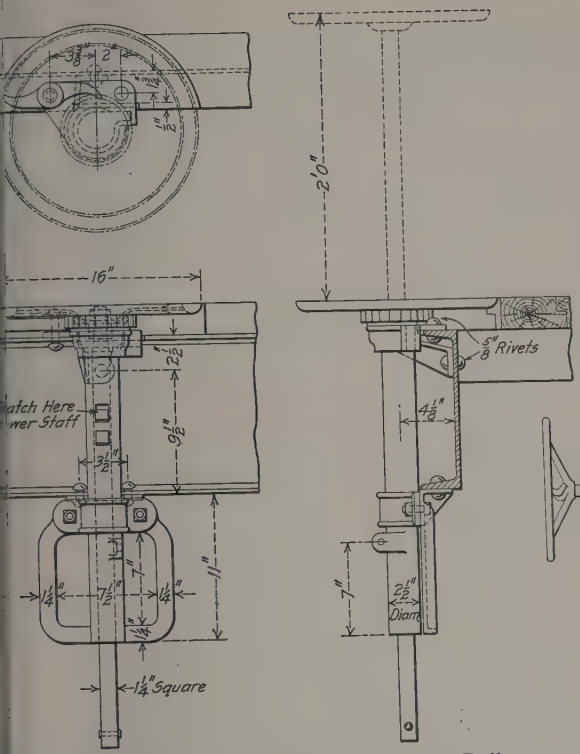


Fig. 2060—Union Drop Brake Shaft. Union Railway Equipment Company.

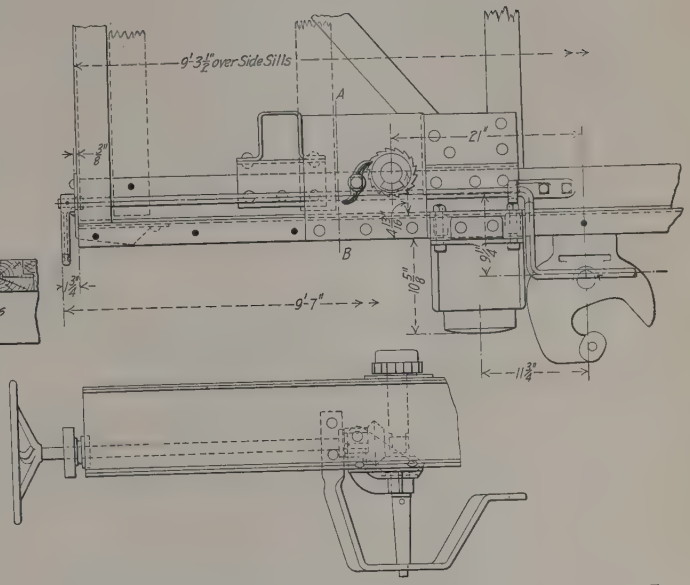


Fig. 2061—Shifting Brake Shaft Device Applied to Flat Car. Pressed Steel Car Company.

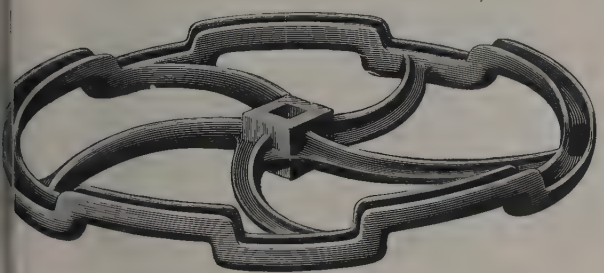


Fig. 2062—Perfect Brake Wheel. Dayton Malleable Iron Company.

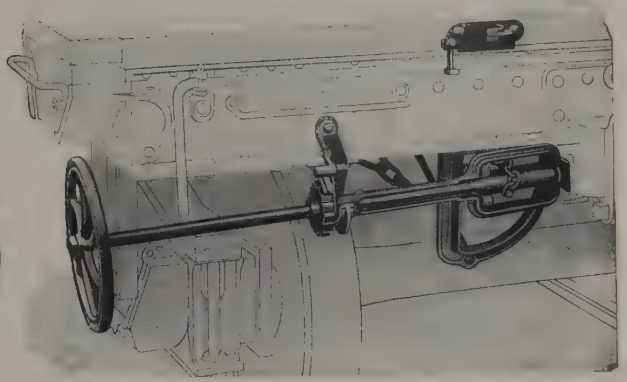
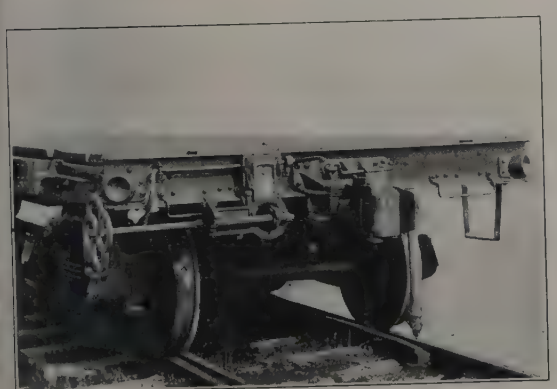


Fig. 2063—Barber Tilting Brake Staff. Standard Car Truck Company.



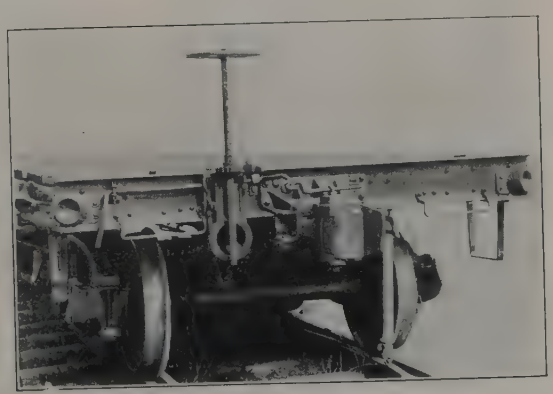


Fig. 2064—Feasible Drop Brake Shaft Applied to Flat Car. National Railway Appliance Company.

(See also Page 962.)

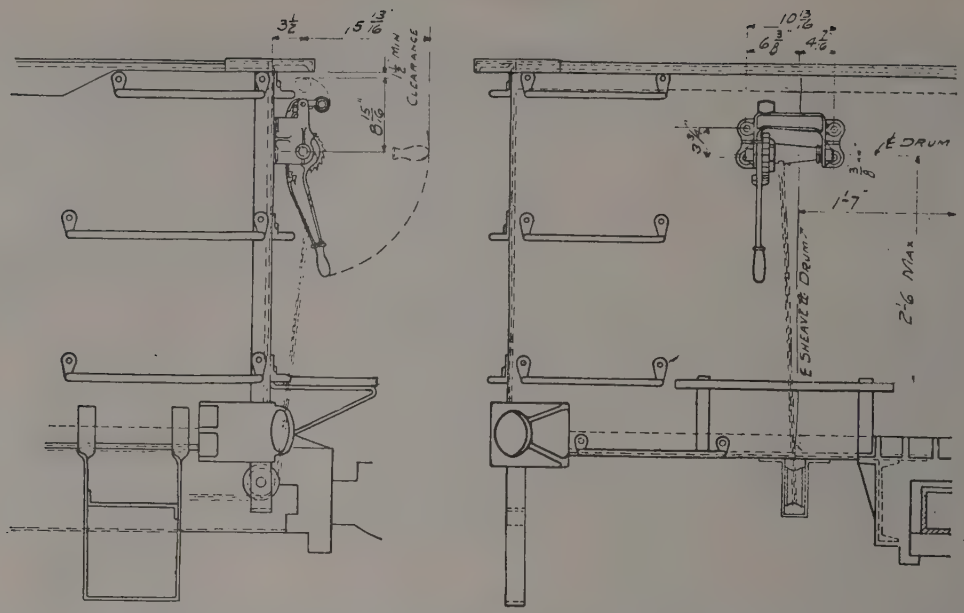


Fig. 2065—Application of Talmage Style "B" Hand Brake. The Talmage Manufacturing Company.
(See also Page 849.)

Fig. 2066—Brake Handle. Adams & Westlake Company.

Fig. 2067—Blackall Ratchet Brake, Flat Car Type, in Release Position. Robert H. Blackall.

Fig. 2068—Kass Safety Brake Step Applied to End of Freight Car. Morton Manufacturing Company.
(See also Page 451.)

Fig. 2069—Type B Acme Brake for Vestibule and Dummy End Cars. Pittsburgh Railway Appliance Company.

Fig. 2070—Type C Acme Pull-Up Brake for All Classes of Freight and Baggage Cars. Pittsburgh Railway Appliance Company.

Fig. 2071—Type A Acme Brake for All Classes of Freight Equipment. Pittsburgh Railway Appliance Company.

Talmage Style B Hand Brake

The Talmage Hand Brake has been developed with the idea of securing a simple braking mechanism which would eliminate the objectionable features of the common hand-wheel type, and provide safe means for the application of a greater braking power than is possible with the ordinary hand brake equipment.

Invented by a trainman who lost an arm in railroad service, this brake was designed primarily to give maximum safety to the operator. The ratchet and pawl, and the brake handle are operated with the same hand which allows the brakeman to keep hold of the car at all times with one hand while the absence of any foot work permits him to maintain a good footing. Due to the pull-up motion the operator always stands in a normal position and the harder he pulls the firmer his foothold. The danger of being thrown from the car due to the sudden failure of the brake chain—a serious and all too frequent occurrence with the usual wheel hand brake—is eliminated by this method of operation.

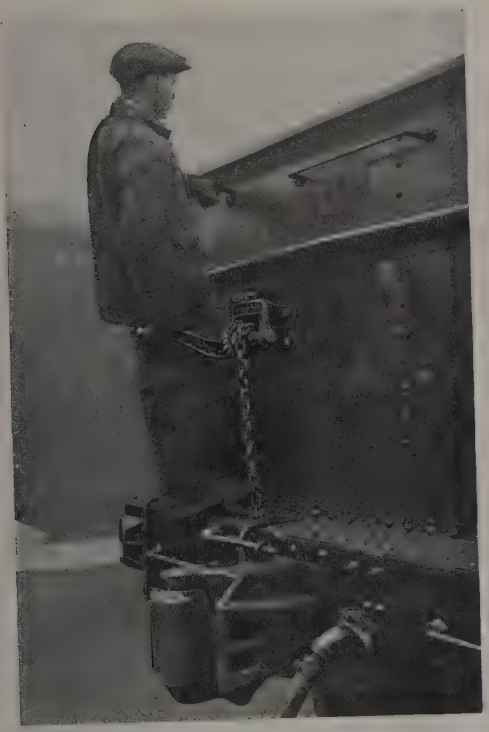


Fig. 2072—Method of Operation

The use of a chain instead of the brake staff on the Talmage Hand Brake makes possible the great saving in the maintenance of the hand brake and the increase in car revenue. The Bureau of Safety reports for the past two years show that 43.9 per cent of the defects reported against the hand brakes were due to some defective condition of the brake staff itself. A slight buckling or bulging of a car end is usually sufficient to throw the rigid brake staff out of alignment thereby making it difficult or impossible to operate the brake. A hand brake that will not properly release, means at the best, undue wear from dragging brake shoes and generally means taking the car out of service. The chain extending up to the winding drum of the Talmage Hand Brake gives a flexibility that permits proper brake operation regardless of the condition of the end of the car.

Fig. 2073—Front View

The Talmage Hand Brake is simple in construction and its method of operation readily understood; no gearing or housing is used, the increased power being obtained by the use of a sheave wheel on the end of the pullrod. The horizontal tapered drum gives a quick take-up of the slack chain and carries a deflector which prevents the chain double-wrapping. The drum will take up the required 36 in. of brake chain and due to its taper will give an increased braking power the greater the amount of chain wind when the same effort is exerted on the brake handle.

The location of this brake below the top of the car prevents the costly damage from clam shell buckets, magnets and other unloading devices, while the roller shaft and other refinements in the design, and the workmanship practically eliminate hand brake maintenance expense. The positive release or graduated release as desired, together with the increased braking power means better control of the cars and a decrease in damage to the cars and lading.

In addition to the increased safety to the operator, greater braking power and lack of maintenance expense the Talmage Hand Brake, due to the low initial cost and ease of application, costs about the same applied as the inefficient ordinary hand-wheel type of brake.

Fig. 2074—Side View

The Talmage Hand Brake is also furnished in a style *C* brake having a spiral horizontal drum which is interchangeable with the tapered drum used on the style *B* brake shown in Fig. 2065. The spiral on the drum prevents the chain double wrapping and allows the operator to pull on a 1½ in. diameter at all times. This spiral drum has a 32 in. chain take-up and gives the same brake efficiency regardless of the amount of chain taken up.

For other products and branch offices, see classified and alphabetical indexes.

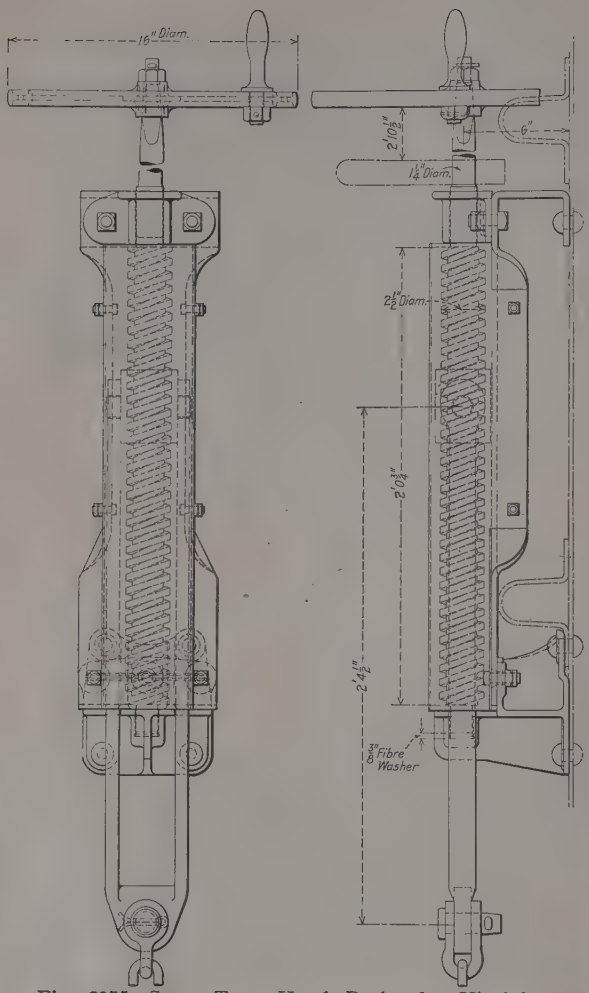


Fig. 2075—Screw-Type Hand Brake for Virginian 120-Ton Gondola Car.

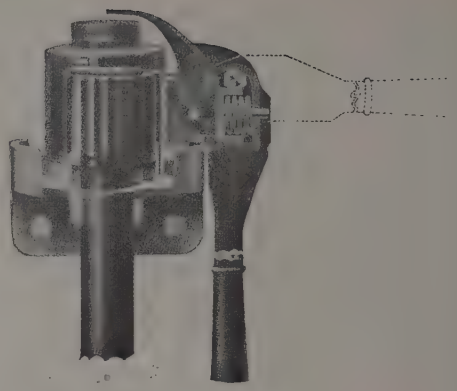


Fig. 2076—Improved Lindstrom Brake. Robert H. Blackall.

Brake Handle Parts—Fig. 2079.

15-A	*Handle Lever*	15-O	*Trigger Rod*
15-B	*Cap*	15-P	*Pawl Pin with Cotter*
15-C	*Trigger with Pin*	15-Q	*Spring*
15-D	*Floor Ratchet*	15-R	*Washer*
15-E	*Foot Pawl*	15-S	*Rod Pin with Cotter*
15-F	*Pawl Connection*	15-T	*Bracket Latch Strike with Pin*
15-G	*Shaft Nut*	15-U	*Bracket with Strike for Open Platform Cars*
15-H	*Bracket for Vestibule Cars*	15-V	*Handle Stop for Open Platform Cars*
15-I	*Floor Plate*	15-W	*Lever Pawl*
15-J	*Shaft for Vestibule Cars or Open Platform Cars*		
15-K	*Lever Ratchet*		
15-L	*Handle Bumper*		
15-M	*Chain Sleeve*		

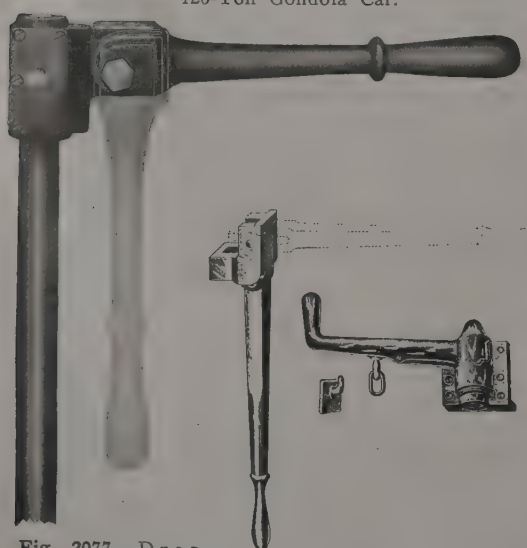


Fig. 2077—Drop Brake Handle. Dayton Manufacturing Company.

Fig. 2078—Brake and Uncoupling Levers. Dayton Manufacturing Company.

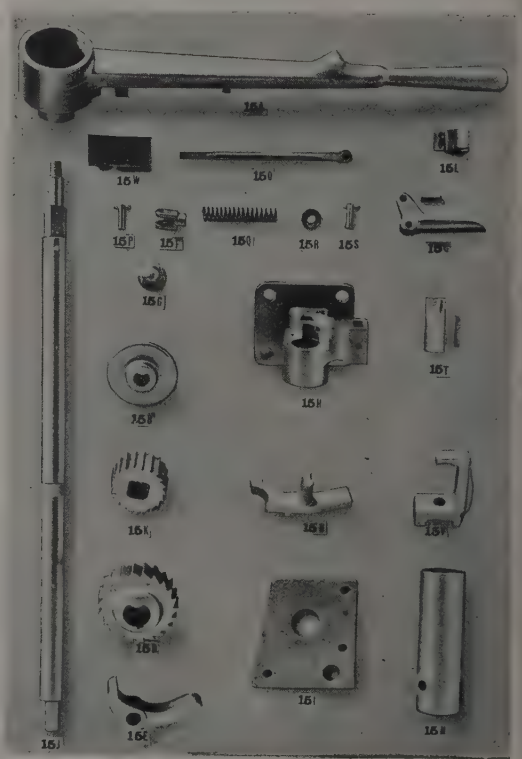


Fig. 2079— Lindstrom Hand Brake. James L. Howard & Company.

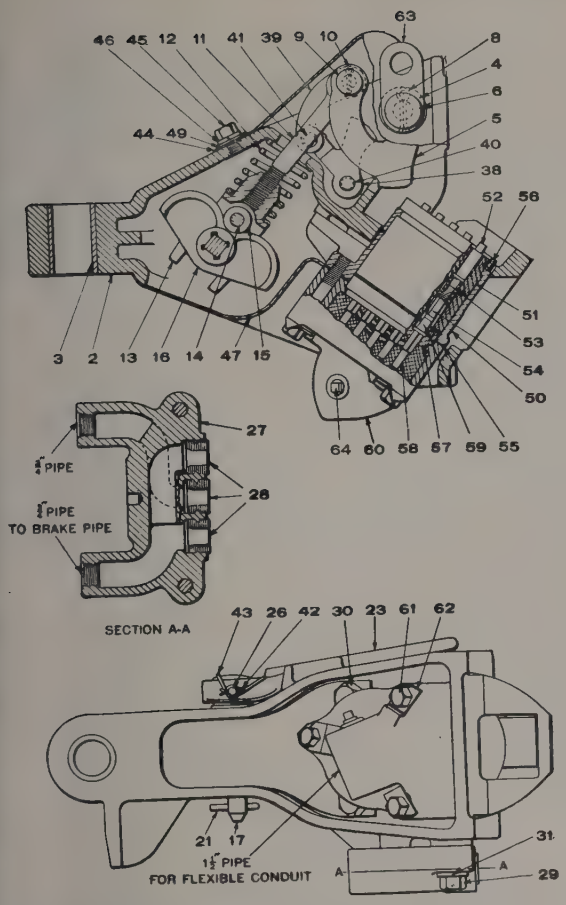


Fig. 2080—Westinghouse Type K-1-A Automatic Car, Air and Electric Coupler.

Names of Parts of Fig. 2080.

2 *Coupler Head.*
3 *Bush for Head.*
4 *Latch Shaft Bush*
5 *Latch.*
6 *Latch Shaft.*
8 *Cotter.*
9 *Latch Rod Rivet Pin.*
10 *Cotter.*
11 *Latch Rod.*
12 *Latch Spring.*
13 *Latch Spring Guide.*
14 *Steel Rivet Pin.*
15 *Roller.*
16 *Uncoupling Cam.*
17 *Cam Shaft.*
21 *Cotter.*
23 *Handle.*
26 *Cottered Rivet.*
27 *Gasket Socket.*
28 *Gasket.*
29 *Cap Screw.*
30 *Cap Screw.*
31 *Lock Washer.*
38 *Trigger.*
39 *Trigger Link.*
40 *Trigger Pin.*
41 *Trigger Link Pin.*
42 *Cotter.*
43 *Handle Spring.*
44 *Latch Cover.*
45 *Cap Screw.*
46 *Lock Washer.*
47 *Cam Cover.*
49 *Washer.*
50 *Electric Portion Housing.*
51 *Front Insulation.*
52 *Plunger.*
53 *Plunger Contact Spring.*
54 *Plunger Nut.*
55 *Housing Cover Gasket.*
56 *Weather Gasket.*
57 *Rear Insulation.*
58 *Terminal.*
59 *Terminal Stud.*
60 *Housing Cover.*
61 *Cap Screw.*
62 *Lock Washer.*
63 *Coupler Link.*

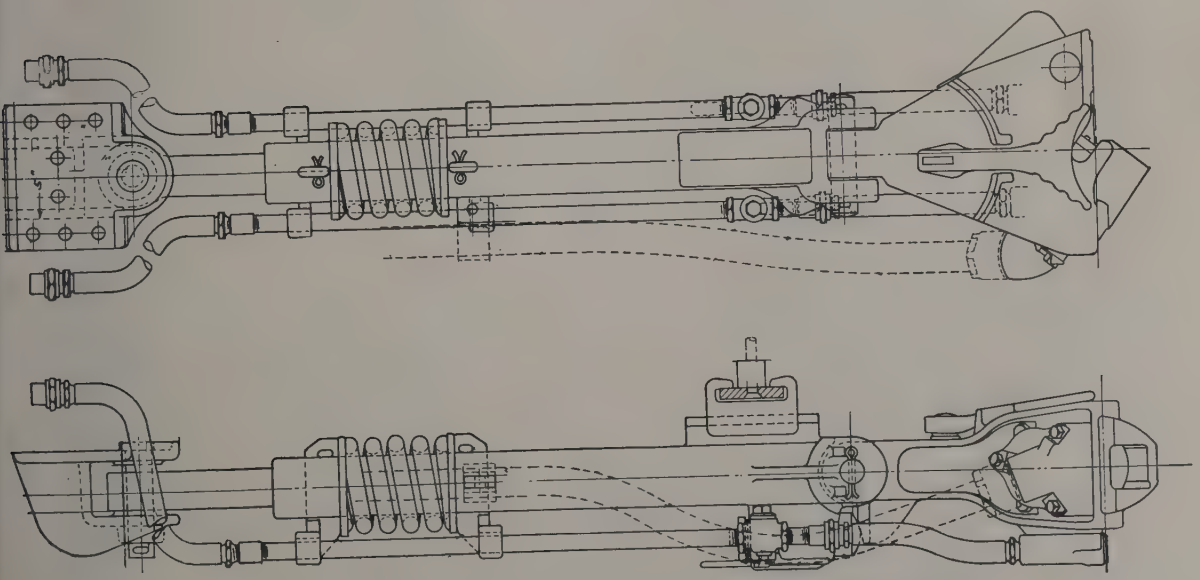


Fig. 2081—Westinghouse K-1-A Coupler Head, Draft Gear and Piping Connections.

Westinghouse Air Brake Company.

(*See also Page* 854.)

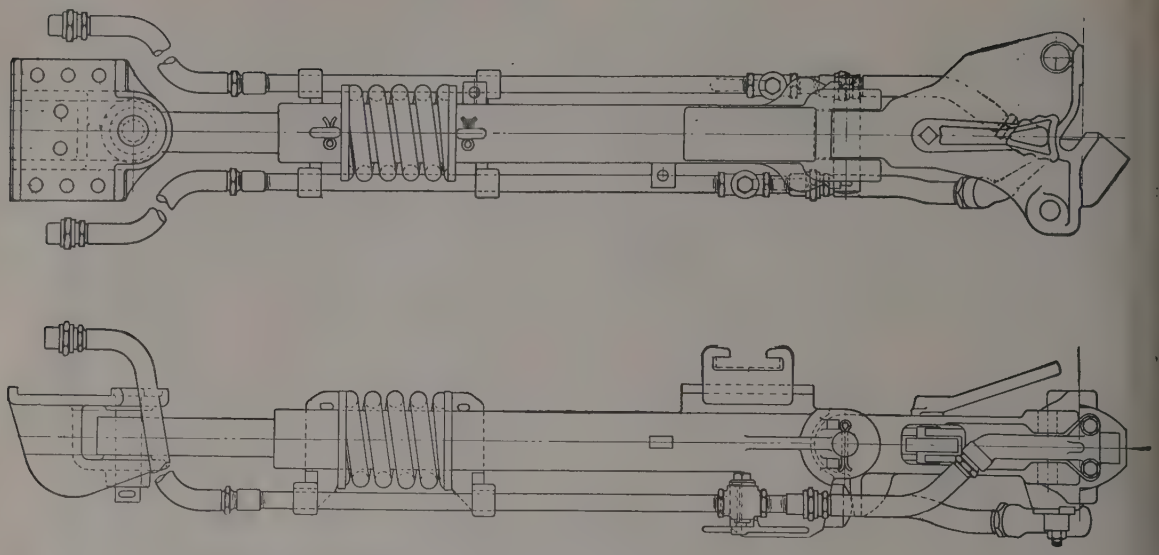


Fig. 2082—Westinghouse C-3-A Coupler Head, Draft Gear and Piping Connections.

Names of Parts of Fig. 2083.

2 *Coupler Head*
4 *Latch Shaft Bush*
5 *Latch*
6 *Latch Pin*
8 *Cotter*
9 *Latch Rod Pin*
10 *Steel Cotter*
11 *Latch Rod*
12 *Latch Spring*
13 *Latch Spring Guide*
14 *Rivet Pin*
15 *Roller*
16 *Uncoupling Cam*
17 *Cam Shaft*
23 *Handle*
26 *Rivet Pin*
27 *Gasket Socket*
28 *Gasket*
38 *Gasket Socket*
29 *Cap Screw*
39 *Square Head Bolt*
40 *Hexagon Nut*
41 *Cotter*

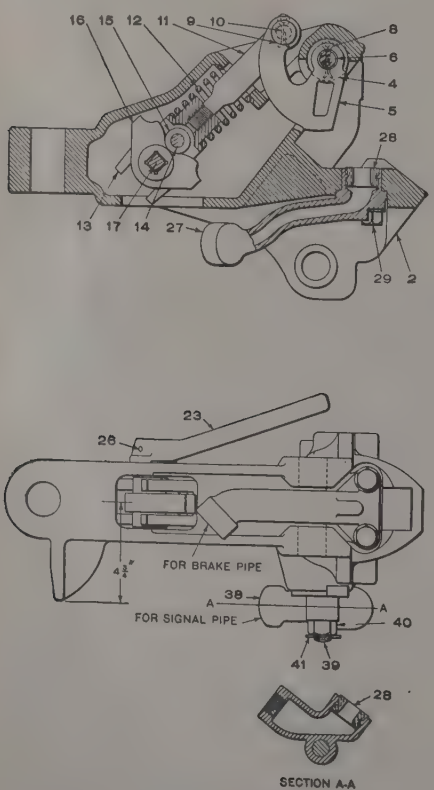


Fig. 2083— Westinghouse Type C-3-A Automatic Car and Air Coupler.

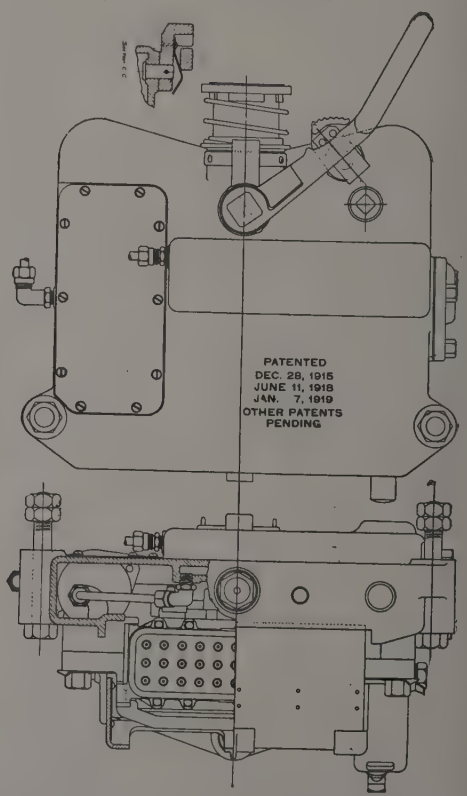


Fig. 2084—Plan View and End Elevation of Electric Portion of Westinghouse H-2-A Coupler.

(*See also Page* 854.)

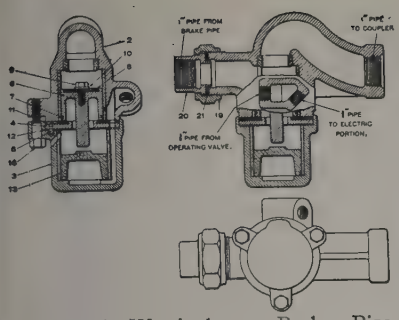


Fig. 2085—Westinghouse Brake Pipe Cut Off Valve as Used by the H-2-A Coupler.

Names of Parts of Fig 2085.

2	*Body*	11	*Large Gasket*
3	*Cover*	12	*Cover Gasket*
4	*Ring*	13	*Piston*
5	*Pin*	15	*Cap Screw for Cover*
6	*Valve*		
7	*Piston Ring*	19	*Union Nut*
8	*Gasket*	20	*Union Swivel*
9	*Cap Screw*	21	*Union Gasket*
10	*Washer*		

Names of Parts of Fig. 2088.

2	*Coupler Head*	24	*Check Valve Piston*
3	*Bush for Head*	25	*Check Valve Seat*
4	*Latch Shaft Bush*	26	*Check Valve Spring*
5	*Latch*	27	*Cap Screw*
6	*Latch Shaft*	28	*Cap Screw*
7	*Washer for Latch Shaft.*	29	*Release Spring*
8	*Cotter for Latch Shaft.*	30	*Piston*
		31	*Piston Ring*
		35	*Cylinder Gasket*
9	*Latch Rod Pin*	36	*Gasket for Air Connection.*
10	*Cotter*		
11	*Latch Rod*	37	*Cylinder Cover*
12	*Latch Spring*	38	*Cap Screw*
13	*Gasket Socket and Cylinder.*	39	*Double Lock Washer*
14	*Gasket Socket Cover.*	40	*Cap Screw*
		41	*Cap Screw*
15	*Pilot Valve Spring*	43	*Operating Piston*
16	*Piston Bush*	44	*Operating Piston Ring.*
17	*Pilot Valve*		
18	*Pilot Valve Cap*	45	*Check Valve*
19	*Piston Seat*	46	*Check Valve Seat*
20	*Gasket Socket*	47	*Check Valve Spring*
21	*Check Valve*	48	*Check Valve Cap*
22	*Check valve Spring*	49	*Operating Piston Cap Nut.*
23	*Check Valve for Brake Pipe.*		

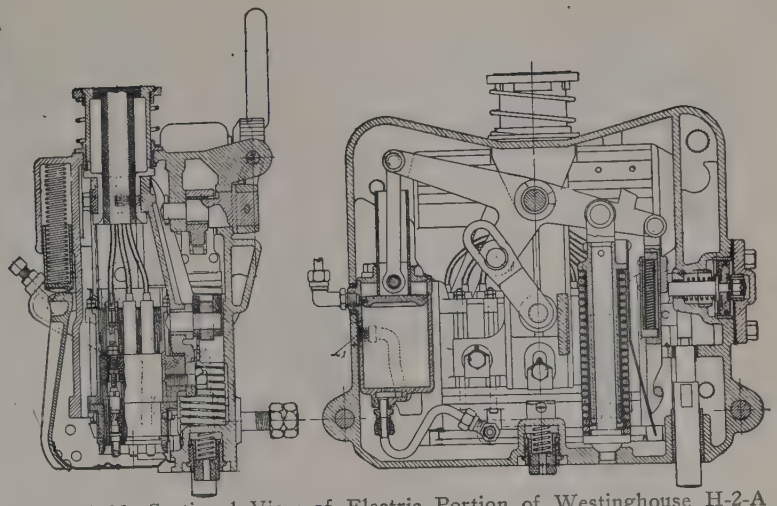
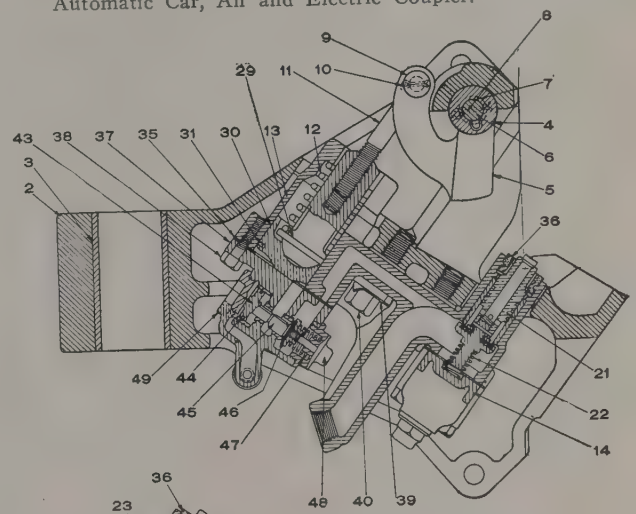
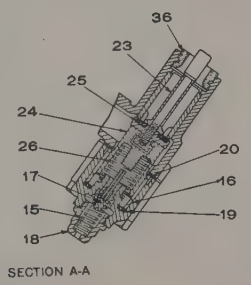


Fig. 2086—Sectional View of Electric Portion of Westinghouse H-2-A Automatic Car, Air and Electric Coupler.





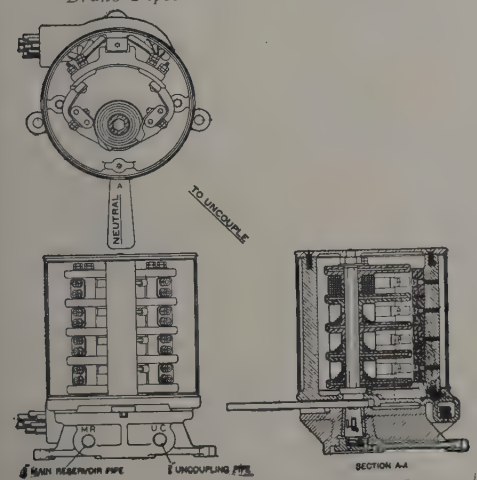


Fig. 2087—Westinghouse Combined Uncoupling Valve and Switch as Used with the H-2-A Coupler.

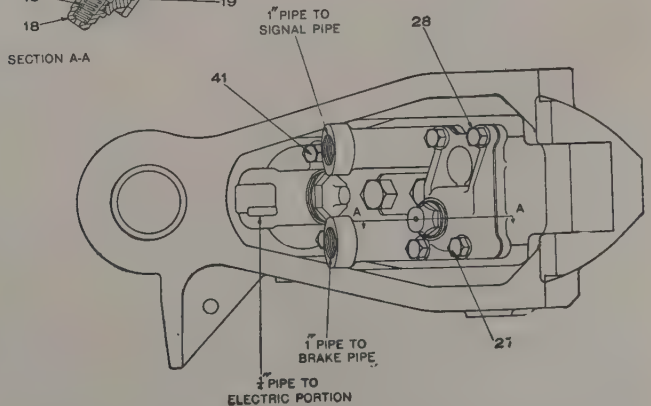


Fig. 2088—Westinghouse Type H-2-A Automatic Car, Air and Electric Coupler; Coupler Head Assembled Without Electric Portion.

(*See also Page* 854.)

Automatic Car, Air, and Electric Couplers

Among the many problems which electric train operation presents, not the least is the means for connecting the cars together. The Westinghouse Air Brake Company is primarily concerned with this problem from the standpoint of air brake operation and maintenance, but extended experience and broad knowledge gained through close association with traffic conditions in the solution of braking problems, has enabled this company to solve other problems relating to the prompt handling of trains.

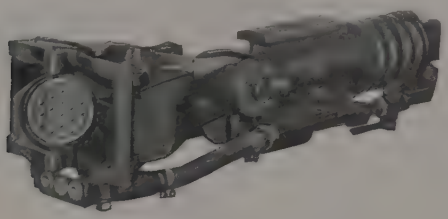


Fig. 2089—K-1-A Type of Coupler

The Tight Lock, Automatic, Air and Electric Coupler for cars, as its name implies, is a device by means of which all connections between cars—mechanical, pneumatic, and electrical—are made automatically, and held rigidly together.

This coupler comprises a cast steel head and drawbar with suitable draft gear spring, and an electric portion. The air connections are brought to outlets at the coupler face and provided with soft rubber gaskets to seal the joints. The electrical portion consists essentially of a series of "butt" type contacts which are brought together when the couplers become engaged, but which are well protected from mechanical injury on the open end of a car. These contacts while coming together are caused to rotate in opposite directions, which subjects the surfaces to a rubbing action, removing all non-conducting material which may have accumulated.

The draft gear and coupler, and all parts which are subjected to buffing or pulling strains, or liable to a severe shock, are either steel castings or forgings made of high grade materials.

The K-1-A Coupler, illustrated in Fig. 2089, is adapted for multiple motor, or motor and trailer operation in street railway service. It is entirely automatic in the coupling operation, but the uncoupling is manual. The impact of the couplers locks them together and makes the air and electric connections, the operation being completed by manipulation of circuit, which closes switches and cut-out cocks. The reverse movement of switches, cut-out cocks and movement of locking handled comprises the uncoupling operation. If the coupler lock is not re-set by hand, it is automatically reset during the initial part of the coupling operation. When this coupler is used without the electric portion, it is called the K-1.

The C-3-A Coupler, illustrated in Fig. 2082, is a car and air coupler, with no electric portion. It may be used in the same service as the K-1.

The H-2-A Coupler, illustrated in Fig. 2090, is suitable for more severe service in suburban, elevated, and subway train operation. The design follows the K-1-A Coupler in the general contour of the coupling faces, but has a separate electrical portion attached underneath the head.

When the couplers come together they are mechanically locked, and continuous air connections made between cars by the mutual opening of check valves in the outlets, and sealing of the gaskets. Coincidently air is admitted and trips pistons which release the slide extending springs, thereby forcing the slides forward into contact.

To uncouple the cars involves manual operation of a combined uncoupling valve and switch, which opens the car line circuits to the coupler head; admits air to a brake pipe cut-off valve to close the brake pipe connection; admits air to the coupler for three purposes—to compress and lock the slide-extending springs in position for subsequent coupling, to release the slide-retrieving springs so the slides may separate, and to release the latches so the coupler heads may separate.

From a safety standpoint the advantages of Westinghouse automatic couplers are important considerations. The element of personal danger in making up trains is eliminated, since the train crew need not go between the cars, all mechanical, pneumatic and electrical connections being made automatically. When the couplers are locked together it is impossible for them to separate, accidentally, while the train is in operation over uneven track; any unintentional separating of the cars will produce an emergency application.

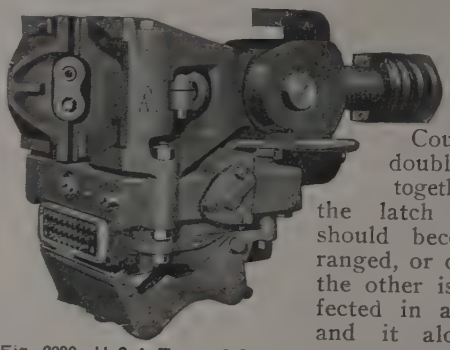


Fig. 2090—H-2-A Type of Coupler

Couplers are doubly locked together; if the latch of one should become deranged, or defective, the other is not affected in any way, and it alone will prevent accidental uncoupling of the cars. Furthermore, all slack is eliminated.

From the standpoint of economy there are many advantages. Time is saved because trains may be made up more promptly and congestion at terminals avoided, while delays due to failure of air or electric connections are obviated.

Maintenance is low since the coupler construction is very substantial and rugged throughout. Movements at pivoted points and relative motions between adjoining couplers are restricted, hence there is practically no wear from these sources. No expense for electric jumper upkeep or replacements is necessary. Wear and tear on those connections are eliminated. Gaskets are subject to practically no abrasion, and may be replaced quickly.

Fig. 2091—Durbin Automatic Connector in Coupled Position as Applied to Passenger Cars.

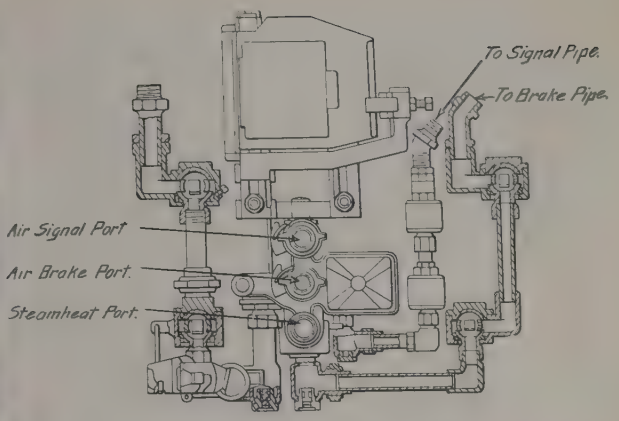


Fig. 2092—End Elevation of Beahm Automatic Connector.

Fig. 2093—Front View of Durbin Automatic Train Pipe Connector as Applied to Passenger Cars.

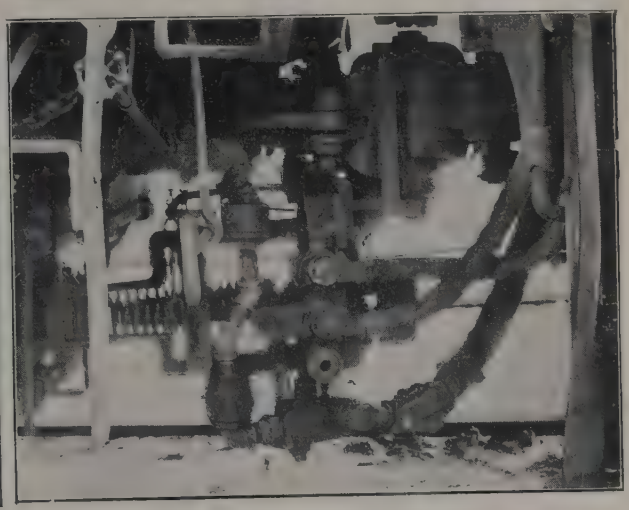


Fig. 2094—Application of Beahm Automatic Connector.

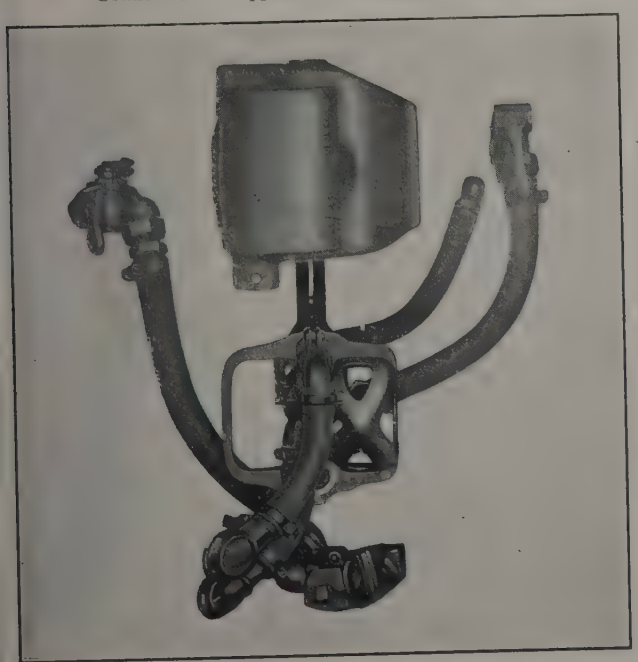


Fig. 2095—American Automatic Connector for Passenger Equipment. American Automatic Connector Company.

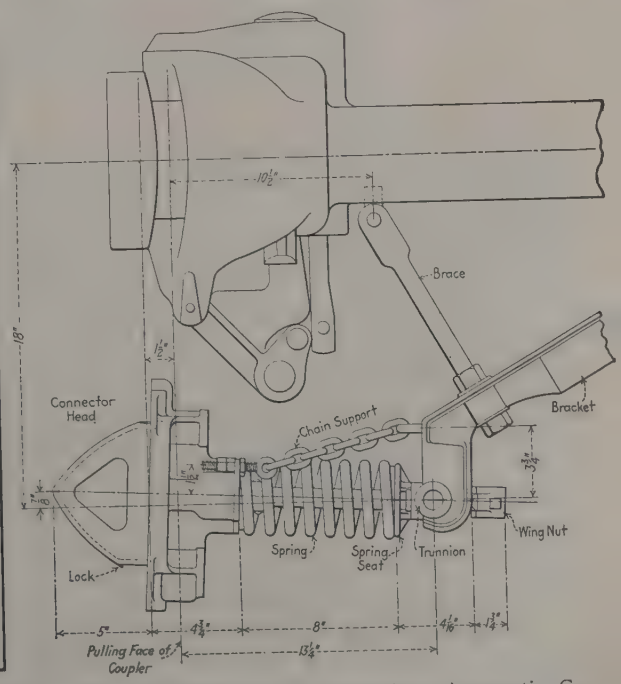
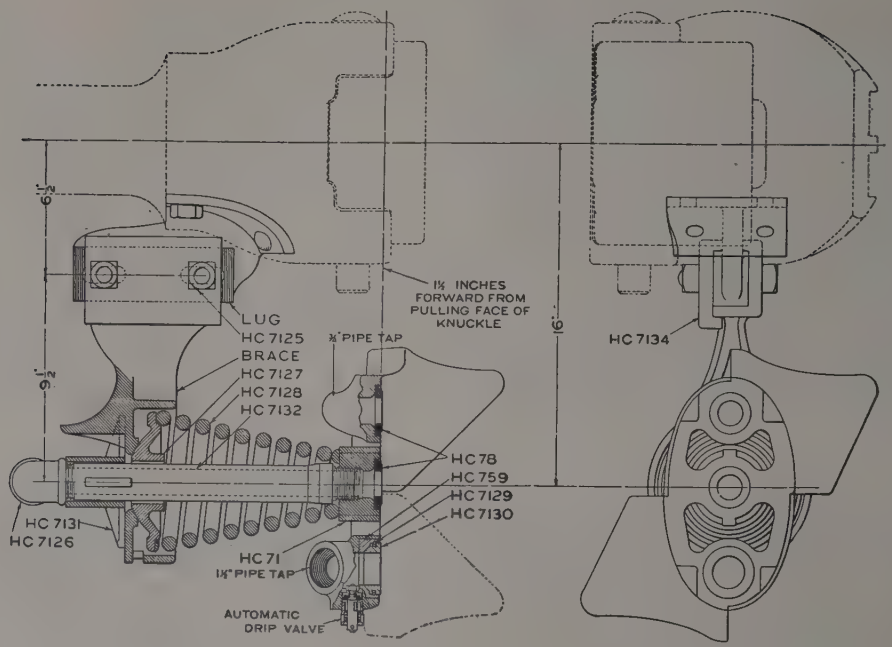


Fig. 2096—Application of the American Automatic Connector. American Automatic Connector Company.



HC 71	*Head*	HC 7127	*Spring Seat*	HC 7131	*Fingers*
HC 78	*Packing Ring*	HC 7128	*Spring*	HC 7132	*Center Pipe*
HC 7125	*Bolt*	HC 7129	*Steam Heat Retainer*	HC 7134	*Side Plate*
HC 7126	*1¼ in. Elbow*	HC 7130	*Steam Heat Seat*	HC 759	*Bush*

Fig. 2097—Automatic Connector for Passenger Equipment. New York Air Brake Company.

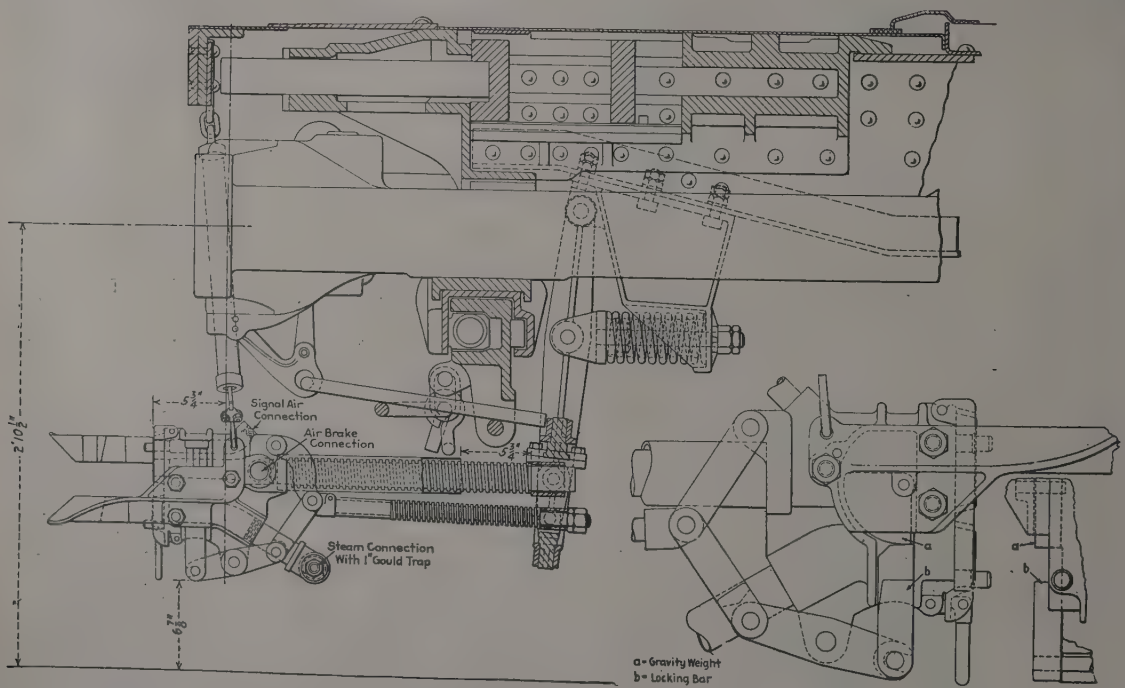


Fig. 2098—Application of Futrell Automatic Connector, Side View of Connector Head at Right. The Futrell Coupler Company.

ig. 2099—Robinson Type 2-H, Automatic Passenger Car Connector. Robinson Connector Company.

Fig. 2100—Robinson Connector Fitted for Interchange with Standard Hose Couplings. Robinson Connector Company.

g 2101—Universal Car and Hose Coupler Applied to Passen-er Equipment. Universal Car and Hose Coupler Company.

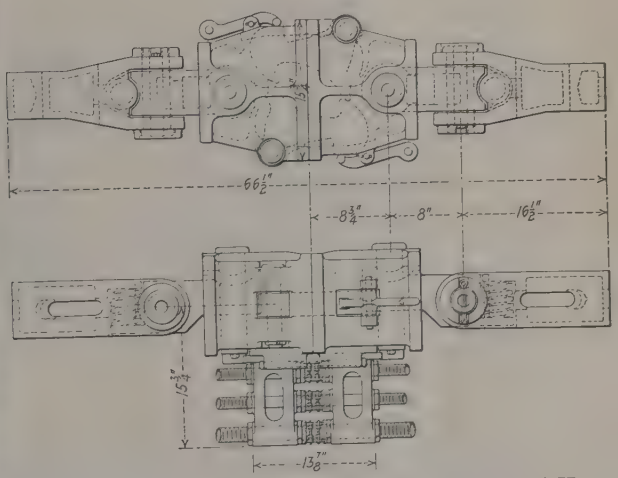


Fig. 2102—General Arrangement of Universal Car and Hose Coupler. Universal Car and Hose Coupler Company.

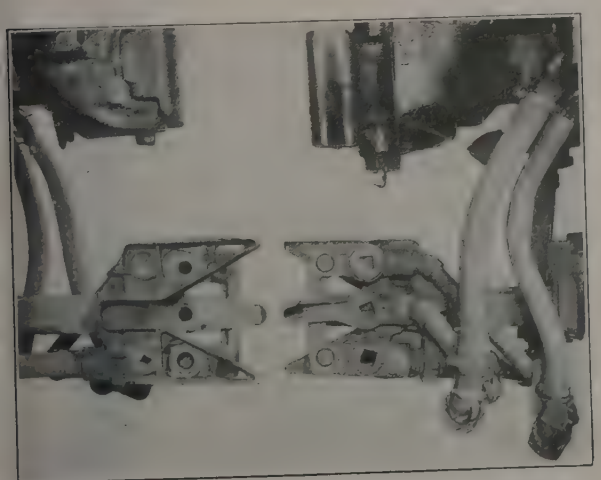


Fig. 2103—Union Automatic Connector Equipped with Flexible Metal Steam Line and Interchange Couplings. Union Connector Company.

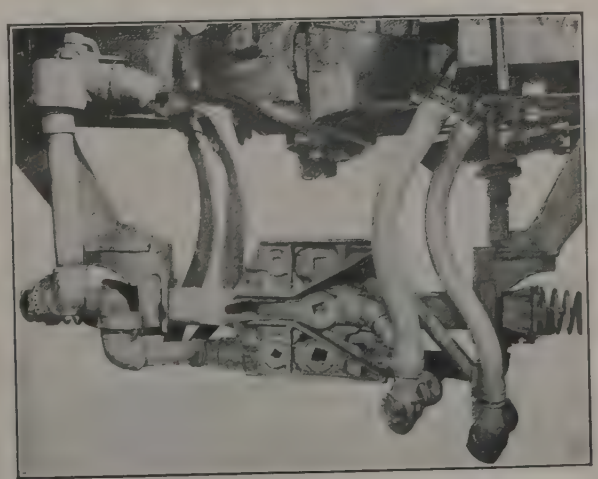


Fig. 2104—Union Automatic Connector in Coupled Position. Union Connector Company.

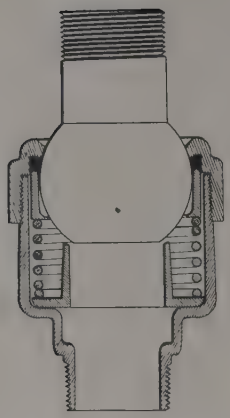


Fig. 2105—Greenlaw Metallic Joint. Argyle Railway Supply Company.

Fig. 2106—Metallic Flexible Steam Hose, Couplers and Lock. Argyle Railway Supply Company.

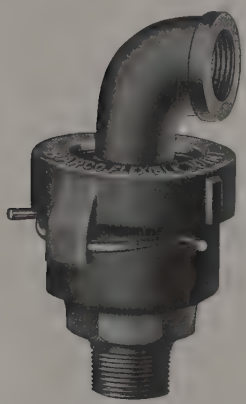


Fig. 2107—Barco 7C-8B Male 90-Deg. Flexible Joint.

Fig. 2108—Barco 7B-8A Flanged 45-Deg. Flexible Joint. Barco Manufacturing Company.

Fig. 2109—Barco Type H-8 Straight Flanged Female Flexible Joint.

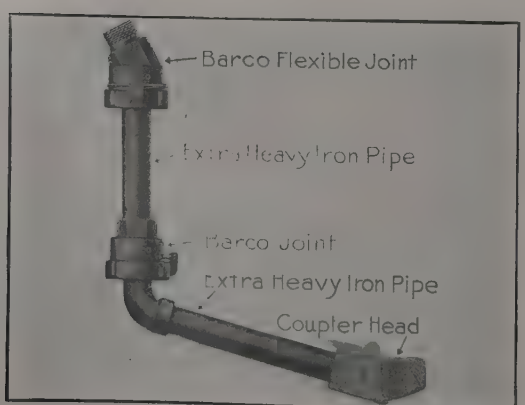


Fig. 2110—Details of Barco Flexible Connection for Cars. Barco Manufacturing Company.

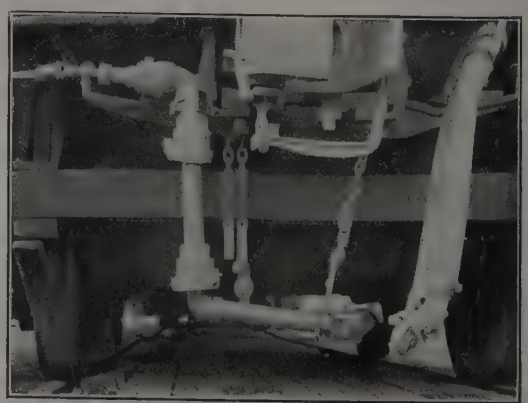


Fig. 2111—Application of Barco Flexible Connection. Barco Manufacturing Company.

(*See also Page* 859.)

Barco Metal Steam Heat Connections

The Barco Steam Heat Connections have been designed to provide an all-metal steam-tight and flexible means for coupling steam heat piping in passenger train service. The flexibility required for such connections is easily obtained by utilizing Barco joints, which in conjunction with standard pipe sections and interchangeable coupler heads, constitute an all-metal, steam heat connection of great durability. This arrangement, as it appears when coupled, is shown in Fig. 2112.

This device is in constant use on various railroads, where it has been subjected to repeated and careful tests, conducted under the most severe operating conditions. The result of these tests, combined with close observation during months of regular service, has conclusively demonstrated the efficiency of Barco steam heat connections.

The most important feature of the Barco product

Fig. 2112—Barco All Metal Steam Heat Connection in Coupled Position

is the fact that, with the exception of necessary gaskets, all parts are composed of metal. Therefore, over an extended period of service, the expense of maintaining this type of equipment will be very low owing to the great durability of metal, especially under the deteriorating action of high temperature steam combined with the rapid atmospheric changes encountered in railroad service.

In considering the utility of the Barco all-metal connections, certain important facts concerning the manner in which ordinary connections between cars usually fail—sudden failure; viz., bursts without warning—should be carefully considered as this generally causes expensive train delays and considerable inconvenience. In the case of all-metal steam heat connections, sudden total failures do not occur. Even after years of service, when it might be expected that metal pipes would become badly corroded, the possibility of sudden failure is remote, because ample warning of a weak condition would be given by the appearance of small steam leaks prior to the final rupture. A badly corroded condition of metal piping is always more or less evident, and its use eliminates the dangers of using a connection which may appear to be in good condition when it actually is at the point of collapse.

It is therefore entirely reasonable to assume that, as has been demonstrated in actual service, the use of Barco connections will eliminate all expense caused by the sudden blowing out of steam heat couplings.

Barco Connections will last throughout the

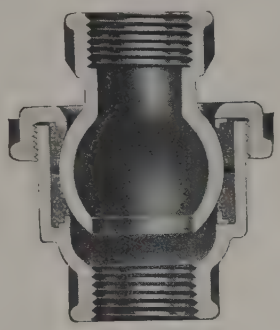


Fig. 2113—Cross Section Showing Internal Construction of the Barco Joint

heating season practically without any attention; and with the occasional replacement of a gasket, they should have a serviceable life equal to that of any other part of the heating system.

A combination lock and support is provided with the Barco Connections. The lock prevents the connection unscrewing from the end valve, and also serves as a point of attachment to which the holding device is secured.

The holding device does not in any way interfere with the operation of the connections, or with other hose between the cars; its function is to prevent the Barco connection from dropping down, when uncoupled, and coming in contact with the rail or road bed.

The advantage of this arrangement will be apparent when consideration is given to the fact that a large number of hose connections are torn from end valves, due to the coupler head becoming caught

Fig. 2114—Barco All-Metal Steam Heat Connection in Uncoupled Position, Coupler Heads Supported

in cross-over switches, or by striking crossing planks and other obstructions, if not hung up in place by the train men.

For other products and branch offices, see classified and alphabetical indexes.

BARCO MANUFACTURING COMPANY, CHICAGO, ILL.

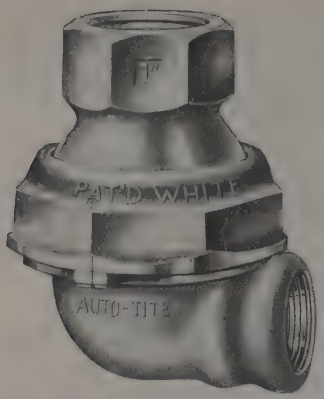


Fig. 2116—Angle "Auto-Tite" Flexible Pipe Joint.

Fig. 2117—"Auto-Tite" Flexible Pipe Joint. International Couplers Co.

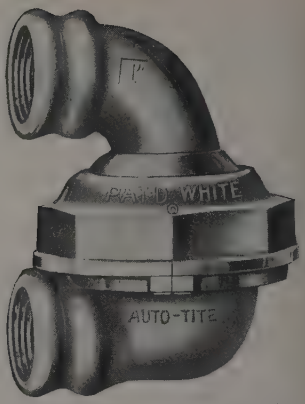


Fig. 2118 — Double Angle "Auto-Tite" Flexible Pipe Joint.

Fig. 2119—Parts of Straight "Auto-Tite" Flexible Pipe Joint.

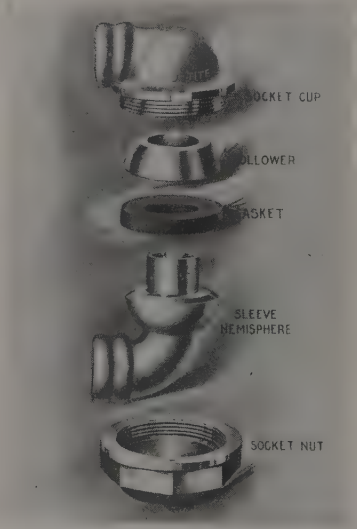


Fig. 2120—Parts of Double Angle "Auto-Tite" Flexible Pipe Joint.

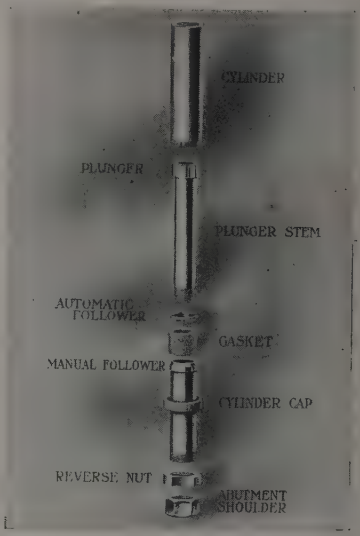


Fig. 2121—The White "Auto-Tite" Traverse Expansion Joint.

International Couplers Company.
(*See also Page* 861.)

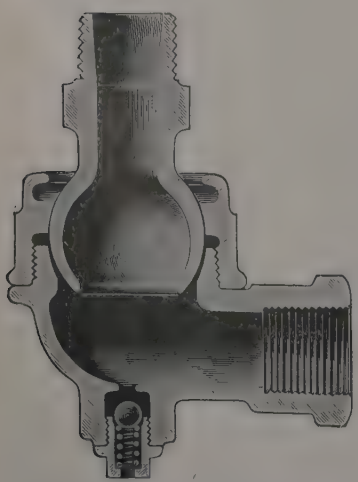


Fig. 2122—Flexible Metallic Joint. Moran Flexible Steam Joint Company.

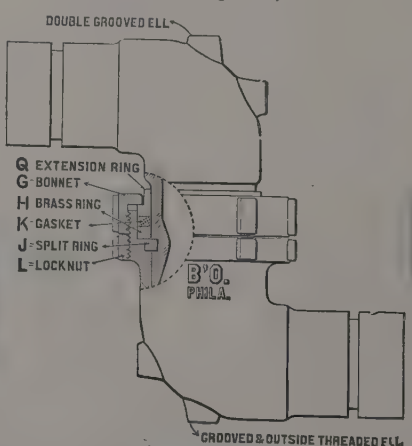


Fig. 2123—Swing Joint. L. J. Bordo Company.

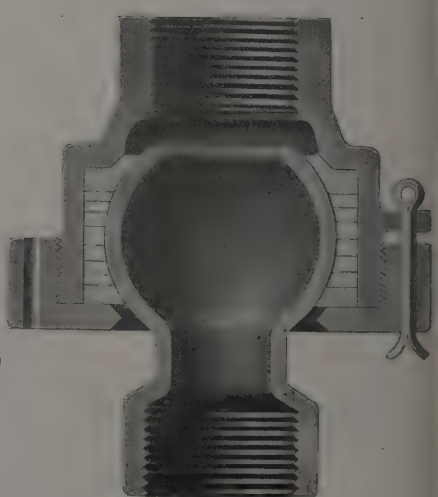


Fig. 2124—McLaughlin Flexible Metallic Joint. Franklin Railway Supply Company, Inc.

Auto-Tite Flexible Pipe Joints

The White Auto-Tite Flexible Expansion Coupling is intended to take the place of rubber hose in making train pipe connections between cars. This coupling remains absolutely tight due to the automatic action of fluid pressure upon a suitable gasket whereby the fluid in seeking to escape, confines itself by its own pressure.

As shown in the cross sectional view—Fig. 2127—of the Auto-Tite Flexible coupling, the inner surface of the socket cup and socket nut is provided with a spherical contour. When assembling this device the socket cup and nut are screwed together until guide marks on the adjacent parts coincide. This causes holes in each member to register as a continuous bore into which a cotter pin may be inserted to keep the parts from working loose. The follower has a sliding engagement with the sleeve hemisphere, and under fluid pressure, acts to compress the gasket outward toward the socket wall. The parts are so formed that pressure exerted on the gasket tends to feed it tightly to a single feather edge at the juncture of the spherical lines of the ball and socket.

Flexible metallic train pipe couplings manufactured by the International Couplers Company, have been subjected to a thorough service test extending over a period of 2½ years. Results obtained from this test prove conclusively that the Auto-Tite flexible coupling is a very satisfactory and economical substitute for rubber hose when used for making train pipe connections.

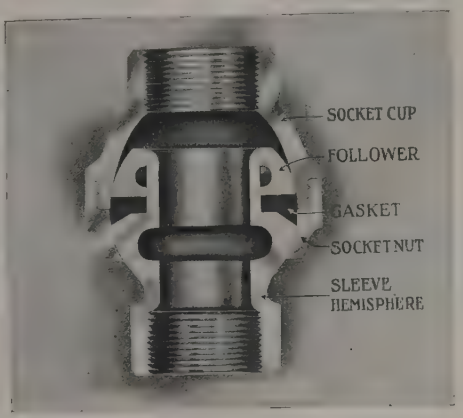


Fig. 2127—Auto-Tite Straight Coupling Section Showing Construction

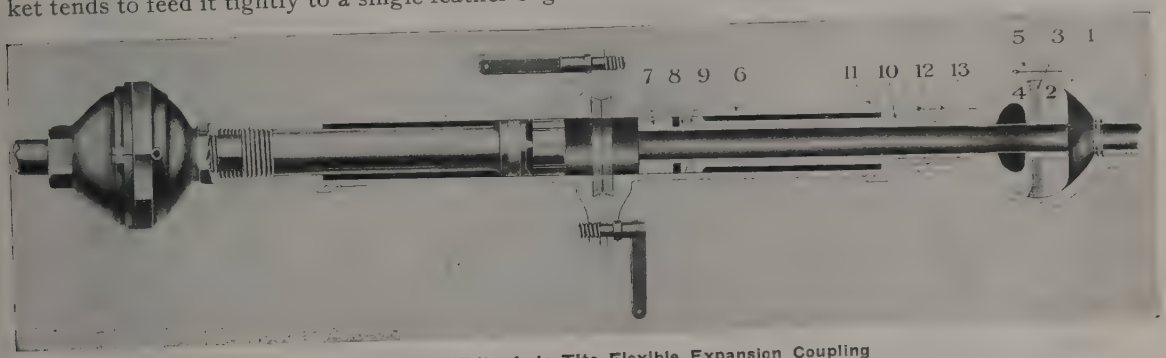


Fig. 2125—White Auto-Tite Flexible Expansion Coupling

A complete flexible expansion coupling is shown in Fig. 2125. This may be made with two flexible joints and one, or two, expansion joints either with or without a rotary coupling.

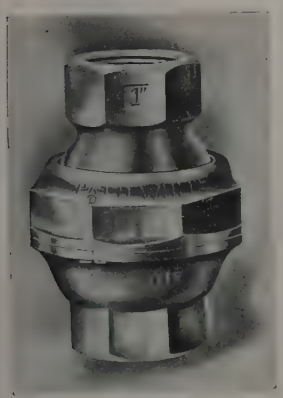


Fig. 2126—Auto-Tite Straight Coupling

The expansion joint consists of a plunger, an automatic follower, a gasket and a manual follower, all having sliding engagement with the inner walls of a suitable cylinder. The gasket is held in a compressed condition between the bevel surfaces of the automatic and manual followers. Fluid pressure admitted behind the automatic follower tends to force the gasket firmly against the cylinder wall and insures an absoblutely tight condition.

The Auto-Tite double angle flexible coupling shown in Fig. 2128, will revolve in a complete circle and in addition it is universally adjustable to the same extent as the Auto-Tite straight coupling. It may be used as a hinge and is very well adapted for service in car yards, car shops, roundhouses and similar locations where high pressure steam, air and water must be supplied to cars or locomotives.

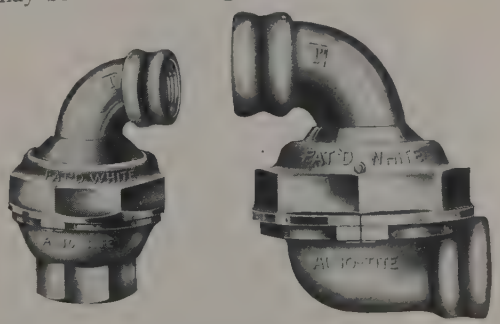


Fig. 2128—Auto-Tite Single and Double Angle Coupling

For other products and branch offices, see classified and alphabetical indexes.

INTERNATIONAL COUPLERS COMPANY, PITTSBURGH, PA.

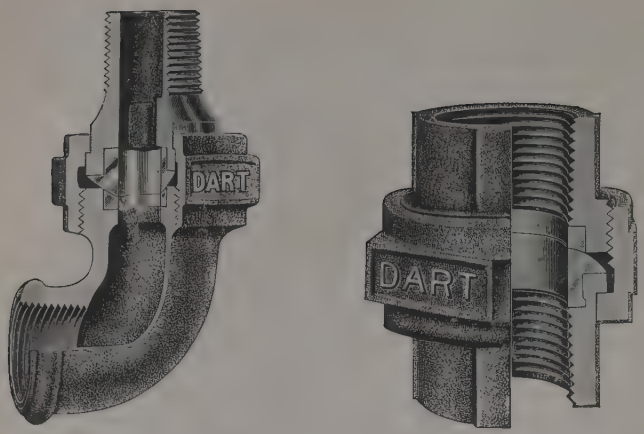


Fig. 2129—Dart Unions. E. M. Dart Manufacturing Company.

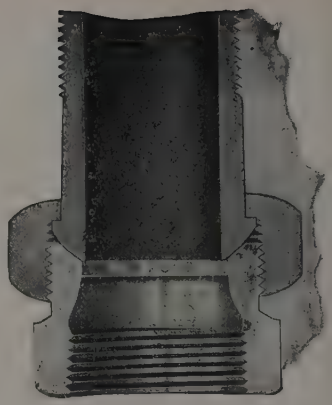


Fig. 2130—Section of Kewanee Male and Female Union. Walworth Manufacturing Company.

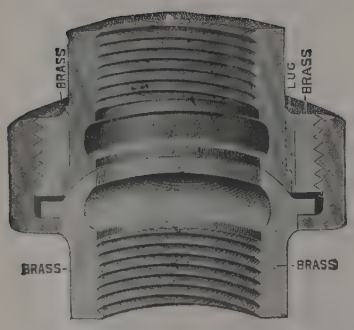


Fig. 2131—Nokoros Union. Illinois Malleable Iron Company.

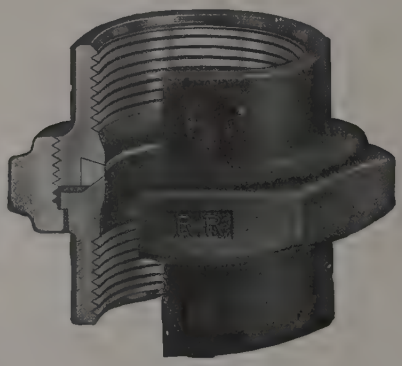


Fig. 2132—Crane Union with Inside Thread. The Crane Company.

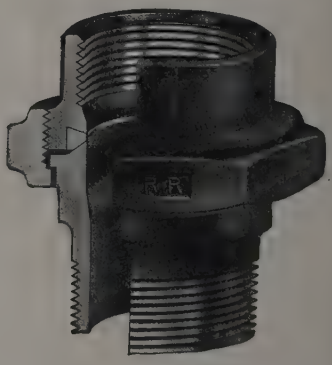


Fig. 2133—Crane Union with Outside and Inside Thread. The Crane Company.

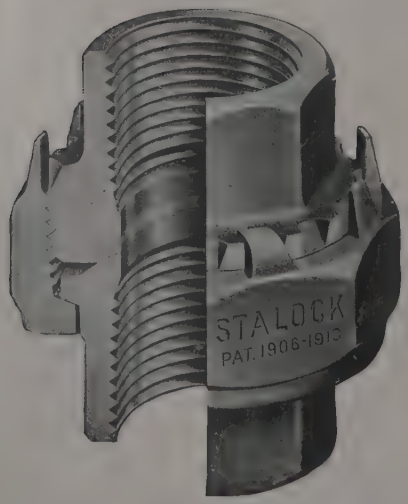


Fig. 2134—"Stalock" Union. Jefferson Union Company.

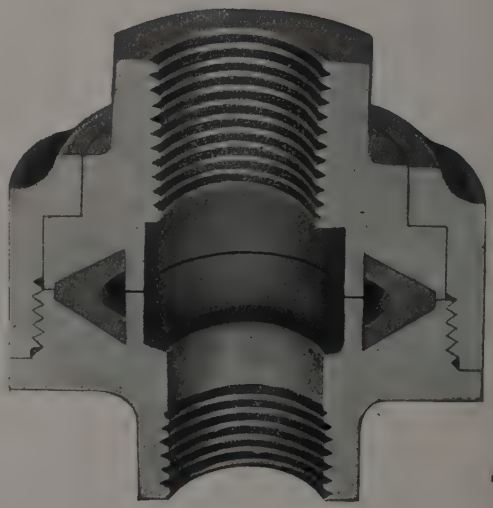


Fig. 2135—"Flexo" Union. The Durbin Company.

Passenger Train Heating and Ventilation

THE HEATING OF PASSENGER TRAIN CARS on American railways is now practically all accomplished by means of steam or electric heating apparatus. On steam operated railways the Vapor System is generally used. Other systems are direct steam; a combination of steam and hot water; or hot water alone. These latter systems of car heating have fallen into disuse and are not being applied to new equipment.

Steam Vapor System

The vapor system is the most modern method of heating steam railway cars. In this system the steam supply is obtained from the locomotive boiler, the delivery being controlled by a pressure regulator installed in the cab. The steam is carried in a train pipe under each car, connections between cars and to the locomotive tender usually being made by rubber hose fitted with suitable couplings; for connection between the tender and the engine, rubber hose has been almost entirely superseded by flexible all-metal connections. The pressure maintained in the train pipe is sufficient to supply live steam throughout its entire length to the rear of the train. From the train pipe, steam is supplied to the heating pipes inside of the car, but, before entering the pipe, it passes through a vapor regulator, located underneath the car, which converts the pressure-steam into a vapor, or steam at atmospheric pressure; steam at any pressure above atmospheric does not enter the pipes inside of the car as the outlet of the system is always open to the atmosphere.

The Vapor Regulator receives pressure steam from the locomotive through the train pipe and converts it into steam or vapor at 212 degrees before it passes into the pipes in the car.

The operation of the regulator depends upon the Thermostatic action of an expansive diaphragm consisting of a sealed flat box of spring brass partly filled with fluid and located in a casing at the bottom of the regulator at the outlet of the heating pipes. When heated to 200 to 212 degrees, the expansion of the fluid causes the swelling of the flat sides of the diaphragm. The expansion and contraction under changes of temperature, through a stem and bell-crank lever, control a valve between high and low pressure chambers of the regulator which are respectively in connection with the train pipe from the locomotive and the pipes of the heating system, and in which train pipe pressure is reduced to vapor at atmospheric pressure. The expansive diaphragm is located in the outlet chamber which is open to the air. The diaphragm is connected by a bell-crank lever and the valve stem, with an automatic valve connecting the high and low pressure chambers and is the immediate point of automatic control of the entire heating system.

A Vapor Cutout Valve, placed on the atmospheric pressure side of the regulator, between the regulator and the heating coil, directs the flow of vapor—steam at atmospheric pressure. When the valve is open, the steam is directed through the radiating pipes and back to the outlet; when it is closed the steam is cut off from the radiating pipes, and kept on the thermostat. Vapor is always passing from the automatic valve to the outlet, either through the radiating system or directly across the cutout valve and thus freezing is prevented. A drip hole in the bottom of the cutout valve body takes care of condensation from the radiating pipes when the valve is closed. This hole also breaks the vacuum that would otherwise exist in the heating pipes with the steam turned off. When the valve is open the hole is blanked by the bottom of the valve.

A quarter turn of the valve lever moves the valve to the shut or open position and either directs the flow of vapor into the heating pipes or across the valve direct to the outlet or thermostatic end of the vapor regulator.

In operation, when the train pipes and the diaphragm are cold, steam from the train pipe passes freely through the open valve and through the whole system to the diaphragm and the outlet. Live steam blowing on the diaphragm for a moment expands it, closes the valve and shuts off the flow of steam around the diaphragm until the temperature drops to about 200 degrees, when it again acts upon the valve to open it slightly and again admit steam to the heating pipes.

Usually this system is non-freezing, regardless of whether steam is turned on or off in the car, as the regulator underneath the car is always in operation and is kept hot so long as there is any steam in the train pipe. As the steam in the heating system is at atmospheric pressure at all times it requires only a small volume of steam from the locomotive boiler.

The heating pipes inside the car are divided into two or more units of radiation, each independently controlled by a separate or a common cutout valve; this permits the use of the entire system in each car or only a portion of it as may be required; in cars such as sleeping, compartment cars, etc., heat may be maintained in one or more compartments as desired. The operation of the system is controlled by a thermostatic device which may be an independent electrically operated appliance or may be an integral part of the vapor regulator.

Pressure and Vapor System

In the Pressure and Vapor Heating System a vapor reservoir is used in conjunction with the vapor regulating valve. It is placed below the blow-off or drip valve, forming an extension to it, and consists of a spiral coil of copper piping surrounding a pipe which also forms an extension to the blow-off valve. This pipe has several slots cut through to allow the hot water escaping from the system to trickle over the spiral copper pipe; the spiral pipe is filled with a liquid that boils at a low temperature and an extension of the pipe is connected to a diaphragm in the frame of the automatic vapor regulating valve. The extension of the diaphragm closes the steam valve by means of the stem as soon as the liquid in the coil reaches a temperature at which it boils, and under which conditions the vapor generated has sufficient force to close the valves against the spring. When the liquid in the coil cools, which follows the cutting off of the steam supplied to the

radiating coils, the vapor condenses and the spring forces the valve open, allowing a fresh supply of steam to enter the heating pipes and supply additional heat to the car.

Direct Steam Heating System

In the direct steam system of car heating the steam from the locomotive is carried directly to the radiators or heating pipes in the cars. The term is used to distinguish the system from those in which the steam is vaporized before entering the heating system or is employed to heat the water which circulates in the radiators or heating pipes in the older system of heating.

Drum System of Car Heating

One of the older methods of heating is the drum system, which employs a hot water circulation within the car. The heat may be supplied by a heater installed in each car or may be obtained from the locomotive. A drum is employed to transfer the heat of the steam to the water of circulation. Simple forms of drums consist of a cylinder or pipe within another pipe of larger cross section, provision being made for the unequal expansion of the pipes, and outlet and inlet orifices being provided for the circulation of the steam and water.

Another type is the coil drum or coil jacket, which generally consists of a large sized pipe or casting capped at both ends. In this drum is placed a coil of copper pipe which is made a part of the hot water circuit within the car. Steam from the locomotive is admitted to the drum around the copper coil, through which heat is imparted to the water of circulation. That part of the circuit above the drum becoming relatively lighter than the water of the circuit, a movement of the circulating medium is produced, creating a steady flow up through the coil. The amount of heat communicated to the circulating medium depends upon the surface of the coil and upon its conductive power to heat. A pressure of from 10 to 20 pounds of steam is carried in the drum.

Double Coil Jet System

The double coil jet system is a system of car heating which combines the drum or jacket feature with the jet or commingler system of injecting steam into the hot water circulation. The steam is first sent through the inner or steam coil of the double coil of the heater, and then through an annulus, into the circulating pipe. The jet is so directed as to aid the circulation in the pipes.

Storage System of Car Heating

Another system of car heating is known as the storage system. This is a direct system in which the radiating pipes are enlarged and inclose a smaller pipe or tube which is filled with salt water or other heat-retaining substance, which, when once heated, continues to radiate heat after the steam is shut off. This system is very little used.

Baker Car Heater

The Baker Car Heater is one of the old types of heating systems and is not now used in standard railway equipment. The heater is arranged to heat water in a coil of pipe, placed inside of a stove, and cause it to circulate through a series of pipes laid near the floor of the car. The water heater consists of a single coil, about 30 ft. in length, or a double coil of pipe inclosed in a flexible steel, jointless fire pot or chamber having no apertures large enough to permit the escape of live coals. This inner fire pot or safe is enclosed in a flexible steel outside casing, with asbestos sheets between the safe and casing, and between the ash pit bottom and sheet iron bottom. A safety plate covers the feed chute at the top, and a cinder-proof door effectually closes the ash pit at the bottom. The smoke pipe and smoke flue base may be destroyed and still leave the fire pot practically fireproof.

The M. C. B. committee on steam line connections reported in 1904 that because of the experiments with automatic couplings a new committee should be appointed to study this situation; 1905 M. C. B. Proceedings, page 206.

The new committee made a progress report and recommended that the railroads discourage the use of such connectors until some arrangement could be made for the interchangeability of the different devices; M. C. B. Proceedings, 1906, page 416.

The committee report in the 1908 M. C. B. Proceedings, page 271, explains the steps which the committee had taken with a view to getting the manufacturers to make their devices interchangeable.

Ventilation

The ventilation of railway cars is closely allied to the subject of heating. Many different types of ventilators have been developed but practically all of them are applied in the deck sash or clerestory, or in the main roof of the car. They are designed to admit or exhaust air to or from the car; the full action of the ventilator generally is obtained only when the car is in motion but the natural rise and fall of air due to variation in temperature usually produces effective operation at all times. Ventilators, according to their position, are designated as deck ventilators, frieze ventilators, etc.; they are also often designated as automatic or self-acting. In many day coaches, ventilation is obtained from the deck windows.

A report of tests with various ventilators is given in the Proceedings M. C. B. Association, 1894, page 234.

A topical discussion on passenger car ventilation will be found in the 1907 M. C. B. Proceedings, page 272.

A report of a committee on the ventilating and heating of coaches and sleeping cars will be found in the 1908 M. C. B. Proceedings, page 338.

A ventilating jack for use in saloons is also sometimes used. It consists of a flaring horizontal tube, constituting a simple form of ventilating device which uses the current produced by the motion of the cars to cause an exhaust current of air.

A hopper ventilator or deflector is used for exhausting air from the closet hopper to the outside of the car.

In refrigerator car ventilation, a current of air must be admitted to and pass through the refrigerator and come in contact with the lading. As it becomes warm it rises upward and passes out; the ventilator is so designed as to control the admission of air and its circulation.

In ventilated box cars a system of slats at each end of the car is arranged so that the ventilators may be readily opened or closed from the outside.

Some excerpts from this report read as follows: "This ventilator—one investigated by the committee—is so designed that it can be substituted for the regular deck sash; or can be arranged outside of the sash, so that the opening of the deck sash will open the ventilator; or it can be arranged to extend through the car roof. The construction consists of two openings or ducts extending into the car, with a deflector located between them and extending outwardly at right angles to the panel through which the ducts pass. Shutters, screens and other details are provided for controlling the device, and for the exclusion of dirt, cinders and rain. The deflector is bent so as to scoop the air into the forward duct and to exhaust it from the rear duct."

"Another type of ventilator is constructed on the aspirator principle, and its entire function is to draw the

air from the car. The arrangement of the ventilator ducts and the force of the outgoing air largely eliminates the possibility for smoke, cinders and rain to enter the car through the deck."

Another system of ventilation "admits air through intake hoods located on diagonal corners of the car. The air passes down a vertical boxing to a horizontal duct under the floor between the side sills and the adjacent intermediate sills. Then the air ascends through slots in the floor to a longitudinal boxing or duct containing steam pipes, extending along the sides of the car, above the floor and immediately over the air duct, thence through pipes under each seat to the aisle, where it ascends and passes out through globe ventilators located along the center of the upper deck of the car."

"On special service equipment, such as dining cars, private cars, and certain sleeping cars, the committee believes that a proper forced draught or blower system is, in some cases, necessary and very desirable as an addition to the regular methods of ventilating these cars."

Steam Heat Hose

Standard—ADOPTED, 1916; REVISED, 1917.

1. *Scope.*—These specifications cover steam-heat hose for passenger equipment cars.

I. MANUFACTURE.

2. Steam-heat hose shall be composed of a tube of rubber, wrapped with at least five plies of cotton fabric and the whole covered with rubber.

II. PHYSICAL PROPERTIES AND TESTS.

3. The railway company's inspector will select for test one piece at random from each lot of 201 pieces. When this hose is received at the test laboratory, a section 2½ in. long will be cut from one end in order to determine the friction, tensile strength and elongation. The remaining portion will then be subjected to steam heat in the digester. After this section has been heated another section 2½ in. long will be cut from it and used to ascertain the friction, tensile strength and elongation, in order to show the change in these characteristics due to the action of heat.

4. *Friction Test Before Steaming.*—A section 1 inch long will be cut from the hose and supported in such a manner that it will turn freely on its axis. A 20-lb. weight will be suspended from the separated end of the fabric. The latter must unwind uniformly, if at all, and not faster than 6 in. in ten minutes.

5. *Tensile Test Before Steaming.*—A strip cut from the tube with a die or other suitable means to the dimensions shown in Fig. 1 will be marked at points 2 in. apart, and

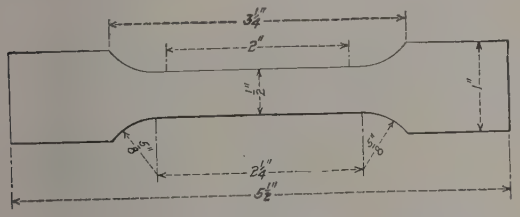


FIG. 2136—SPECIMEN FOR HOSE TENSILE TEST.

the width and thickness will be accurately measured. It will then be slowly stretched in a suitable tensile-testing machine until it breaks. The ultimate tensile strength must not be less than 600 lb. per sq. in. and the elongation of the 2-in. section at the time of fracture must be not less than 6 in.

6. *Friction Test After Steaming.*—A section 1 inch long will be supported in such a manner that it will turn freely on its axis. A 15-lb. weight will be suspended from the separated end of the fabric. The latter must unwind uniformerly, if at all, and not faster than at the rate of 6 in. in ten minutes.

7. *Tensile Test After Steaming.*—A strip cut from the tube with a die or other suitable means to the dimensions shown in Fig. 1 will be marked at points 2 in. apart, and the width and thickness will be accurately measured. It will then be slowly stretched in a suitable tensile-testing machine until it breaks. The ultimate tensile strength must not be less than 450 lb. per sq. in., and the elongation of the 2-in. section at the time of fracture must not be more than 8 in. or less than 4 in.

8. *Digester Test.*—The digester shall consist of a cylinder containing dry saturated steam at a pressure of 45 lb. per sq. in. The hose shall be put into this digester and will remain there for 48 hours continuously. An examination of this section, after being submitted to the heat of the steam, should not disclose any blistering of the inner tube or any loosening of the tube from the fabric. Examination and test after heating, prescribed in the specifications, will be made as soon as possible after the specimen has cooled for 24 hours. The tests will be made at a temperature of not less than 60° F.

III. SIZE AND DIMENSIONS.

	Maximum, Inches.	Minimum, Inches.
Length	24¼	23¾
Inner diameter	....	....
Outer diameter	....	....
Thickness of tube	....	⅛
Thickness of cover	....	1/16

IV. WORKMANSHIP.

1. *Tube.*—The tube should be composed of at least two calendars of rubber. It must be free from holes, bits of wood, bark, sand and other foreign matter, and from other imperfections. It must be so firmly joined to the fabric that it can not be pulled off without tearing it.

2. *Fabric.*—The fabric must be of duck, with the warp containing not less than 27 strands, 3 threads per strand, and the filler 18 strands and 4 threads per strand. It must be frictioned on both sides and have, in addition, a distinct layer of rubber on one side, readily visible between the plies when the finished hose is cut open.

3. *Cover.*—The material of the cover should be a rubber compound which has good weather-resisting qualities, as

FIG. 2137—STEAM HOSE LABEL.

firmly attached to the fabric as is the tube, and to be equally free from defects. The end of the hose should be cut off true to length, but shall not be capped.

V. MARKING.

4. *Serial Number.*—Each lot of 200 hose or less must bear the manufacturer's serial number, beginning with 1 on the first of each year and continuing consecutively until the end of the year. Serial numbers of hose which are

rejected must not be used again. With each lot of 200 hose or less, one extra piece of hose must be furnished free of cost.

5. *Label.*—Each piece of hose must have securely vulcanized to it a label of white or red rubber, as shown herewith.

VI. Inspection.

6. *Rejection.*—If the sample fails to pass the above tests, the lot represented by it will be rejected and the same serial number must not be applied to any other steam hose during the same calendar year.

7. *Inspection.*—If the sample passes all the tests, all pieces represented by it will be accepted if free from injurious mechanical defects.

Rejected hose will be returned at the expense of the manufacturer.

8. *Rehearing.*—Samples tested in accordance with these specifications, which represent rejected hose, shall be held for two weeks from date of test report.

Steam and Air Connections for Passenger Cars

Standard

Train line pipe shall be 2 inches, internal diameter. Adopted, 1912.

End valve shall have not less than 1½ in. opening. Adopted, 1912.

Steam and Air Connections for Passenger Cars.

Recommended Practice

The steam heat, air brake and air signal connection should be located as adopted in 1903 and as shown in Fig. 1886.

Specifications for steam and air connections were adopted in 1903.

Steam hose, 1⅝ in. inside diameter and of such length as to provide 31 in. from face of coupling gasket to end of hose nipple; 1½ in. steam hose couplings of dimensions to agree with those shown in chapter on "Passenger Train Heating." Gaskets to have 1½ in. diameter opening and constructed so that normal diameter of opening will be maintained; couplings not provided with gravity traps;

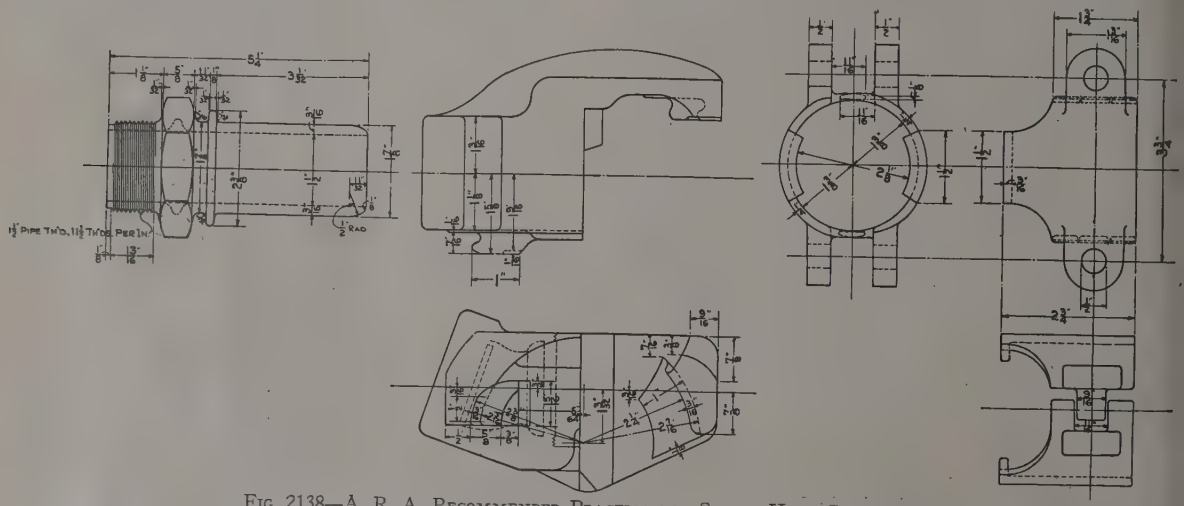


Fig. 2138—A. R. A. Recommended Practice for Steam Hose Couplings.

Air brake hose must be 1⅜ in. inside diameter and 22 in. long. Adopted, 1911.

Air signal hose must be 1 in. inside diameter and 22 in. long. Adopted, 1903; revised, 1911.

Angle cock should be 30 degrees from the vertical. Adopted, 1911.

Air signal elbow 30 degrees from vertical. Adopted 1916.

inlet valves to have reduced openings which should be as small as possible and maintain the volume of steam required by the radiating pipes of the car heating system for the severest weather conditions.

A topical discussion on "What are the advantages or disadvantages of 2" main steam pipe with 1⅝" hose?" will be found in the 1904 M. C. B. Proceedings, page 235.

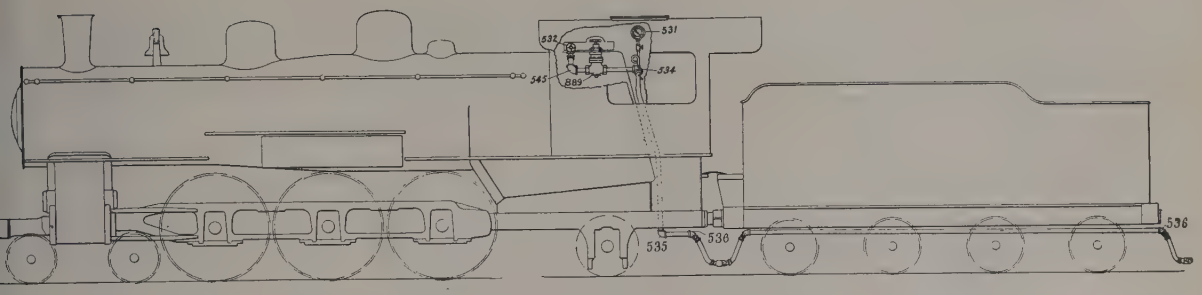


Fig. 2139—Arrangement of Gold Heating Apparatus on Locomotive and Tender.

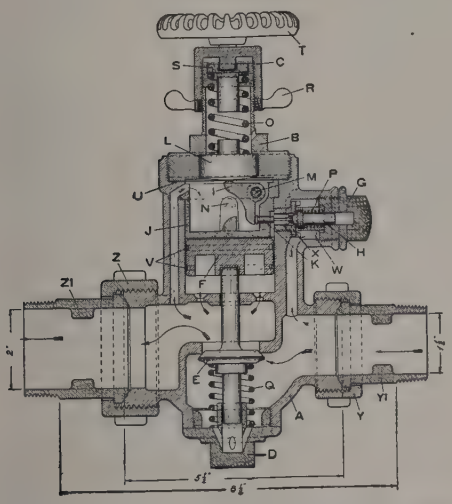


Fig. 2140—Gold Pressure Regulator No. 1014. Size 1½x2 inch. Heavy Duty Type.

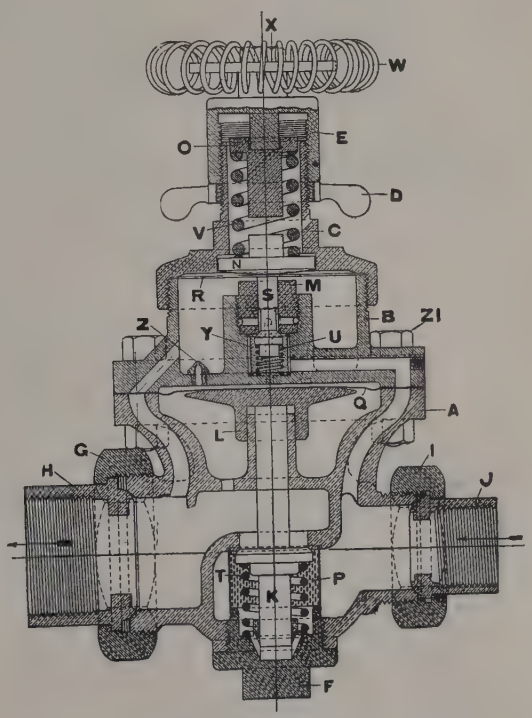


Fig. 2141—Gold Ideal Pressure Regulators No. 874—1 x 1½ inch. 889—1½ x 2 inch.

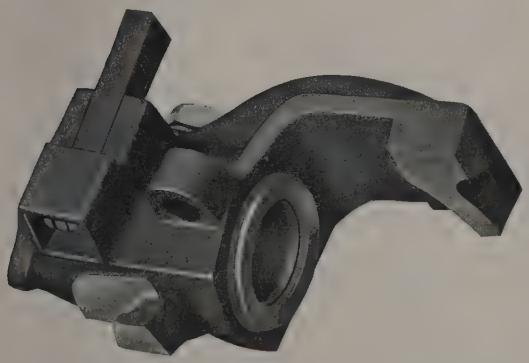


Fig. 2142—Gold M. C. B. Coupler with Stationary Gasket.

Gold M. C. B. Gasket.

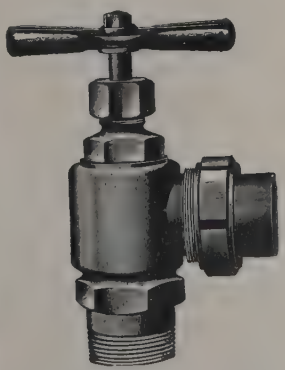


Fig. 2144—Gold Locomotive Steam Heat Starting Valve No. 532, Size 2 x 1½ inch.

Fig. 2143—Gold M. C. B. Coupler, No. 804S., with Oscillating Gasket.

Gold Oscillating Gasket 403C.

Gold Car Heating & Lighting Company.

(See also Page 869.)

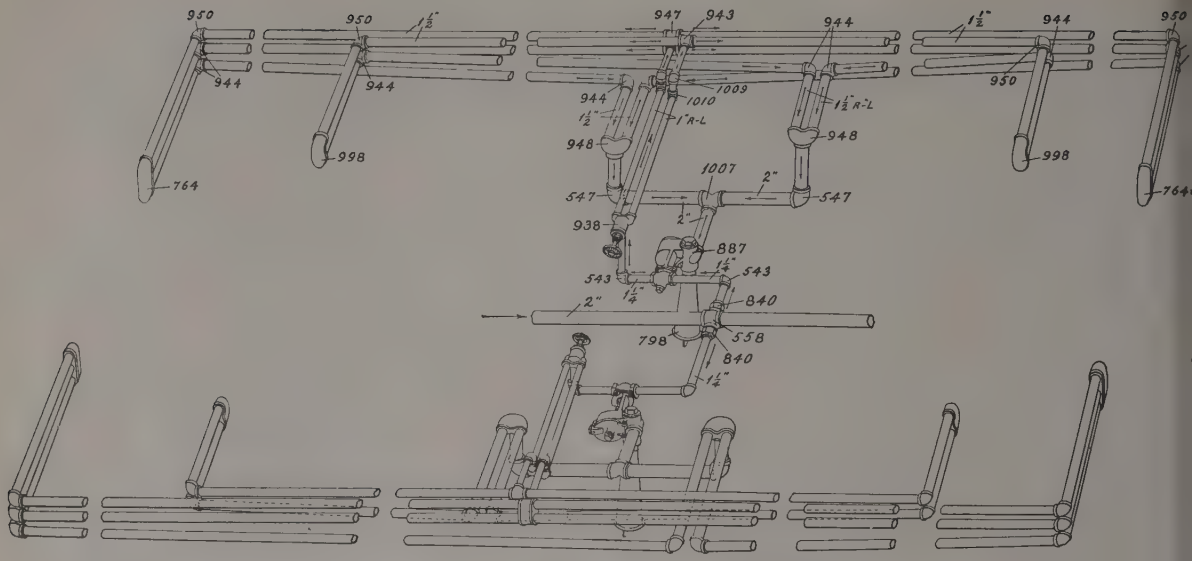


Fig. 2145—Gold Vapor System for Steel Passenger Cars. (Under-Hung Vapor Regulator.)

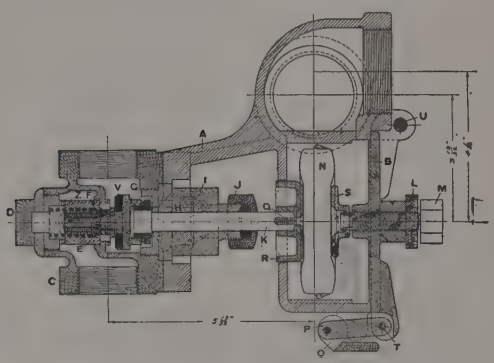


Fig. 2146— Gold Vapor Valve, No. 887.
(Vapor Regulator)

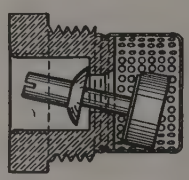


Fig. 2147—Gold Gravity Safety Trap No. 882.

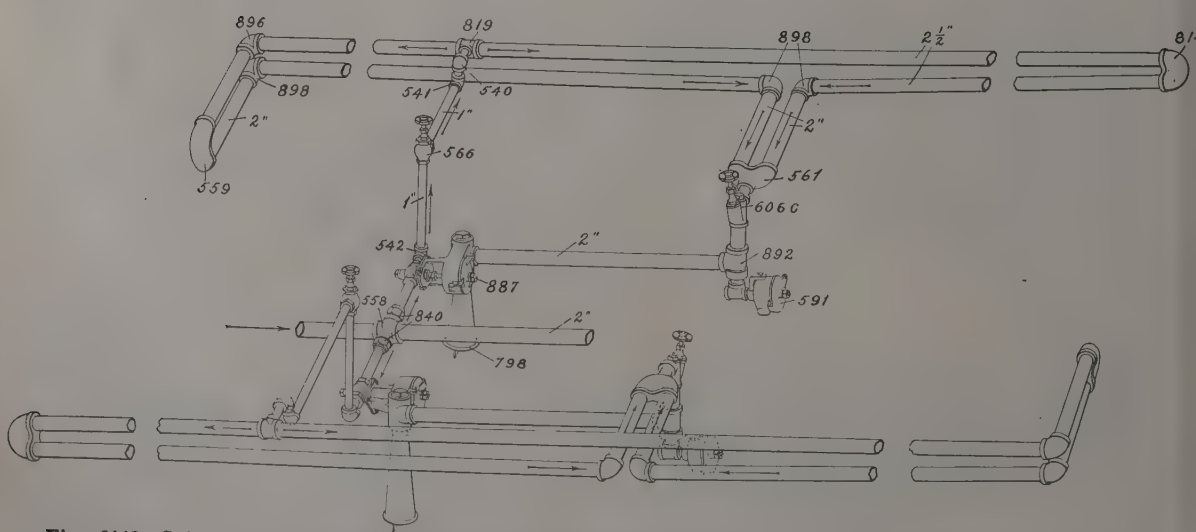


Fig. 2148—Gold Combination Vapor—for Mild Weather—and Pressure System—for Cold Weather—as Applied to Steel Coaches.

Gold Car Heating & Lighting Company.

(*See also Page* 869.)

Gold Vapor System

The Gold Vapor System of car heating, maintaining steam at atmospheric pressure in radiating pipes at approximately 212 deg., has been designed to perform its functions automatically in an adequate manner with a minimum steam consumption. The system consists simply of two packless twin supply valves—No. 1145—two vapor valves—No. 887—and two packless end valves—No. 1126—which, with the necessary radiation piping, steam hose couplers and but few special fittings comprise the complete equipment. The vapor valve section of one side of a car is shown in Fig. 2149.

The Gold packless twin supply valves differ from most other valves in that the steam is on top of and not against the seats; therefore, tight valves are assured at any pressure. The motion of the valve is rotary. One quarter turn allows the steam to enter one part of the radiating pipes and a half turn puts the entire system on that side of car into service. The steam enters the upper radiating pipes, permitting the condensate to pass by gravity to the thermostatic diaphragm chamber of the vapor valve and out through the ventilated drip horn.

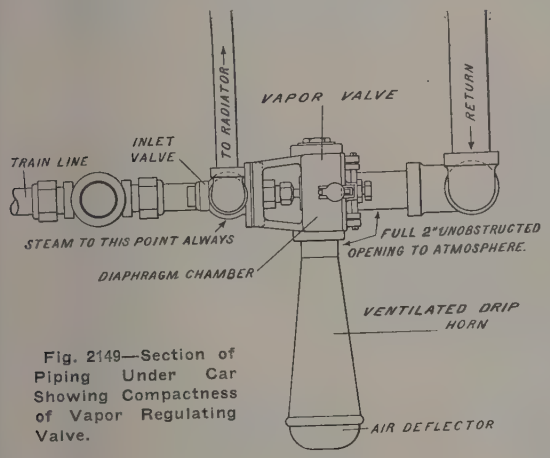


Fig. 2149—Section of Piping Under Car Showing Compactness of Vapor Regulating Valve.

The Gold vapor valves are located underneath the car, one on each side, and controls the supply of steam to the radiating pipes. The normal position of the vapor valve is open. When the temperature of the condensate from the radiating pipes has risen to a predetermined degree in the thermostatic chamber of the vapor valve, the diaphragm is expanded and shuts off the flow of steam to the radiator pipes until the diaphragm cools sufficiently to allow the valve to open and steam is again admitted to the radiating pipes.

Thus in cold weather more pulsations are given to the system owing to the more frequent cooling of the diaphragm; therefore, the temperature of the radiating pipes is of a higher degree.

Among the advantages of the Gold Vapor System may be mentioned:

Four graduations of heat can be obtained in the car.

The system is simple and cheap to install; few wearing parts make it cheap to maintain.

Perfect drainage of condensation is assured as the drip is always open to the atmosphere.

Freezing is impossible whether the car is on steam or not, owing to the free opening without obstruction of any kind provided for drainage, to the fact that all piping underneath car is protected by the pipe covering, and to the important fact that the vapor valve diaphragm chamber is close to the admission valve, the point of pressure steam, keeping the diaphragm chamber warm by conduction.

Fig. 2150—Thermostat

Fig. 2151—Electro-Magnetic Valve

The vapor valve operates without bell cranks, levers, etc., and is not affected by the variation in train line pressures.

Gold's Electric Thermostat control is an inexpensive equipment that can readily be installed on any system of car heating. It automatically turns on and off the steam, keeping the car at an equable temperature without other attention. This equipment consists of a thermostat, usually placed on the wall at the middle of the car, and one or more electro-magnetic inlet valves placed on the crossover pipes either underneath the seats or underneath the car, the small electric current being obtained from the lighting circuit.

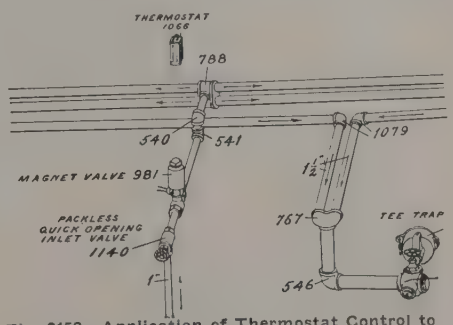


Fig. 2152—Application of Thermostat Control to Pressure System

Gold Electric Thermostatic control, whether used with straight steam or with vapor systems, results in a material saving in steam and a much lower pressure may be carried on the train line. In the heating of cars at terminals, yard tests have shown a saving of from 50 per cent to 75 per cent in steam consumption, and the cars are maintained at an equable temperature when delivered at terminals to receive passengers.

For other products see classified and alphabetical indexes.

GOLD CAR HEATING & LIGHTING COMPANY, BROOKLYN, N. Y.

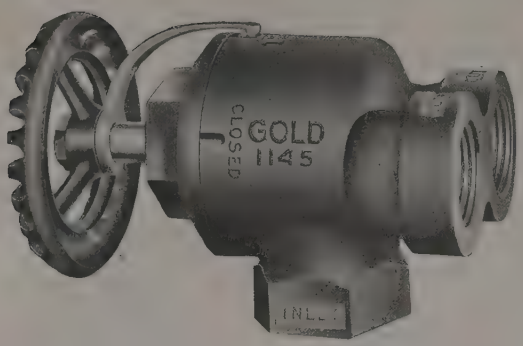


Fig. 2153—Packless Twin Supply Valve, No. 1145, for Operation of Two Circuits as in Vapor System.

Fig. 2154—Gold Packless End Valve No. 1126, With Automatic Drip for Releasing Condensation at Rear of Train.

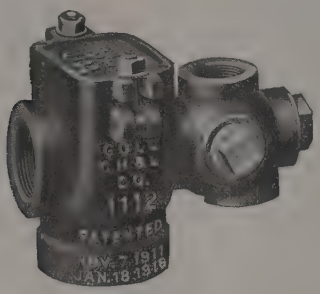


Fig. 2155—Gold Vapor Valve No. 1112 for Application Inside of Car.

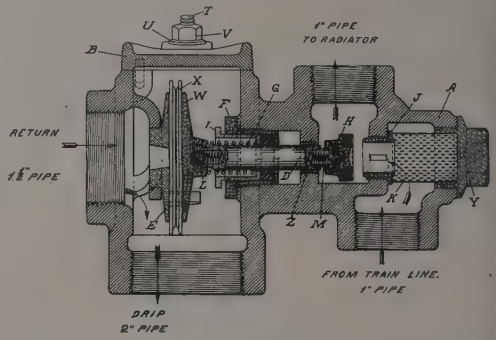


Fig. 2156—Sectional View. Valve No. 1112.

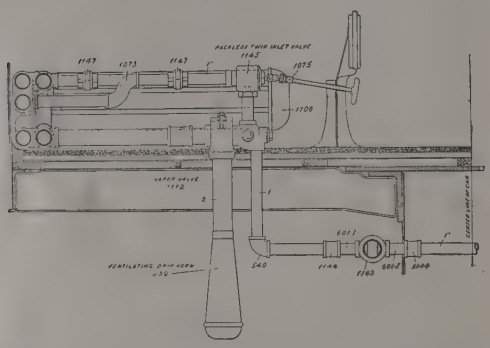


Fig. 2157—Application of Gold Vapor Valve No. 1112 to Passenger Coach, Showing Ventilating Drip Horn No. 939.

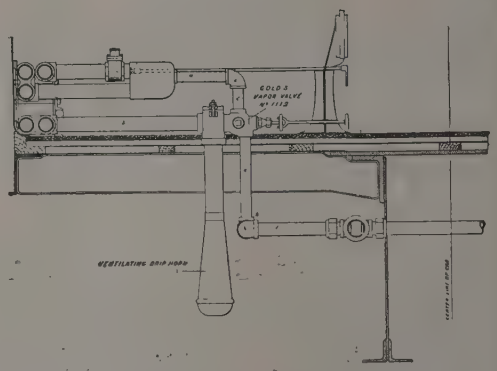


Fig. 2158—Application of Gold Vapor Valve No. 1112 to Existing Piping.

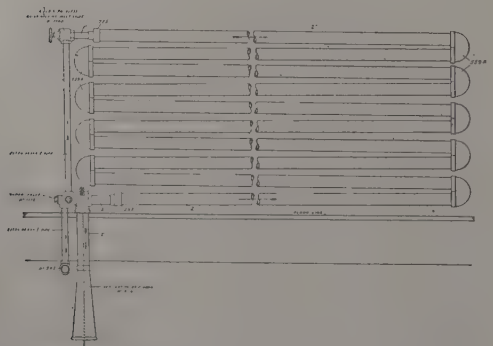


Fig. 2159—Application of Gold Vapor Valve No. 1112 to Baggage or Mail Car Coil.

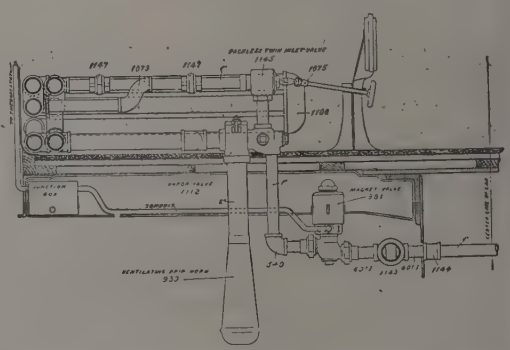


Fig. 2160—Application of Gold Thermostatic Control Valve to System Using Vapor Valve No. 1112.

Gold Car Heating & Lighting Company.

(*See also Page* 869.)

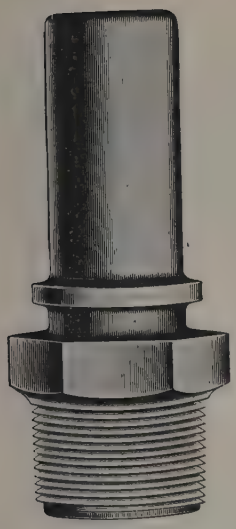


Fig. 2161—Steam Hose Nipple.

Nipples and Clamps. See Figs. 2063-2064.

Interior Diameter of Hose	Nipple No.	Clamp No.
1¼ in.	855	856
1⅜ in.	801A	803
1½ in.	801B	803
1⅝ in.	526A	1035

Clamps made in two styles.
A—without eye.
B—with eye.

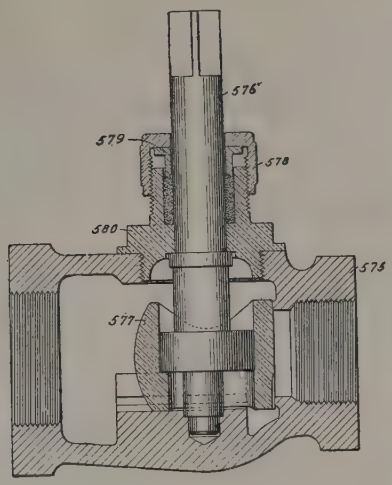


Fig. 2162—End Valve, No. 574.
(Old Standard.)

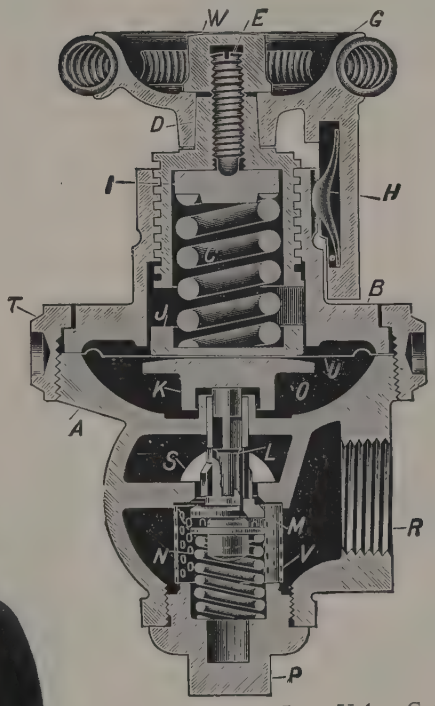


Fig. 2163—Gold Stop Valve Car Pressure Regulator, No. 737.

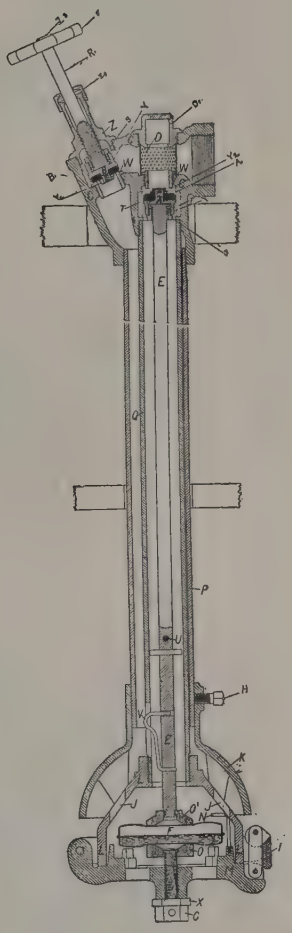


Fig. 2164—Gold Vertical Trap, No. 606.

Fig. 2165—Gold Steam Hose Clamp.

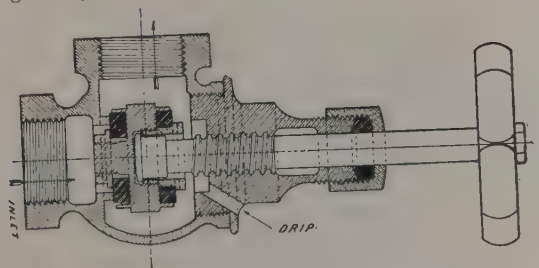


Fig. 2166—Gold Drip Valve, No. 870, for Insertion at the Base of the Riser Pipe to the Baggage Car Coil to Shut Off Steam from the Outside.

Gold Car Heating & Lighting Company.

(*See also Page* 869.)

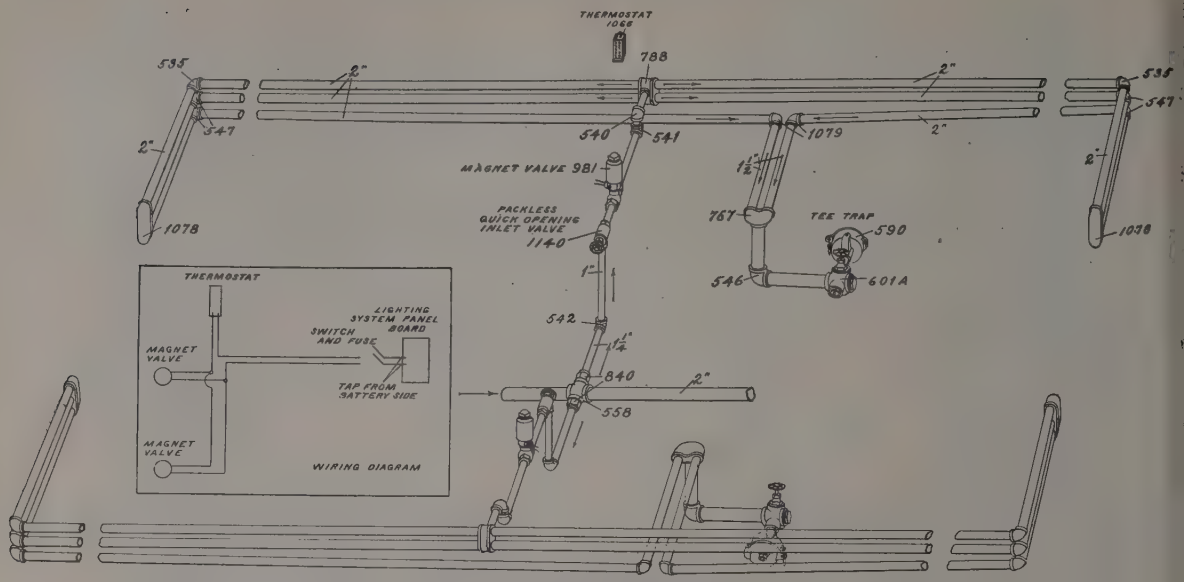


Fig. 2167—Gold Straight Steam System with Thermostatic Control for Steel Passenger Cars.

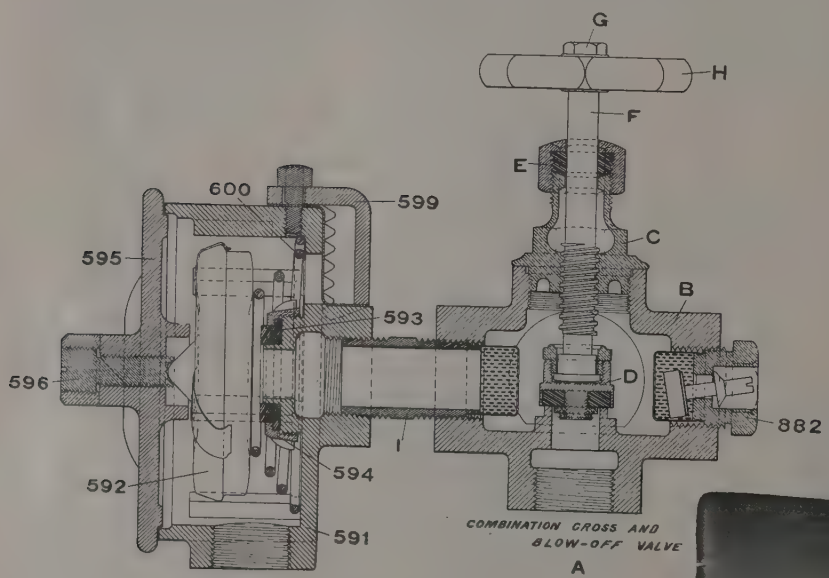


Fig. 2168—Gold Horizontal or Tee-Trap, No. 590.

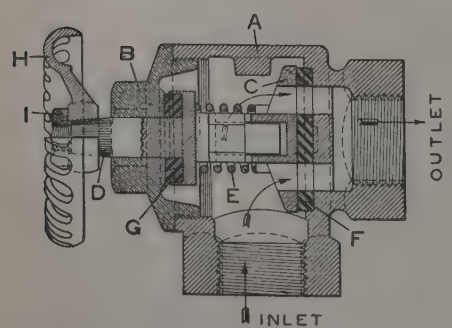
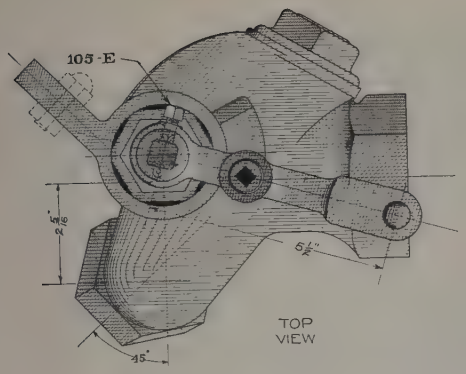
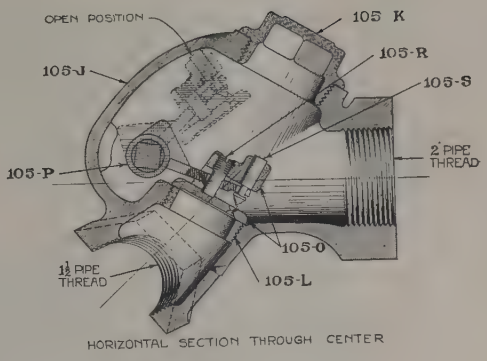


Fig. 2169—Sectional View No. 1140 Valve

Fig. 2170—Location of No. 1140 Valve Under Car Seat.





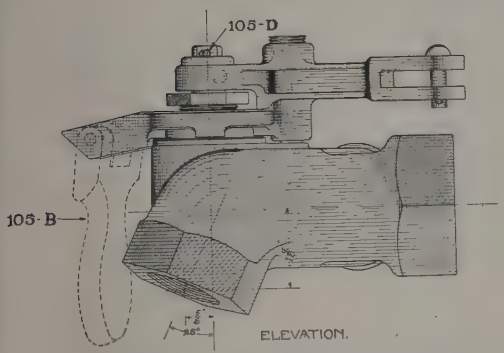


Fig. 2171—End Train Pipe Valve.

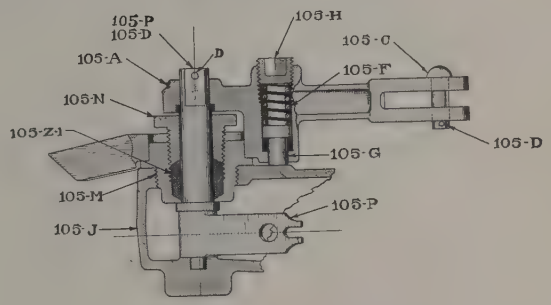


Fig. 2172—End Train Pipe Valve Cross Sections.

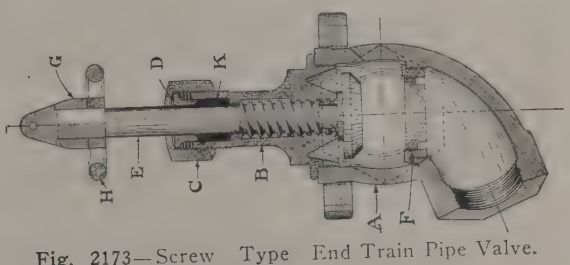


Fig. 2173—Screw Type End Train Pipe Valve.

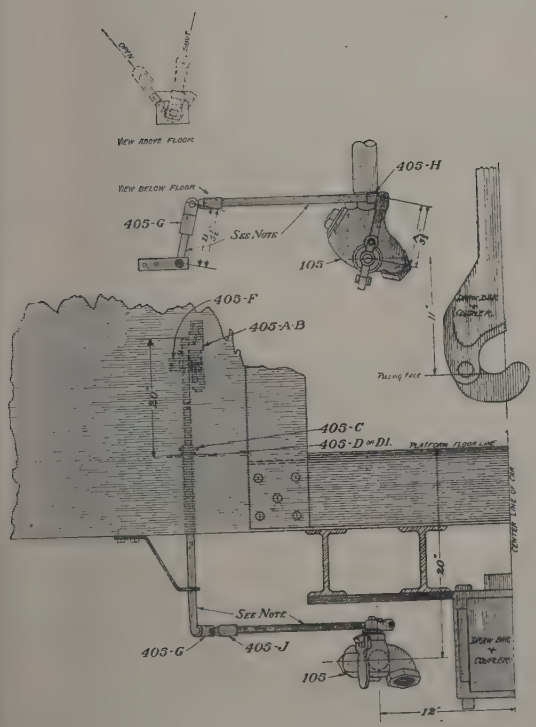


Fig. 2174—Method of Operation of No. 105 End Valve from Car Platform.

Fig. 2175—No. 1 Style Vapor Cutout and Drain Valve.

(See also Page 877.)

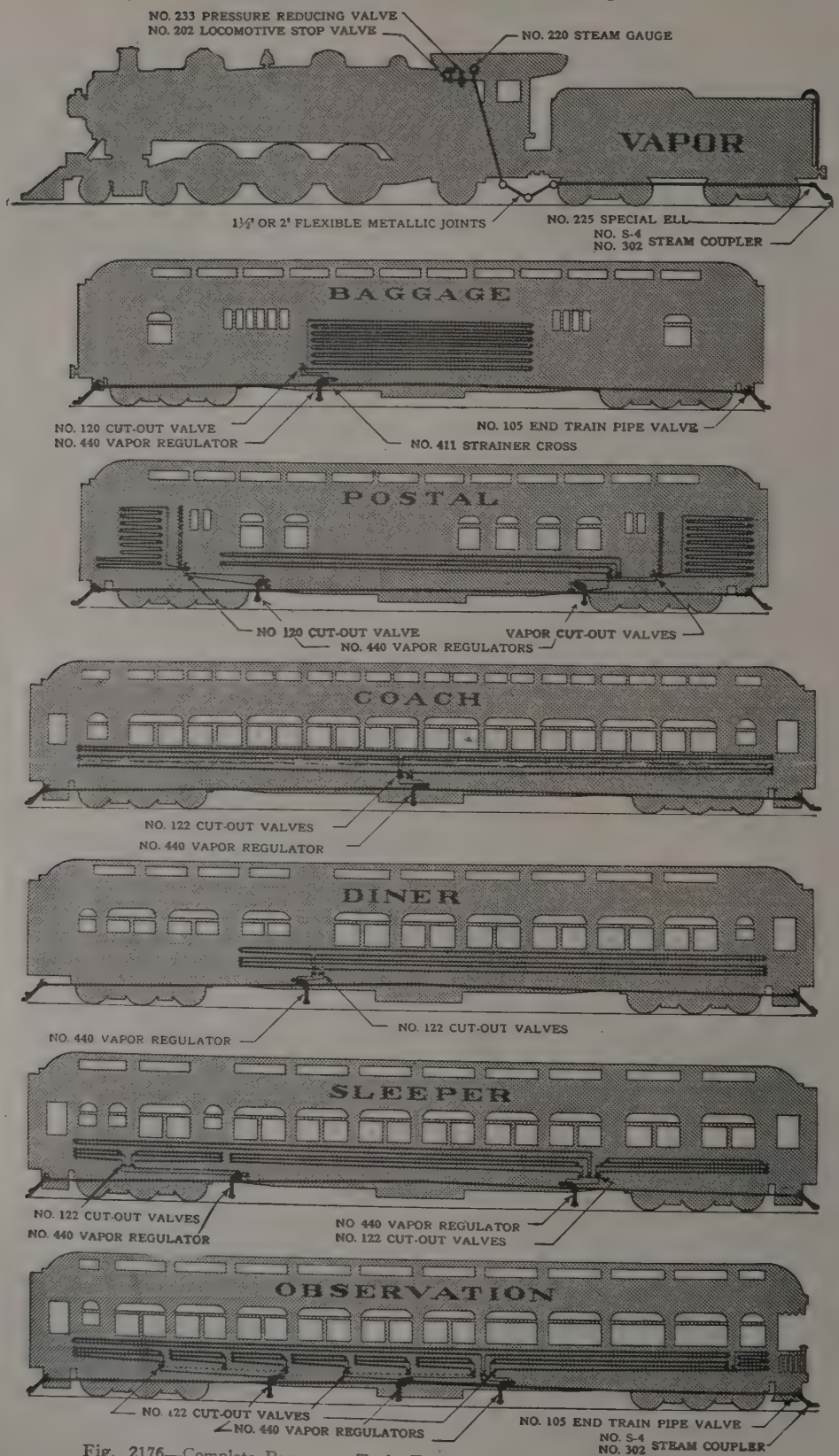


Fig. 2176—Complete Passenger Train Equipped with Vapor Heating System.
Vapor Car Heating Company, Inc.

(*See also Page 877.*)

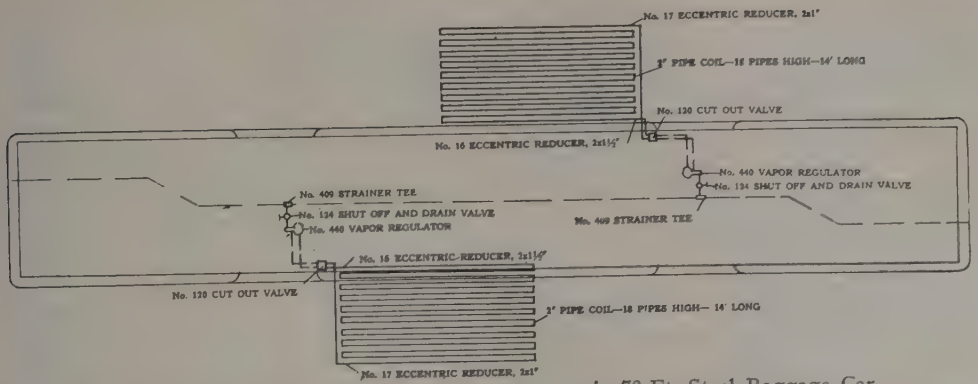

No. 17 ECCENTRIC REDUCER, 2x1"
3" PIPE COIL—16 PIPES HIGH—54' LONG
No. 120 CUT OUT VALVE
No. 16 ECCENTRIC REDUCER, 2x1½"
No. 440 VAPOR REGULATOR
No. 124 SHUT OFF AND DRAIN VALVE
No. 409 STRAINER TEE
No. 124 SHUT OFF AND DRAIN VALVE
No. 440 VAPOR REGULATOR
No. 409 STRAINER TEE
No. 16 ECCENTRIC REDUCER, 2x1½"
No. 120 CUT OUT VALVE
3" PIPE COIL—18 PIPES HIGH— 14' LONG
No. 17 ECCENTRIC REDUCER, 2x1"

Fig. 2177—Floor Plan of Heating Arrangement in 70-Ft. Steel Baggage Car.

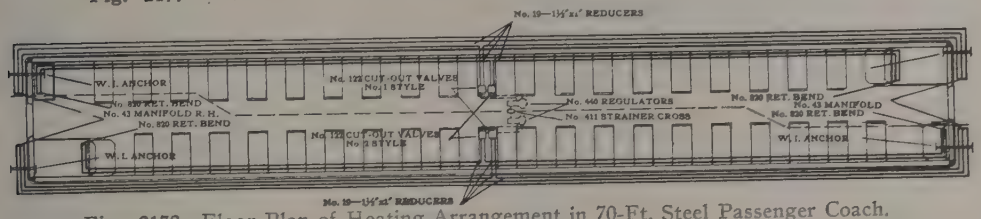

No. 19—1½"x1" REDUCERS
W. I. ANCHOR
No. 820 RET. BEND
No. 43 MANIFOLD R. H.
No. 820 RET. BEND
No. 122 CUT-OUT VALVES No. 1 STYLE
No. 122 CUT-OUT VALVES No. 2 STYLE
W. I. ANCHOR
No. 440 REGULATORS
No. 411 STRAINER CROSS
No. 820 RET. BEND
No. 43 MANIFOLD
No. 820 RET. BEND
W. I. ANCHOR
No. 19—1¼"x1" REDUCERS

Fig. 2178—Floor Plan of Heating Arrangement in 70-Ft. Steel Passenger Coach.

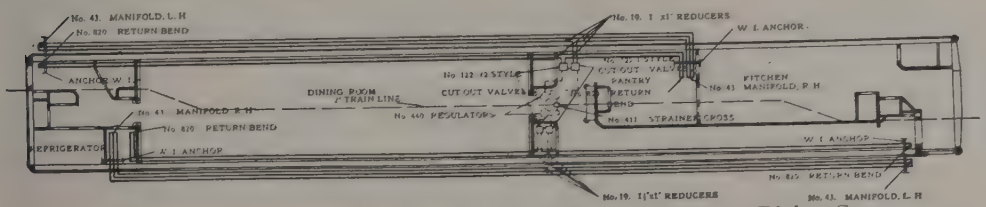


Fig. 2179—Floor Plan of Heating Arrangement in 72-Ft. Steel Dining Car.

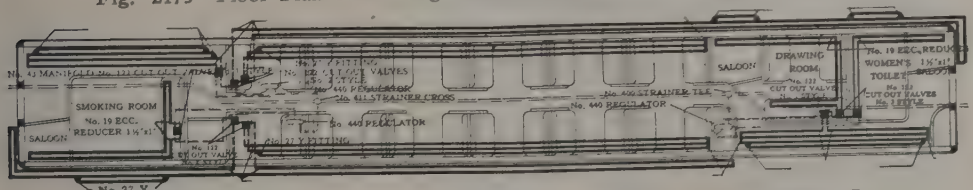


Fig. 2180—Floor Plan of Heating Arrangement in 70-Ft. Steel Sleeping Car.

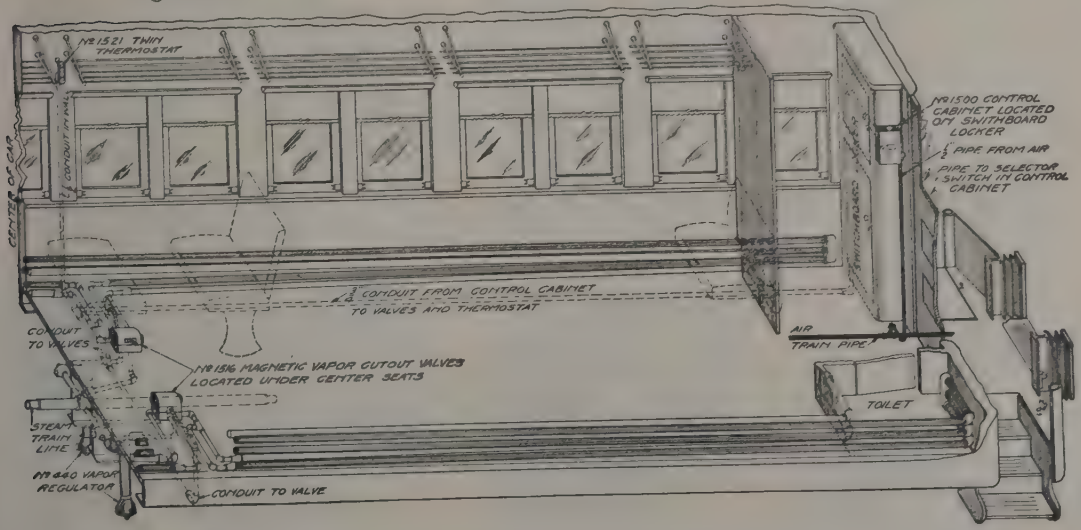

№1521 TWIN THERMOSTAT
CONDUIT FROM CAB
CENTER OF CAR
№1500 CONTROL CABINET LOCATED OFF SWITHBOARD LOCKER
½" PIPE FROM AIR
PIPE TO SELECTOR SWITCH IN CONTROL CABINET
SWITCHBOARD
CONDUIT FROM CONTROL CABINET TO VALVES AND THERMOSTAT
CONDUIT TO VALVES
№1516 MAGNETIC VAPOR CUTOUT VALVES LOCATED UNDER CENTER SEATS
AIR TRAIN PIPE
TOILET
STEAM TRAIN LINE
№440 VAPOR REGULATOR
CONDUIT TO VALVE

Fig. 2181—General Arrangement of Vapor Heating System with Double Automatic Control.

Vapor Car Heating Company, Inc.

(See also Page 877.)

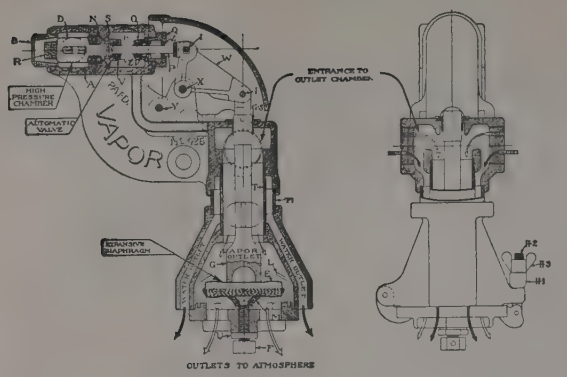


Fig. 2182—Cross Section of Short List Type Vapor Regulator.

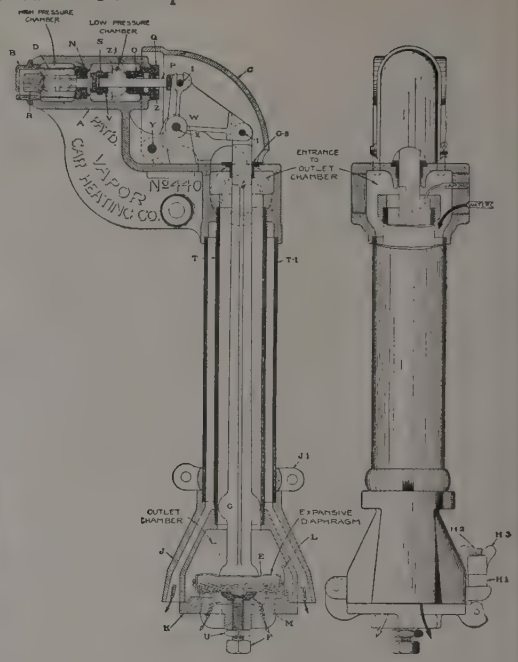


Fig. 2183—No. 440 Vapor Regulator.

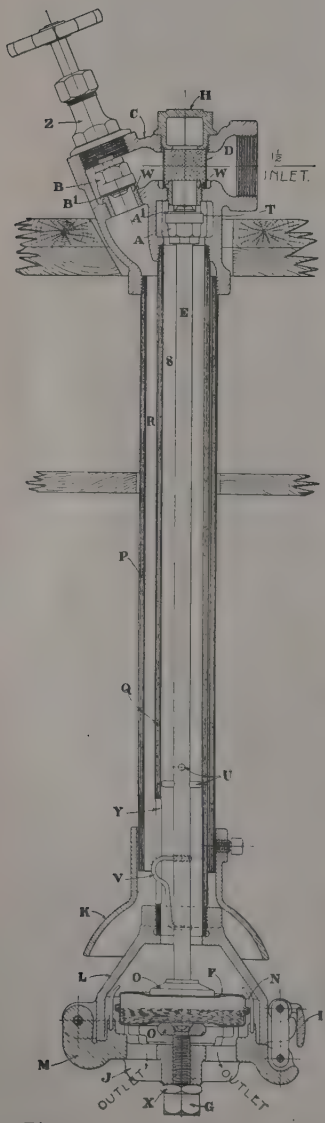


Fig. 2186—Vertical Steam Trap.

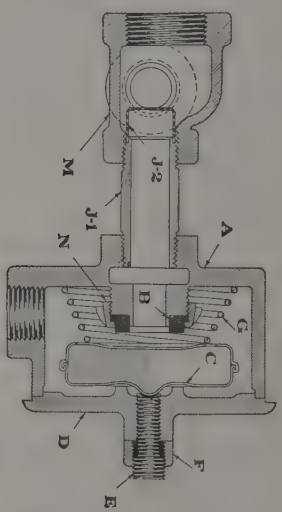


Fig. 2184—No. 113 Type Trap.

List of Parts of Fig. 2182.

A	Body	N*	Disc and Gasket
B	Cap	O	Stuffing Box
C	Shield	P	Stem
D	Strainer	Q	Bonnet
E	Diaphragm	R	Disc Holder
F*	Set Screw	S	Valve
G	Operating Rod	T	Inside Tube
G-5	Deflector Ring	T-1	Outside Tube
H	Cover Lock	U*	Lock Nut
I	Lower Lever Pin	V	Valve Nut
I-1	Upper Lever Pin	W	Lever
J	Lower Casing	X	Fulcrum Pin
J-1	Clamp	Y	Shield Bolt
K	Hinge Cover	Z	Dust Protector
L	Diaphragm Hooks	Z-1	Packing Ring
M	Diaphragm Plate		(*See also Page* 877.)

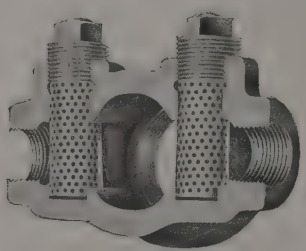


Fig. 2185—Train Pipe Strainer Cross No. 411.

Fig. 2187—Train-Pipe Strainer Tee No. 409.

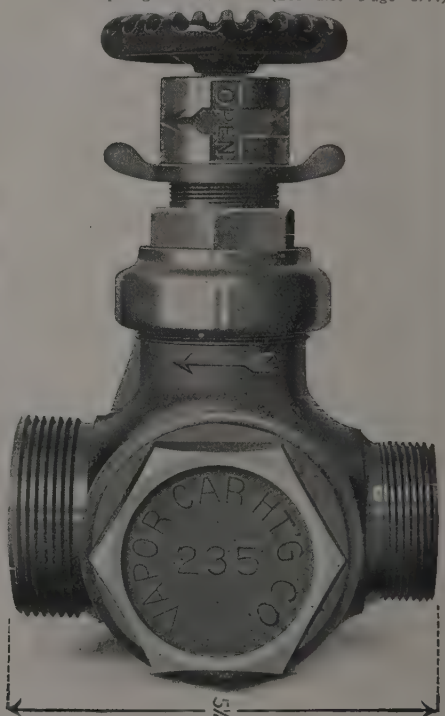


Fig. 2188—Pressure Reducing Valve No. 235.

Vapor Car Heating Company, Inc.

(*See also Page* 877.)

Vapor Car Heating Equipment

Ideal car heating conditions require correct volume and pressure of the steam supplied by the locomotive; the reduction of friction and elimination of leaks in train line connections; and the proper distribution and regulation of heating surface to heat each car economically and satisfactorily under all conditions.

Pressure Reducing Valve, No. 235 has a 2-in. outlet and will supply steam in sufficient volume and pressure for the longest trains. Worn cylinder walls or pistons may be renewed without removing valve from boiler connections—Fig. 2188.

Flexible Metallic Conduits, No. 270—Fig. 2192—are designed to take the place of rubber hose. Full 2-in. ports are provided throughout and all weight is carried by outside steel bearings. The gasket "follows-up" wear and automatically maintains steam tight joints. These conduits are easy to handle and allow every possible motion for connections between cars. High pressures do not affect the flexibility. They may be applied to present standard 1½-in. end valves and present standard steam couplers, or they may be used with full 2-in. end valve and 2-in. port coupler.

Of the steam couplers manufactured by this company, type S-4 is now in general use and conforms to A. R. A. standards. The No. 304—Fig. 2198—known as the "take-up" type has a positive lock, couples with sidewise movement, and will interchange with all present standard steam couplers. Coupler No. 307 is similar to No. 304, except that it has a 2-in. port throughout, being designed for roads desiring full 2-in. opening throughout the train line. This coupler is not interchangeable with present standard couplers.

End train pipe valve of the "quick opening" type is known as No. 105, and is now in general

Fig. 2189—End Train Pipe Valve No. 105

use. This valve has a full 1½-in. opening, can be operated from platform or side of car and has auxiliary bleed port for draining condensation at the rear of the train line. The same principles are embodied in valve No. 102, which has a full 2-in. port throughout. This valve was designed for use with the No. 270 Flexible Metallic Conduits and No. 307 Steam Coupler, to provide full 2-in. opening throughout the train-line.

The Vapor or "Atmospheric Pressure" System of Car Heating has been used successfully on a large number of railroads for many years. Two important reasons explain this. First, there is the "short circuit" feature which keeps the exposed outlet of the apparatus hot at all times when steam is on the train line, regardless of whether steam is used

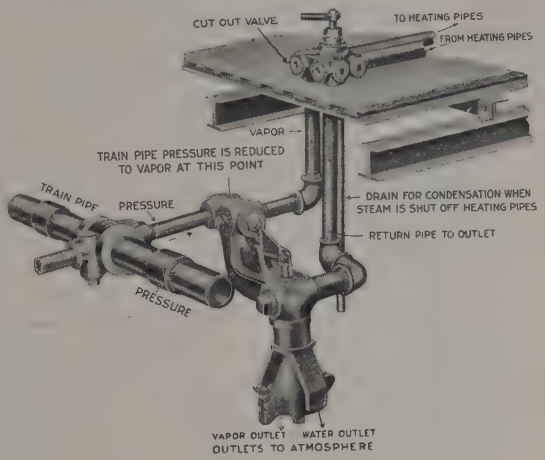

CUT OUT VALVE
TO HEATING PIPES
FROM HEATING PIPES
VAPOR
TRAIN PIPE PRESSURE IS REDUCED TO VAPOR AT THIS POINT
TRAIN PIPE PRESSURE
DRAIN FOR CONDENSATION WHEN STEAM IS SHUT OFF HEATING PIPES
RETURN PIPE TO OUTLET
VAPOR OUTLET
WATER OUTLET
OUTLETS TO ATMOSPHERE

Fig. 2190—Vapor Regulator (underneath car)

in any of the radiating pipes inside the car. This feature prevents the heating system from freezing. The second reason is found in the "multiple regulation" feature of the piping arrangement for coaches, which permits the independent use of 20, 30, 40, 50, 60, 70, 80 or 100 per cent of the total radiation, as may be desired to meet varying requirements.

The Improved Vapor System known as the Double Automatic Control Vapor System is electrically operated but embodies all the other valuable principles of the original manually operated Vapor System, including the "short circuit" feature. This system, operating automatically, maintains at 70 degrees F. the temperature of a car in passenger-carrying service. When the locomotive is detached and car is "laying over" in yards or terminals, the temperature is automatically maintained at 50 degrees F.—sufficient to prevent freezing of the water system and to permit cleaning or other work inside car. Passenger cars spend about two-thirds of their time at terminals and during this period are often unnecessarily overheated.

Real economy for the railroads is possible through the use of this Double Automatic Control Vapor System. It will save approximately one-half the coal now consumed in heating cars while standing in yards or terminals. At the same time it insures uniformity of temperatures—70 degrees F. while in passenger-carrying service, and 50 degrees while in yards or terminals. A further advantage of its use is the elimination of responsibility on part of train or yard men for regulating temperatures in passenger cars either to meet demands of traveling public or to prevent freezing in yards. This System may be applied to any electric-lighted car, and cars now equipped with the standard hand-operated Vapor System may be readily converted to this Improved Double Automatic Control Vapor System.

For other products and branch offices, see classified and alphabetical indexes.

VAPOR CAR HEATING COMPANY, INC., CHICAGO, ILL.

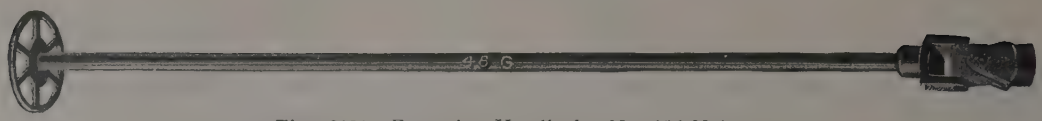


Fig. 2191—Extension Handle for No. 106 Valve.

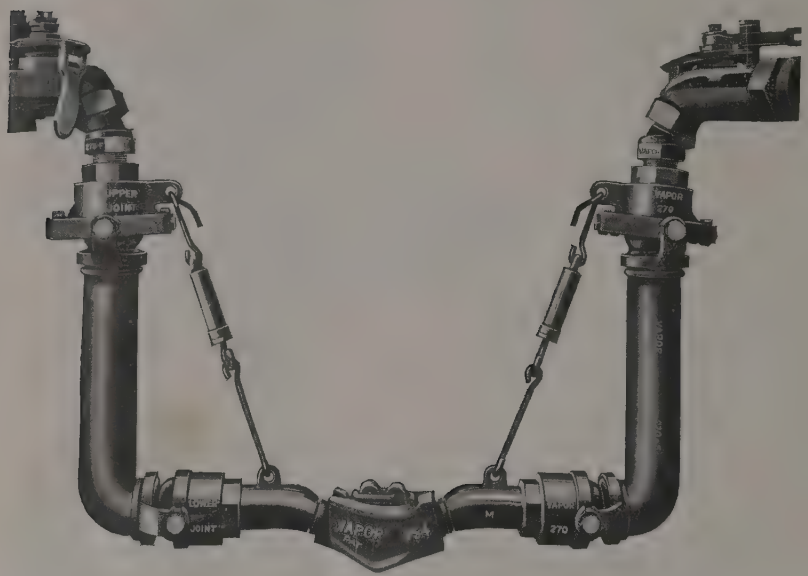


Fig. 2192—Flexible Metallic Connection No. 270, for Steam Heating.

Fig. 2193—Steam Hose Nipple.

Fig. 2194—Steam Hose Clamp.

Fig. 2195—Steam Hose Coupler No. 302.

Fig. 2196—Steam Hose Coupler S-4.

Fig. 2197—Steam Hose Coupler No. 307.

Fig. 2198—Steam Hose Coupler No. 304.

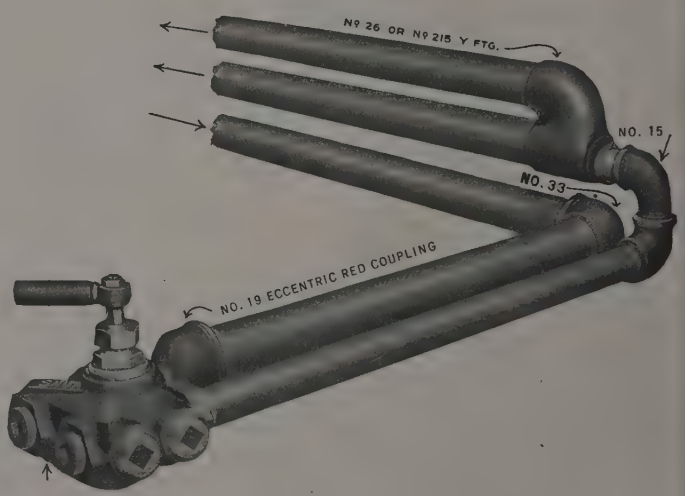


Fig. 2199—One Method of Connecting a Three-Pipe Coil Feeding at the end.

Vapor Car Heating Company, Inc.

(*See also Page* 877.)

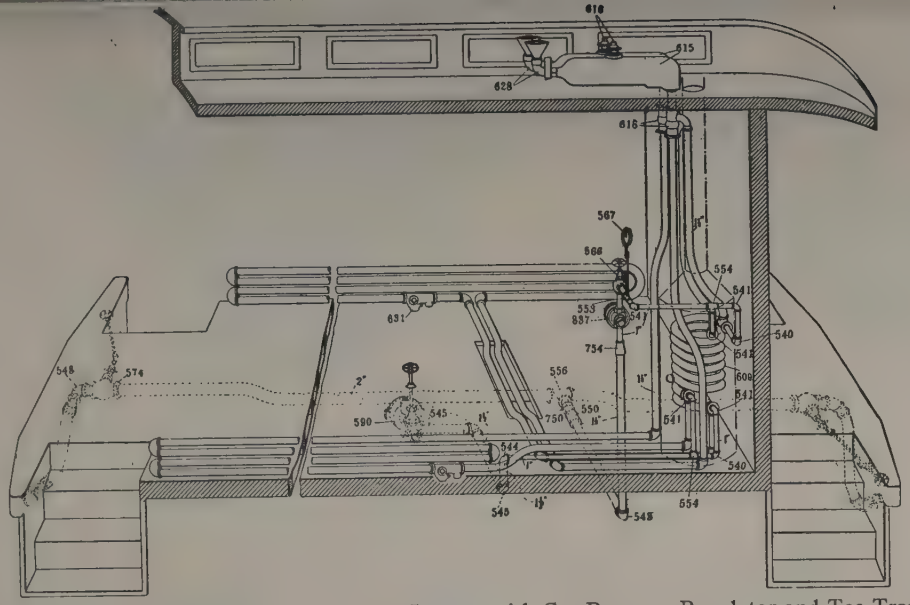


Fig. 2200—Gold Hot Water Circulating System with Car Pressure Regulator and Tee Trap. (Vertical Trap Can Be Used if Desired)

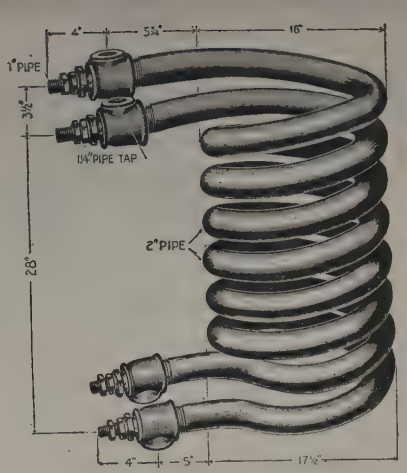


Fig. 2201—Gold Double Duplex Coil (high); 2 in., No. 609.

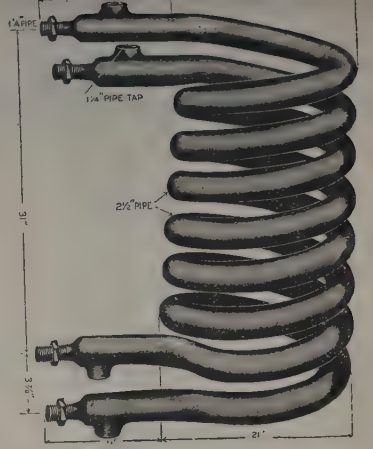


Fig. 2202—Gold Double Duplex Coil with Welded Ends; 2½ in., No. 609A.

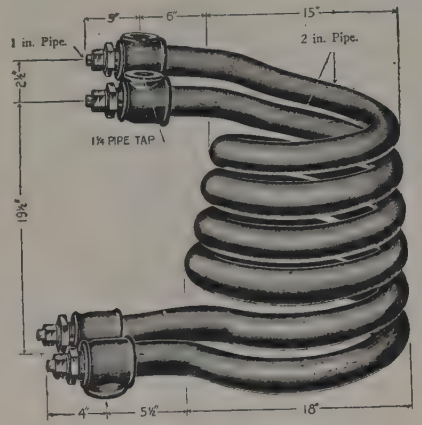


Fig. 2203—Gold Double Duplex Coil (low); 2 in., No. 608.

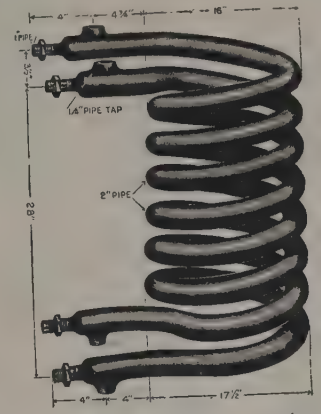


Fig. 2204—Gold Duplex Coil with Welded Ends; 2 in., No. 608A.

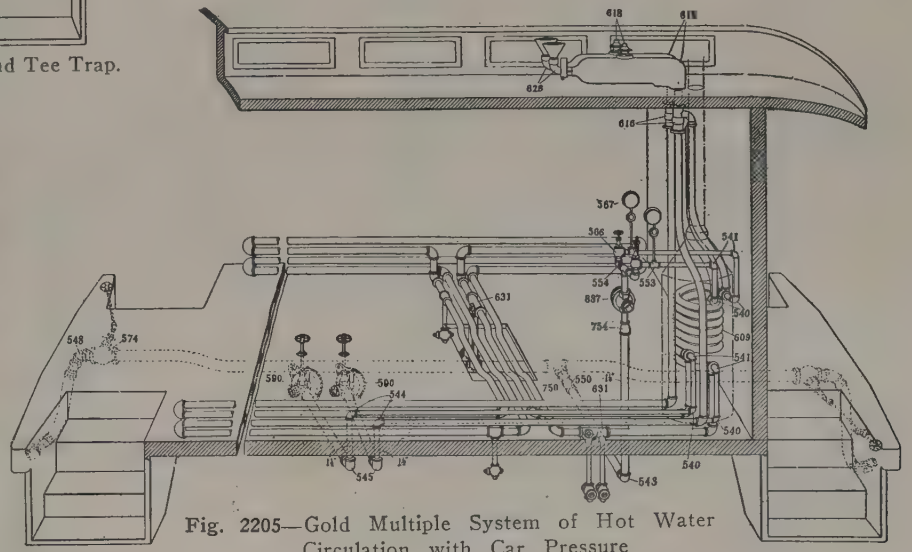


Fig. 2205—Gold Multiple System of Hot Water Circulation with Car Pressure Regulator and Tee Traps.

Gold Car Heating & Lighting Company.

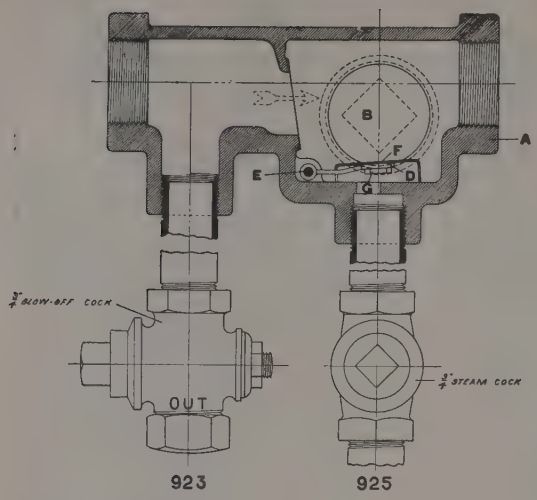


Fig. 2206—Gold Filling Device, No. 631.

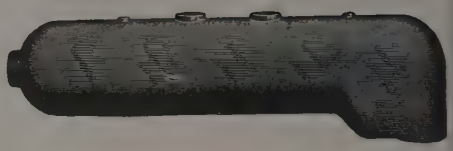


Fig. 2207—Expansion Drum, No. 615.

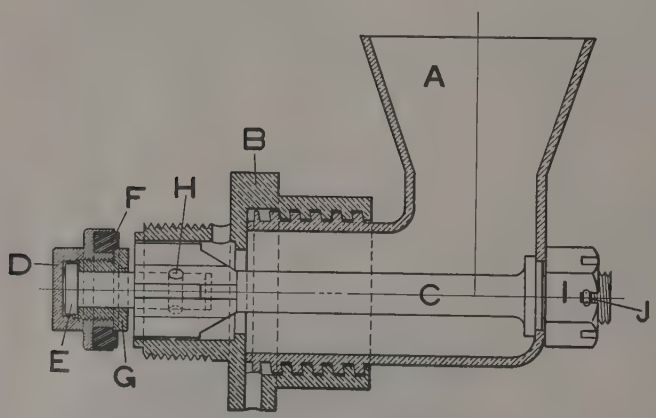


Fig. 2208—Sectional View, Gold Funnel Cock, No. 1021

Fig. 2209—Gold Pop-off Safety Valve No. 1138.

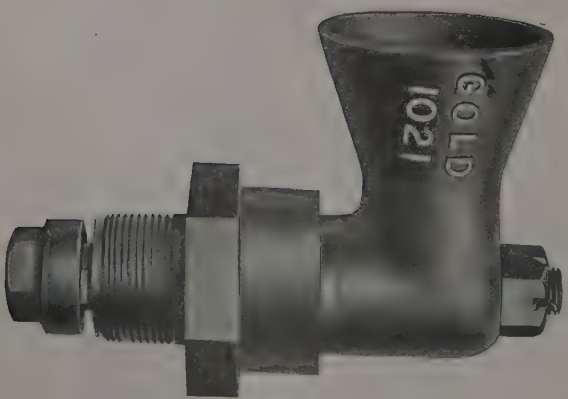


Fig. 2210—Gold Funnel Cock, No. 1021.

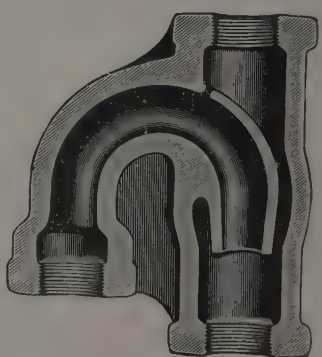


Fig. 2211—Gold Sealed Jet Accelerator, No. 616.

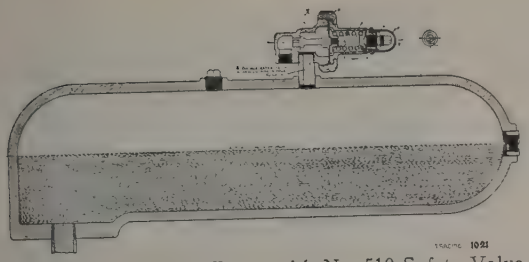


Fig. 2212—Expansion Drum with No. 510 Safety Valve.

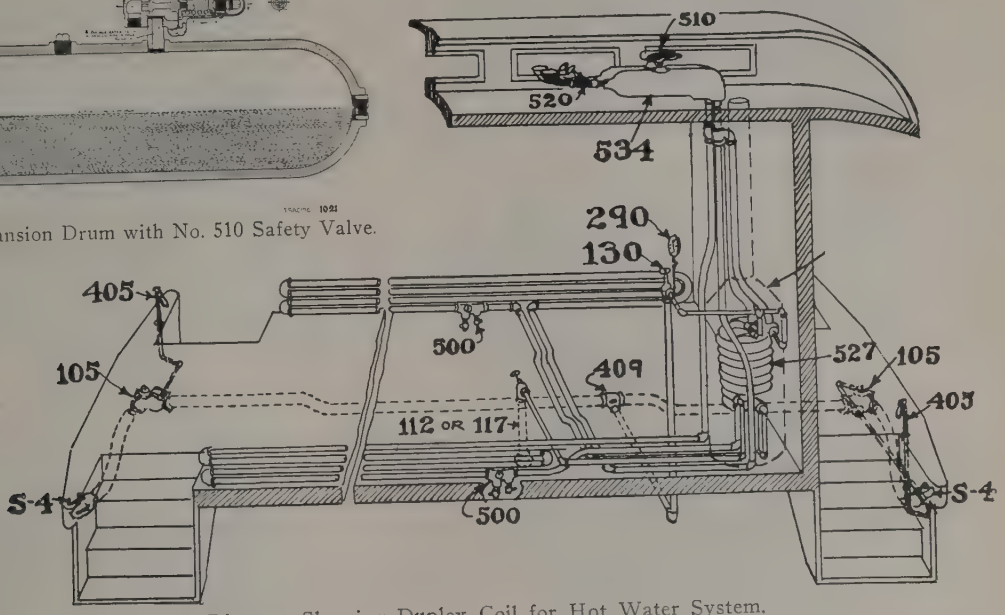


Fig. 2213—Diagram Showing Duplex Coil for Hot Water System.

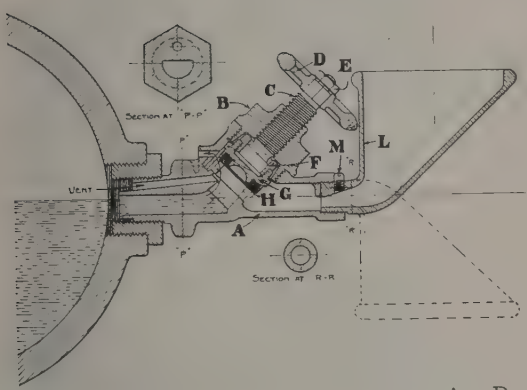


Fig. 2214—Combination Valve for Expansion Drum of Hot Water Circulating System.

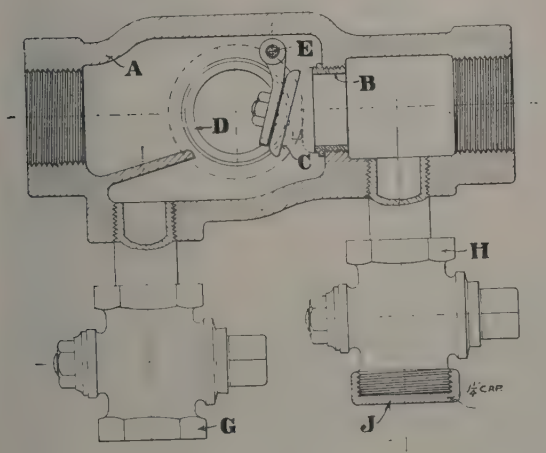


Fig. 2215—Section Through No. 500 Hot Water Filling Device.

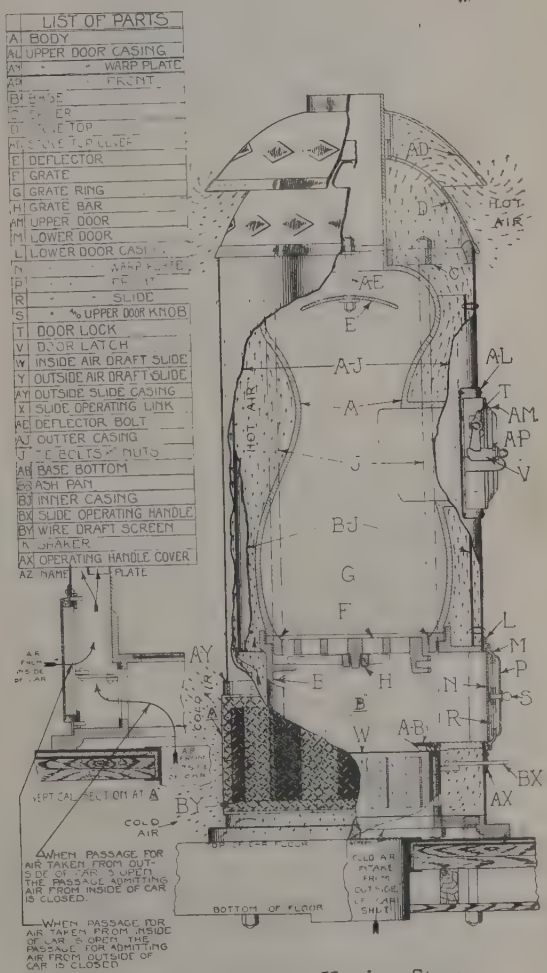


Fig. 2216—Emergency Heating Stove.

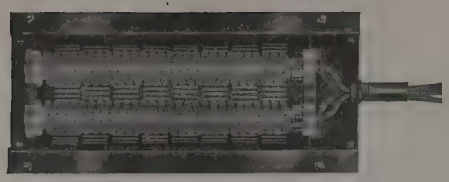


Fig. 2217—Gold Interchangeable Deflector Cross-Seat Heater No. 405-E. Interior View, Deflector Removed.

Fig. 2218—Application of Gold No. 405-E Heater to Cross-Seat.

Fig. 2219—Gold Electric Heater Switch, No. 114-E.

Fig. 2220—Gold Interchangeable Deflector Cross-Seat Heater No. 405-E. End View Without End Plate Showing Method of Attaching Service Wires.

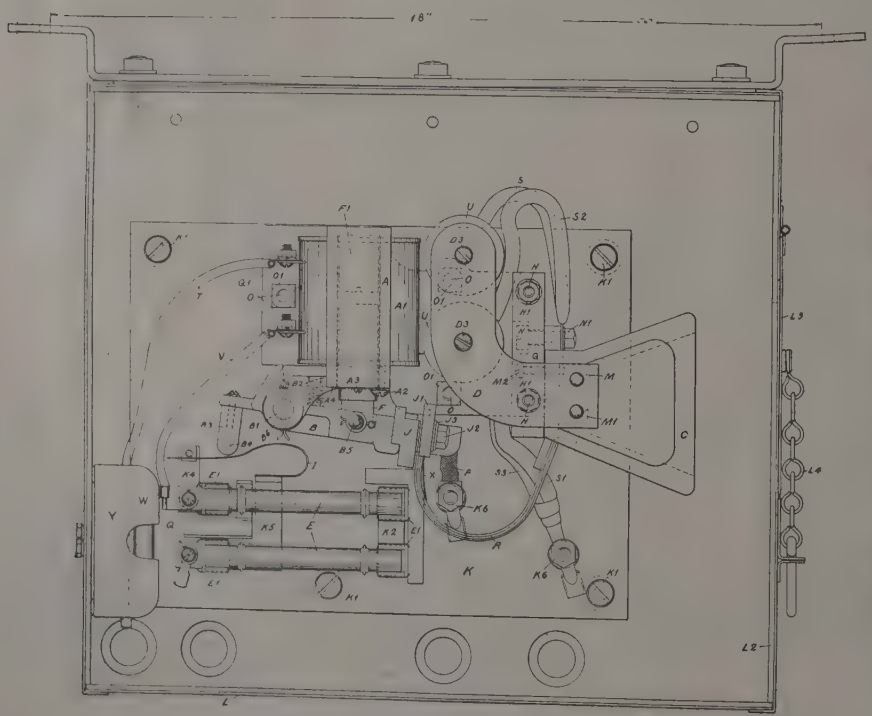


Fig. 2221—Gold Magnetic Switch No. 1015 (Heavy Duty Type) Used with Thermostat No. 1066 for the Automatic Control of Electric Heat.

Fig. 2222—Gold Six-Coil Electric Heater No. 360-E.

Gold Car Heating & Lighting Company.

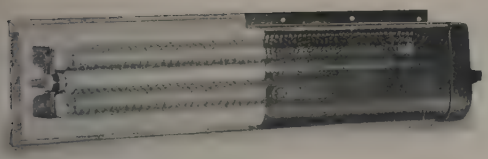


Fig. 2223—Two-Coil Electric Truss Plank Heater, No. 199-E.

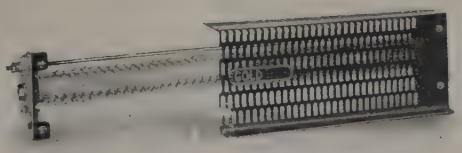


Fig. 2224—One-Coil Electric Truss Plank Heater, No. 206-E.

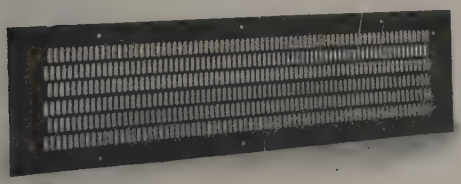


Fig. 2225—Panel Heater, Front Style, No. 177-E.

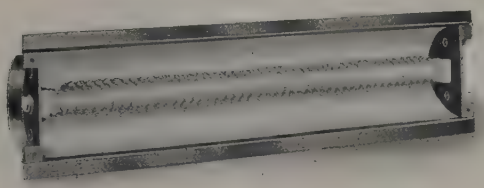


Fig. 2226—One-Coil Electric Panel Heater, No. 212-E.

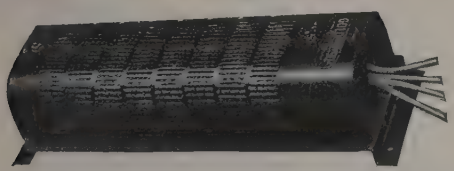


Fig. 2227—Interchangeable Heater No. 417-E, for Installation Under Longidudinal Seats Without Risers

Fig. 2228—Ventilated Porcelain Core Supports Used in Electrical Heater.

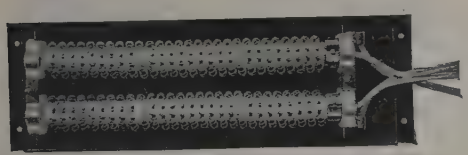


Fig. 2229—Heater No. 417-E, Interior View.

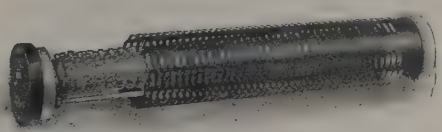


Fig. 2230—One-Coil Electric Cylinder Heater, No. 120-E.

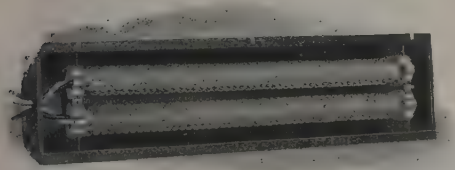


Fig. 2231—Two-Coil Electric Panel Heater, No. 322-E.

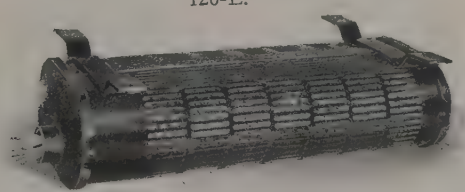


Fig. 2232—Two-Coil Electric Cross Seat Heater, No. 145-E, Type C.

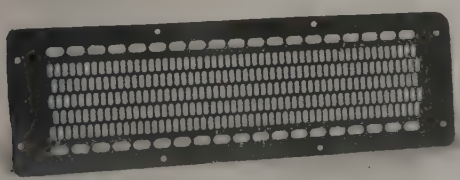


Fig. 2233—Panel Heater, Front Style, No. 329-E.

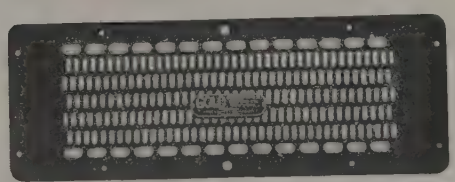


Fig. 2234—Panel Heater Front No. 414-EA for Heater No. 414-E.

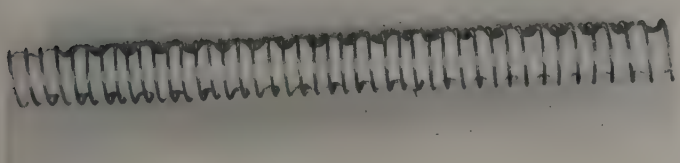


Fig. 2235—New Type Support and Coil for Older Type of Electric Heaters.

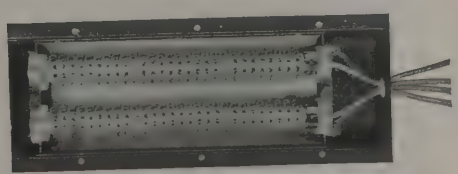


Fig. 2236—Interchangeable Panel Heater No. 414-E.

Gold Car Heating & Lighting Company.

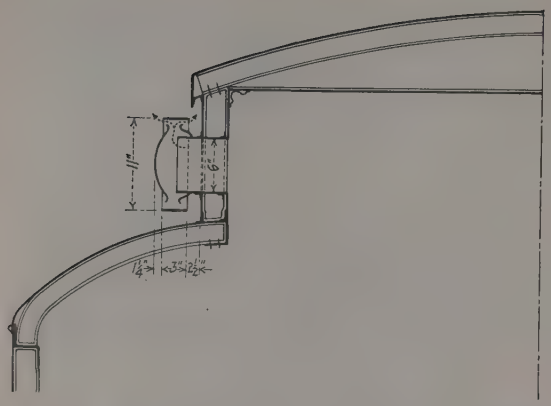


Fig. 2237—Application of Globe Ventilator in Deck Sash.

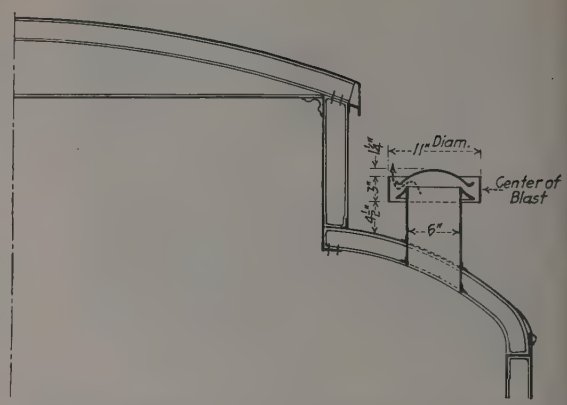


Fig. 2238—Application of Globe Ventilator Over Saloon.

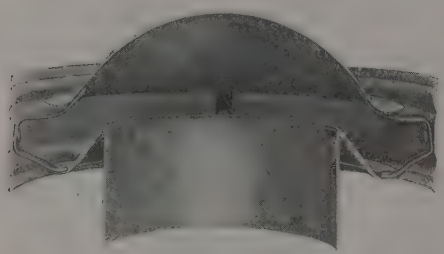


Fig. 2239—Sectional View of Globe Ventilator.

Fig. 2240—Dome Top, Globe Ventilator.

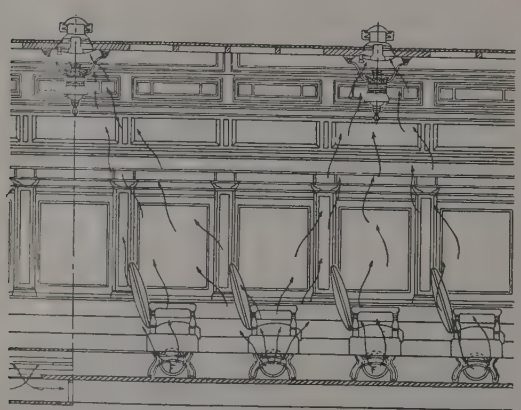


Fig. 2241—Application of Globe Ventilators Over Gas Lamps.

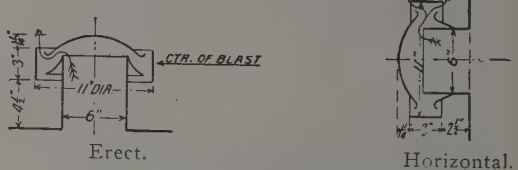


Fig. 2242—Two Positions of Globe Ventilators.

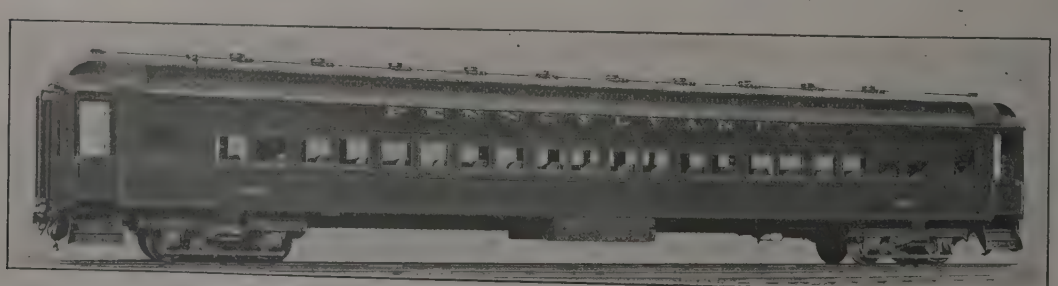


Fig. 2243—Application of Globe Ventilator to Top of Passenger Car.

Globe Ventilator Company.

(*See also Page* 885.)

Globe Ventilators and Lamp Jacks

Proper ventilation in a crowded railway or electric car is an absolute necessity. The ventilation system must furnish a continuous flow of air, as due to the limited cubic capacity of a car, the initial fresh air is vitiated within a few minutes.

Globe Ventilators can be relied upon to furnish a continuous exhaust with no inward draft. They are placed at or near the top of a car and will rapidly change the enclosed air, the rate of flow depending upon the number of ventilators used. The ventilators are constructed of heavy galvanized copper bearing steel which is rust proof and of long life. They are equally efficient on any type of roof construction.

Two types of Globe Ventilators are in general use. The flat top as shown in Fig. 2244 is used on the top of the car when the greatest possible clearance is desired. The dome top ventilator which is shown in Fig. 2240 is easily installed and makes a good appearance. It is storm proof and operates just as efficiently on the deck of a car—Fig. 2246—as when on the roof. An application of this type is shown in Fig. 2245 where dome top ventilators are used on the top of Gasoline

Fig. 2244—Globe Flat Top Ventilator.

Driven Car. This use ably demonstrates the efficiency of the Globe Ventilators, as quickly ridding a car of gasoline fumes is a thorough service test.

The Globe Ventilator for buildings is of a similar type and is widely and successfully used on railway depots, machine shops, round houses, and buildings of every description.

The Globe Lamp Jack—as shown in Fig. 2247—is a slight variation from the ventilator. These lamp jacks are placed on the car top, insuring a clear, steady flame and causing the lamps to burn equally well, whether the train is speeding forward at fifty miles an hour or is at a standstill. A very large percentage of the Pintsch Gas Lights, now in service on American railways is equipped with a Globe Lamp Jack. They are storm and cinder proof and like the ventilators

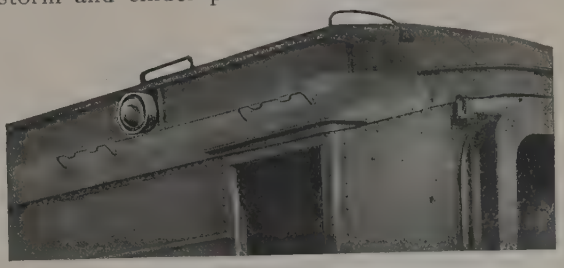


Fig. 2246—Globe Deck Ventilator with Dome Top.

are made of long lived, heavy, galvanized copper bearing steel.

The production of efficient and satisfactory ventilating equipment requires careful attention to the details of manufacture, combined with conscientious workmanship and skill in sheet metal manipulation. Careless or improper practices in

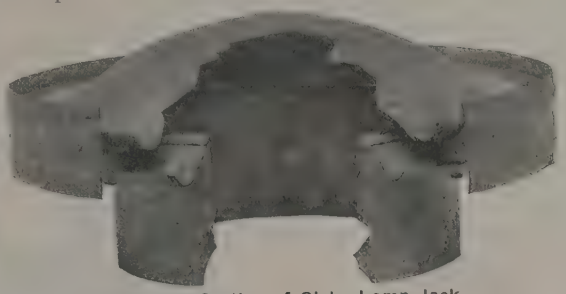


Fig. 2247—Section of Globe Lamp Jack.

the forming, rolling, soldering and joining processes would result in reduced ventilating efficiency and a lowered resistance to the deteriorating effect of weather conditions.

The Globe Ventilator Company has concentrated upon the production of carefully designed, well-built, sheet metal ventilators and lamp jacks. These are manufactured in a modern plant, under expert supervision and with complete facilities for the fabrication of a high grade product.

The simplicity in construction of the Globe Ventilator provides economy in first expense and practically a total absence of maintaining cost. The care with which it is made, as well as the rust-resisting quality insures many years of satisfactory service.

Fig. 2245—Globe Dome Top Ventilators on Top of Gasoline Motor Car

GLOBE VENTILATOR COMPANY, TROY, N. Y.

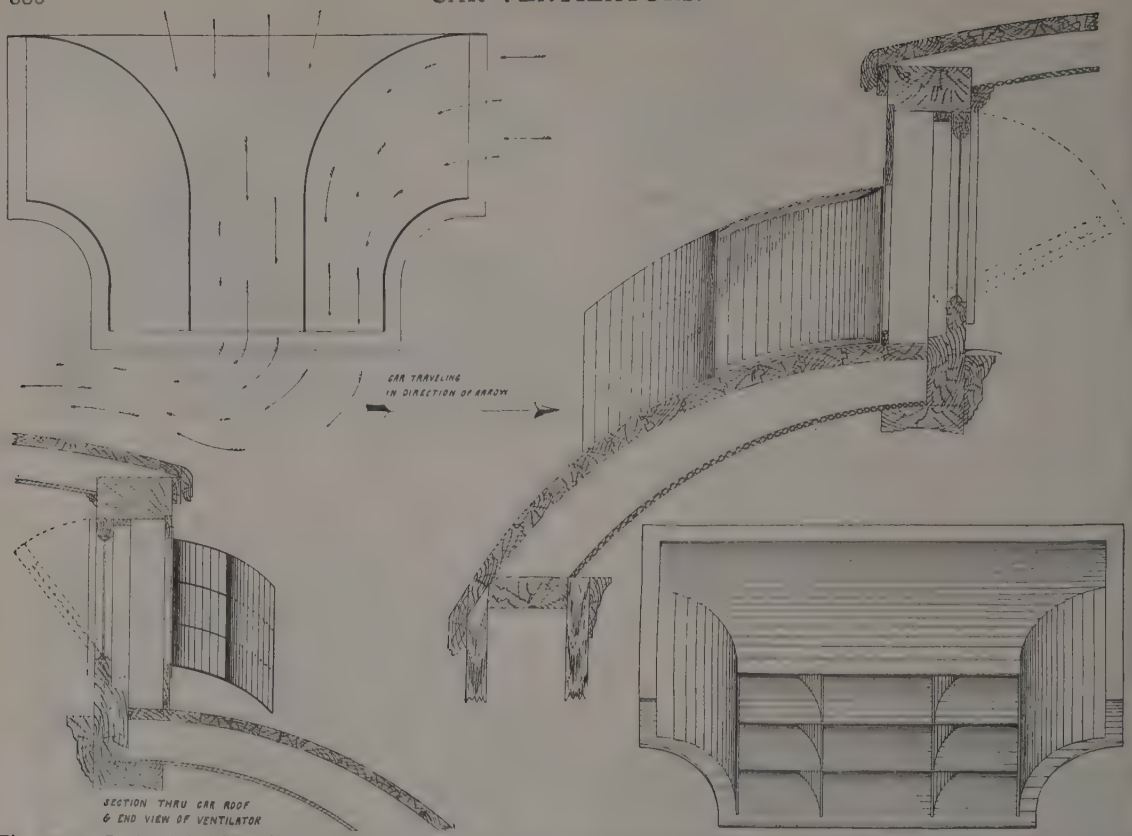
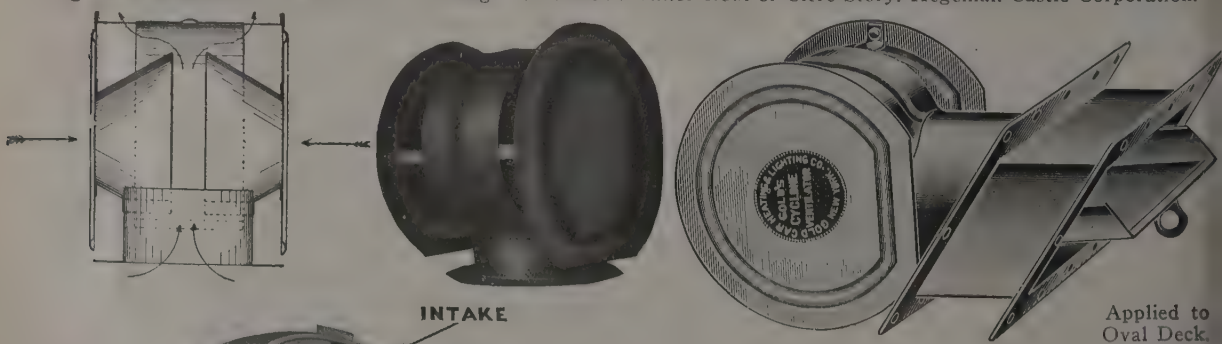


Fig. 2248—Garland A-1 Ventilator for Passenger Cars with Monitor Roof or Clere-Story. Hegeman-Castle Corporation.



Applied to Oval Deck.

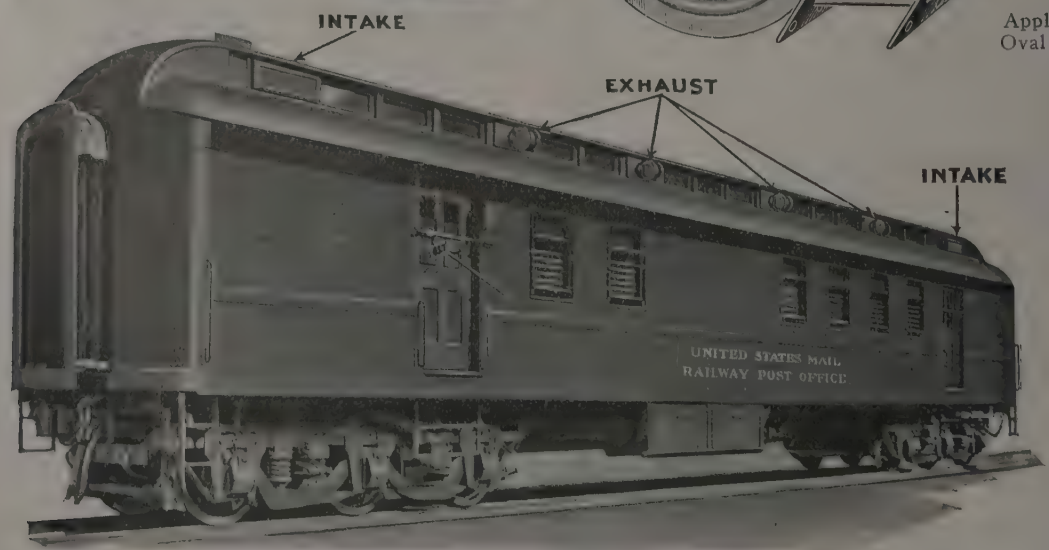


Fig. 2249—Application of Gold Cyclone Ventilators to United States Mail Car. Gold Car Heating & Lighting Compan

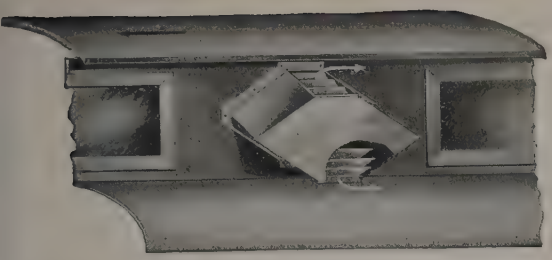


Fig. 2250—Diamond Type Exhaust Ventilator for Monitor Roof Cars.

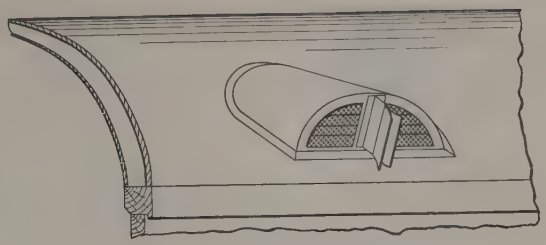


Fig. 2251—Automatic Ventilator Hood Applied on Arch Roof Cars.

Automatic Ventilator Company.

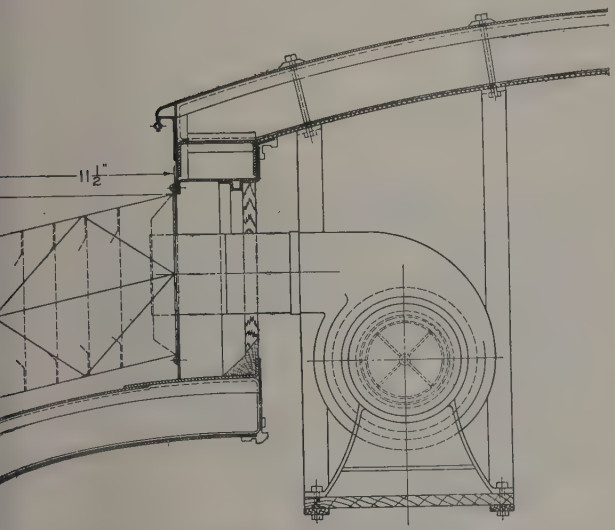


Fig. 2252—Application of Mudge Blower and Ventilator for Dining and Private Cars.

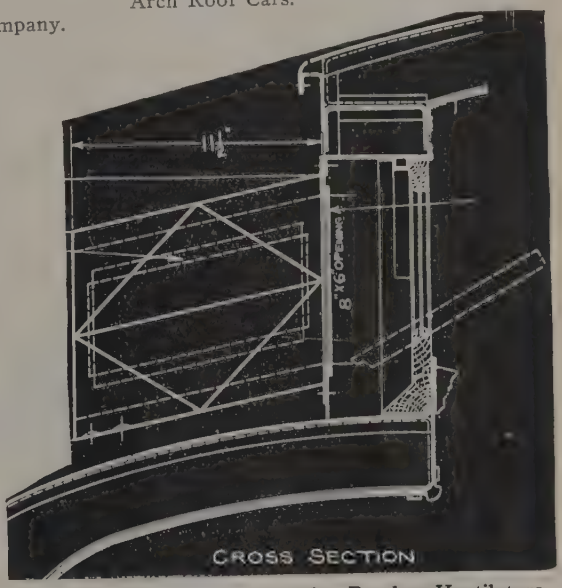


Fig. 2253—Application of Mudge-Peerless Ventilators.

Fig. 2254—Mudge Volume Blower.

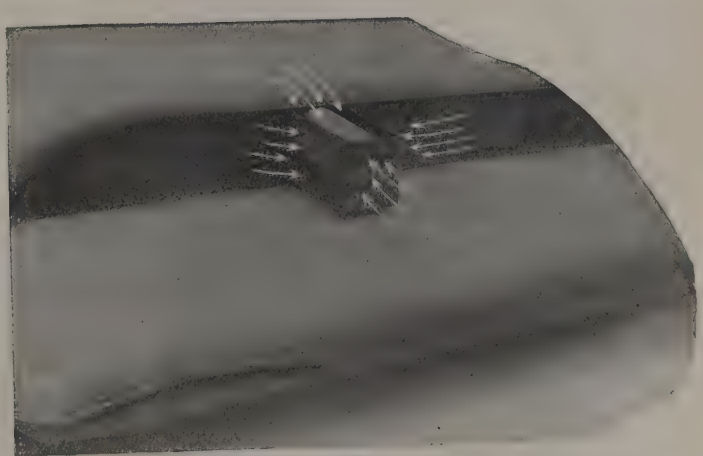


Fig. 2255—Mudge-Peerless Pullman Standard Type Ventilator. Air currents create exhaust action.

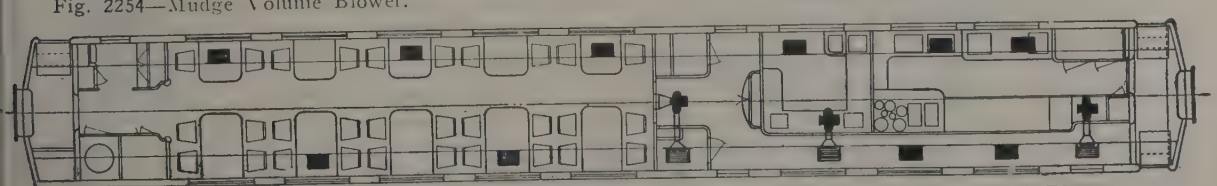


Fig. 2256—Floor Plan of Diner with Recommendations for Mudge-Peerless Ventilators and Blowers.

Mudge & Company.

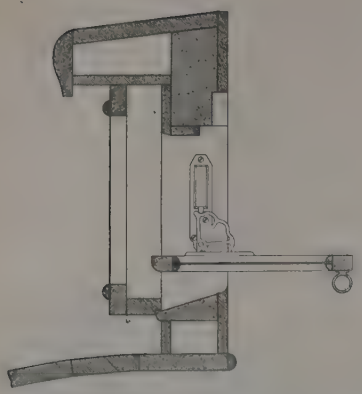


Fig. 2257—Fresh Air Intake, Cross Section of Wood Car. Vapor Car Heating Company.

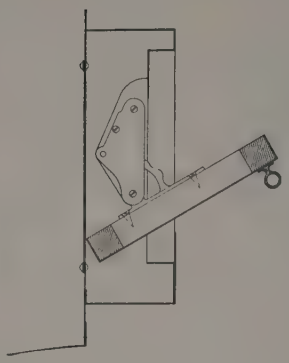


Fig. 2258—Fresh Air Intake, Cross Section of Steel Car. Vapor Car Heating Company.

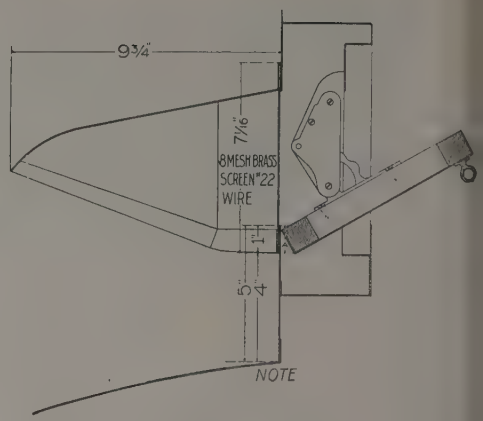


Fig. 2259—Ventilating Hood, Cross Section of Steel Car. Vapor Car Heating Company.

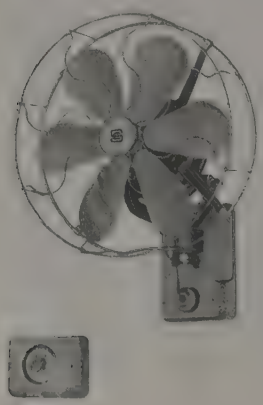


Fig. 2260—Bracket Fan No. 19210. The Safety Car Heating and Lighting Company.

Fig. 2261—Register for Ventilator Pipe. James J. Howard.

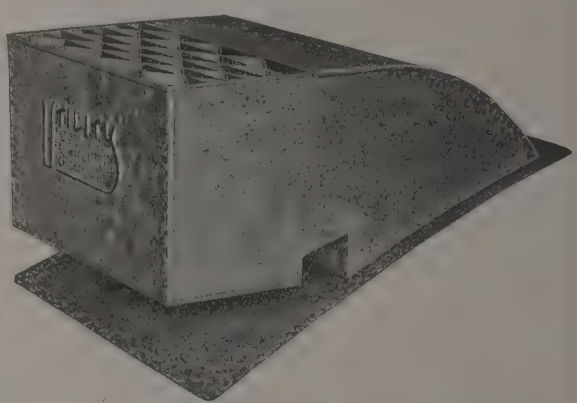


Fig. 2262—Utility Honeycomb Ventilator for Arch Roof Cars. Railway Utility Company.

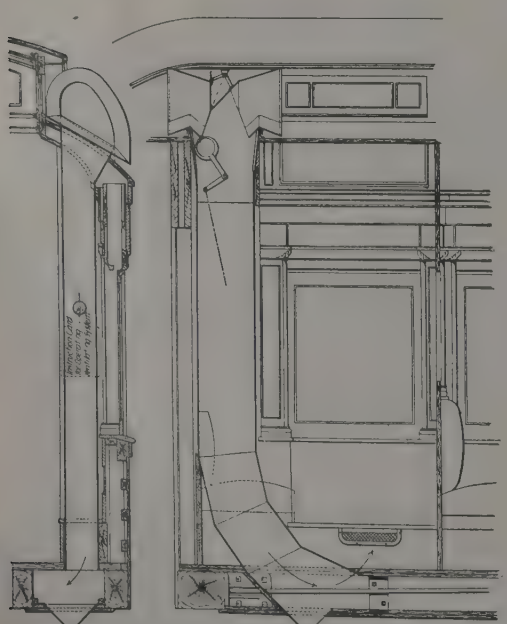


Fig. 2263—Pennsylvania Railroad Ventilating Apparatus for Passenger Train Cars.

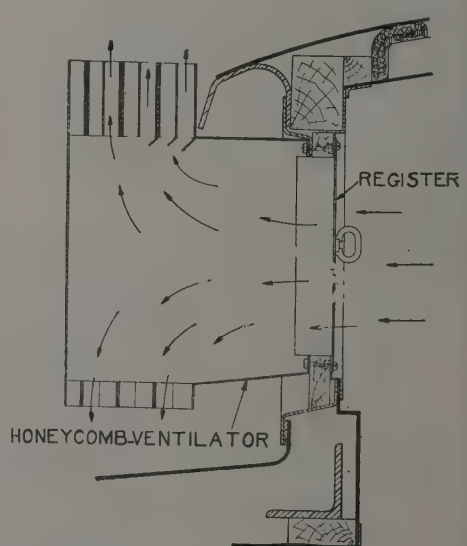


Fig. 2264—Utility Honeycomb Ventilator. Applied in Clere-Story. Railway Utility Company.

Passenger Train Lighting

THE MODERN METHOD OF CIGAR LIGHTING is by means of electric equipment installed on the cars and such apparatus has been developed to a point where very satisfactory results are obtained. Other older methods of car lighting are: the Pintsch gas system; the gasoline vapor system; and acetylene gas system. These systems are still in use on many old cars but are not being applied to the most modern equipment—many gas equipments have been removed from old cars and replaced with electric lighting apparatus. In some few cars oil lamps are still used but this method of car lighting has practically been discarded by American railroads.

Electric Lighting Systems

Electric lighting for railroad cars was first used about the year 1881 but it was not until about 1900 that apparatus was developed that would give satisfactory service. There are several systems of electric lighting: The axle-generator system—the most commonly used—the head-end system; and the storage system.

Axle-Generator System

The axle-generator system of electric lighting is the most commonly used on American railroads. It comprises the following principal parts: Generator secured to the under side of the car body or mounted on the truck frames; a suspension by which the generator is supported; a drive, connecting the armature shaft to the axle; a regulator for controlling the voltage and output of the generator at all train speeds; an automatic switch designed to open on reverse current for the purpose of preventing discharge of the battery through the generator; and a battery of a suitable number of storage cells to insure a constant supply of electric current when the generator is not operating, as when cars are not in motion. Usually a lamp regulator is also employed for controlling the voltage impressed on the lamp circuits, but in one system employing a constant-voltage generator this is not required.

Successful operation of this system requires that the polarity of the generator terminals remain unchanged with a movement of the car in either direction and at all train speeds; from the cutting-in speed of the generator to the maximum speed, the generator output and voltage must be maintained within definite working limits. The generator must be automatically connected or disconnected from the battery circuit as the train speed falls below or rises above the critical generator speed. As the lights may be burned at any time the transfer of the load from the battery to the generator and vice versa should result in no appreciable change in the candle power of the lamps; the voltage impressed on the lamp circuit should be maintained within such limits as will give satisfactory illumination and reasonable life of lamps.

The common method of operating the axle-generator system is by means of a belt drive from the truck axle pulley to the generator pulley. Various methods have been devised for maintaining proper belt tension and the system has been brought to a state of efficient operation, but continual efforts are being made to develop a satisfactory direct drive and thus eliminate the cost of belt replacements which, due to the oscillation of the trucks, amounts to a very considerable sum of money yearly. The A. R. A. committee on Train Lighting, in their report to the 1922 convention, gave the valuable data on the use of belts, and a description of several designs of direct drives. These are shown on pages 905-907.

Head-End System

The head-end system of electric lighting is so called because of the fact that a generator located at the head end of the train furnishes power for lighting the entire train. This system was first used about the year 1887 and several methods of operation have been developed, although the system is not now much used. These methods are: A generator located on the locomotive and driven by a steam turbine; a generator in the baggage car at the head of the train and driven by a steam turbine or a gas engine; a generator in the baggage car driven by a belt to the car axle.

Indicating, regulating, and controlling apparatus is placed near the generator in an accessible position; train line wires run the entire length of the train, flexible connections between cars being made in the vestibule; storage batteries, consisting of a suitable number of cells connected in series and placed in battery boxes, are attached to the under side of the cars. Lamp regulators are sometimes installed in each car to compensate for the line drop and to maintain constant voltage at the lamps.

The disadvantage of the head-end system is especially noticeable when it is necessary to break-up and make-up trains, as it is always necessary to place a car equipped with a generator at the head end. Another disadvantage is that a large proportion of the cars must also be equipped with a sufficient number of storage batteries to insure light when they are not coupled to a generator car.

Storage System

In this system of lighting each car is provided with storage batteries, which must be charged at terminals during the lay-over period. Usually the cells are carried in a battery box suspended underneath the car body. An advantage of the storage system is that no expensive generating set is required.

Electric Lighting Equipment

The principal parts of electric lighting equipment for railway cars are: The generator, generator regulator, lamp regulator, pole changer, storage batteries and various electric switches.

Storage Battery

The storage battery used in electric lighting in railway cars is an electro-chemical device, consisting of a number of cells connected in series, each cell containing two groups of plates immersed in a liquid electrolyte, the functions and properties of which are to receive and store electrical energy and to deliver it to the lighting circuit of the car as occasion may require. Storage batteries are of two kinds, one known commercially as Alkaline and the other as Lead-Lead-Sulphuric Acid. The alkaline storage battery is of nickel steel and the active materials are nickel hydrate for

the positive plates and iron-oxide for the negative plates. The electrolyte is an alkaline solution, potassium hydrate in water. In the lead-lead-sulphuric acid battery the active materials are lead peroxide for the positive plates and sponge lead for the negative plates. The electrolyte is dilute sulphuric acid.

Generator Regulator

The generator regulator is a device for controlling the action or output of the axle driven generator. As it is desirable to arrange the generator to become operative or generate its full voltage at a low speed, provision must be made for taking care of the output of the generator when it runs at a very high speed. Generator regulators are generally designed to control the field of the axle generator, weakening it at high speeds and strengthening it at low speeds. They are made in various ways, the three principal types being rheostatic type, contacting type and counter electro-motive-force type.

The rheostatic type consists of a rheostat of some form in the shunt field circuit of the generator. The resistance of this rheostat is generally varied by means of some motive power device, such as a solenoid or small motor. The action of the motive power device is controlled by the electrical conditions that obtain in the system. The contacting type employs a fixed resistance in the field circuit of the generator, which is intermittently cut in and out, depending upon the conditions; such a regulator acts substantially like a rheostatic device and accomplishes the same purpose.

The counter electro-motive-force type consists of a small motor-driven generator which generates counter electro-motive-force or back pressure in the field circuit of the main generator. This force is controlled in the same manner as the operating device of the rheostatic or contacting types of regulator.

In all systems employing variable speed generators which do not have inherent constant voltage or constant current regulation, an auxiliary device for controlling the action or output of the axle driven generator is necessary.

The Rosenberg car lighting dynamo as originally designed for European service was inherently a constant current variable speed machine which did not require any auxiliary regulator.

As adapted for constant voltage operation in this country special resistance units in the form of a Whetstone bridge are employed to control the field excitation, no electro-mechanical, or devices requiring moving parts being used.

Lamp Regulator

The lamp regulator is an electrical device for maintaining constant voltage at the lamps thus insuring more constant brilliancy. It may be of the rheostatic or counter electro-motive-force type. As a rheostatic device it varies resistance in series with all the lamps, responding to variations in lamp voltage and having a tendency toward maintaining constant lamp voltage; if of the counter electro-motive-force type, it acts in the same way as far as the lamps are concerned, but varies a counter electro-motive-force in series with the lamps instead of varying a resistance. The regulator usually is mounted underneath the car body where the heat which is dissipated in it may be easily taken care of and radiated. It is governed by an auxiliary relay or equivalent device, generally placed inside of the car with the other electrical apparatus.

Pole Changer

The pole changer is an automatic device for preserving the polarity of an axle generator. It is made generally in one of three types: rotating, mechanical or electrical type.

The rotating type employs the principle of shifting the brushes of the generator automatically when the direction of rotation changes through an angle equal to the pole pitch; that is, the angle between two poles of the generator. If it is a two-pole machine, the brushes must be shifted 180 degs.; if a four-pole machine 90 degs. The rotating type employs no switches or contacts that might interfere with the continuity of the armature circuit, and it permits the brushes taking a "lead," advantages not possessed by the other types which necessarily employ fixed brushes.

The mechanical type consists of a reversing switch operated mechanically by the rotation of the armature shaft in one direction or the other. When the armature rotates in one direction the switch is automatically closed to make proper connections under these conditions and vice versa.

The electrical type consists of a reversing switch, generally operated by solenoids, the entire mechanism being placed inside of the car, with the other electrical apparatus. This reversing switch is automatically thrown one way or the other, depending upon the direction of the rotation of the generator armature.

No pole changer is required in the case of the Rosenberg type of generator, since the principle of operation is such that it develops the same polarity for either direction of rotation.

Pintsch Gas System

The Pintsch system of car lighting burns an oil gas made from crude petroleum or similar oils. The gas is carried under pressure—about 150 lb. per sq. in.—in a gas-holder or tank secured underneath the car body; this pressure is automatically reduced, by means of a pressure regulator, to a uniform pressure of about ½ oz. at the burners regardless of the pressure in the gas-holder.

The arrangement of this apparatus is as follows: The gas-holder is connected by a system of piping and special fittings to a regulator; from the regulator the gas passes through a low pressure pipe line toward the roof of the car; branch pipes conduct the gas from the low pressure line to the lamps.

The lamps used with this system are known as Pintsch lamps, the essential features being the closed globe at the bottom, the white porcelain reflector above the flames near the top of the globe, and the method of supplying air.

Various forms of lamps are made, all on the regenerating principle, the inlet air being highly heated before reaching the flames, thereby producing extreme whiteness and steadiness of light. The original design of lamp employed a gas tip but later designs embodied a gas mantle inclosed in a bulb.

In the operation of the system air is admitted to the lamp immediately above an upper dome; passing thence through an orifice in a mica chimney, located inside of the dome, it comes in contact with sheet iron flues and in its downward passage becomes highly heated; it then passes into a space between the dome and the chimney, is deflected by a diaphragm, and passes close to the chimney, where it is still further heated. It then passes outward between the diaphragm and a ring reflector, through orifices near the outer rim of this reflector into the bowl, and thence to the flames. In its tortuous course the effect of drafts against the lamp is entirely nullified.

The products of combustion escape directly through an annular space between the chimney and a cup reflector, and thence by flues out through the crown at the top of the lamp. Any air in excess of the amount required for proper combustion of the gas is also carried off through the space above the body of the lamp.

The gas-holder is filled from a charging station at which gas is held under pressure in storage tanks; during the

charging operation the system in each car is connected to the supply line by means of a flexible hose. A gage communicating with the high pressure pipes connecting the various parts of the apparatus below the car serves the double purpose of registering the amount of pressure in the receiver at any time and of showing the amount of gas consumed in lighting the car for any given period.

Acetylene Gas System

The acetylene gas system of car lighting uses acetylene gas, which may be generated in an apparatus inclosed in one end of the car; in a gas generator mounted under the car; or in gas stations usually located at terminals and stored under pressure in tanks which are placed under the car, replacements being made when the tanks are empty.

In one system of acetylene lighting the gas is stored in tanks filled with asbestos and charged with 4/10 of a volume of acetone—a colorless liquid obtained from the dry distillation of wood which absorbs large quantities of acetylene under pressure. When the pressure is relieved the acetylene is given off and the acetone remains in the tank and may be used again when recharging; acetylene may be stored in a tank under pressure of 150 lb. and may not be exploded by any known means when the tank is filled with asbestos bricks. In this system the gas is generated in stations at terminals, and the car tanks are supplied direct from the stations or charged from yard lines connected with the stations. The lamps and piping for the car are similar to those used with the Pintsch gas system.

In another acetylene system the gas is generated by the use of carbide and water in an apparatus enclosed in one end of a car. The carbide is contained in cartridges, pockets, or baskets; the water, flowing down and coming into contact with the carbide, generates acetylene gas, which is stored in a receiving tank located under the car. The piping arrangements through the car and the form of the lamp are similar to those of the Pintsch gas system.

Another similar system employs a gas generator mounted under the car. The carbide is put in a cartridge which is put in or removed from the generator from the outside of the car.

Vapor Gas System

The vapor system of gas lighting is so designed that gas charging plants are not required; the gas is produced by mixing air with the vapor of gasoline. Air is taken from the air brake system and, passing through a carburetor charged with gasoline, becomes suitable for illuminating purposes. The gas is burned in a mantle lamp and produces a soft white light.

In the operation of this system, air is taken from the auxiliary reservoir of the brake system through a check valve and into the air storage tank through a supply valve. It then passes up into the car to a shut-off valve which is placed in a convenient location. From the shut-off valve the air is carried to a thermostatic regulator and into the carburetor, where it mixes with the gasoline vapor. The gas thus formed passes through a regulator to the main cock inside the car and thence through the roof piping to the lamps. The check valve prevents the stored air from returning to the brake system when the brakes are inoperative; with this arrangement, when the car is cut off from the air supply a sufficient quantity of air is held in the tank to keep the lights burning. The carburetor and air storage tank are combined, the carburetor being placed within the tank so that it will be well protected from injury; there is no connection between the air storage compartment and the carburetor. In order that there may be no liquid gasoline carried through with the gas, the carburetor is packed with an absorbent material, consisting of cotton wicking made up in the form of cartridges which fit tightly in the carburetor with baffle plates between them. Each baffle plate has an opening at the outer edge for the passage of the gas and the arrangement is such that the holes in adjoining plates are on opposite sides of the carburetor, thus causing the air to pass through every part of the carburetor and become thoroughly saturated with the gasoline vapor.

A topical discussion on the progress made and the present state of the art of car lighting will be found in the 1902 M. C. B. Proceedings, page 312. Other reports will be found in the 1903 Proceedings, page 294; 1910 Proceedings, page 484; 1911 Proceedings, page 338; 1912 Proceedings, page 327; 1913 Proceedings, page 511; 1914 Proceedings, page 329; 1915 Proceedings, page 423; and 1916 Proceedings, page 376. Part of these specifications were adopted as Standard in 1917.

In 1918 sizes of ball bearings for axle generators were adopted as Recommended Practice.

Revisions were made in 1920; in 1922 the Committee made a report giving particular attention to direct-drive for axle generators and electric lamps. Descriptions of direct drive as presented by the committee are given on pages 905-907; the report on axle generators and lamps reads in part as follows:

The committee recommends that paragraph 6 i. 1 read as follows, the words in parentheses being those eliminated from the present text:

"6 i. 1. With the battery discharging and with the battery voltage 31 volts or less, the drop in voltage across the terminals of the lamp regulator resistance shall not exceed 1 volt—per 25 amperes flowing—for the connected lamp load."

6 i. 2. Gives voltage limits for a current value to be specified by the railroad company and recommends that this value be 125 per cent of the connected lamp load. As there is no necessity for specifying a load greater than will be encountered in service, the committee recommends: that paragraph 6 i. 2 should read as follows, the words in parentheses being those eliminated from the present text:

"6 i. 2. With armature r. p. m. increasing at approximately uniform rate from minimum full load speed to maximum speed in not more than five minutes and again decreasing to its original value, the voltage shall be maintained at . . . . volts plus or minus one volt—at any current value not exceeding . . . amperes—at any current value equal to or less than the connected lamp load."

Present recommended practice shows only limiting dimensions of two sizes each of two types of bulbs, i. e., "G" bulbs in 18½ and 30 sizes, and "S" bulbs in 17 and 19 sizes.

This information does not fully describe the lamps, and, as the type "C" lamp has now been developed—and with it a new style of bulb—the committee presents a full schedule of train lighting lamps divided into two portions—a standard or regular schedule and a special or intermediate schedule.

Table I covers standard or regular schedule tungsten train lighting lamps as listed by the manufacturers. Table II covers the special or intermediate schedule of lamps that are available but not regularly listed.

The straight side or "S" type bulb is recommended in place of the round or "G" bulb because of its lower cost. The 50-watt PS-20 tungsten gas filled or "C" lamp—a comparatively new development—provides 50 per cent more illumination without increase in current consumption and is recommended in place of the vacuum lamp.

Figs. 2279 and 2280 show the dimensions and shapes of the different styles of bulbs.

TABLE I.

STANDARD OR REGULAR SCHEDULE

Size in Watts.	Voltages.	Type and Size of Bulb.	Vacuum (B) or Gas Filled (C).
10	30–34	S–17, G–18½	B
15	30–34	S–17, G–18½	B
25	30–34	S–17, G–18½	B
50	30–34	S–19, G–30	B
50	30–34	PS–20	C
75	30–34	PS–22	C
100	30–34	PS–25	C
15	60–65	S–17, G–18½	B
25	60–65	S–17, G–18½	B
50	60–65	S–19, G–30	B
75	60–65	PS–22	C
100	60–65	PS–25	C

TABLE II.

SPECIAL OR INTERMEDIATE SCHEDULE

Size in Watts.	Voltages.	Type and Size of Bulb.	Vacuum (B) or Gas Filled (C).
15	30–34	PS–16	C (Diffusing Bulb)
20	30–34	S–17, G–18½	B
25	30–34	PS–16	C (Diffusing Bulb)
50	30–34	PS–20	C (White Bulb)
100	30–34	PS–25	C
15	60–65	S–17, G–18½	B
25	60–65	S–17, G–18½	B
50	60–65	S–19, G–30	B
75	60–65	PS–22	C
100	60–65	PS–25	C

The committee believes that the following sizes will meet the general requirements of train lighting service, and that the railroads should confine their demands to these as far as possible.

Size in Watts.	Voltages.	Type and Size of Bulb.	Vacuum (B) or Gas Filled (C).
15	30–34	S–17	B
25	30–34	S–17	B
50	30–34	PS–20	C
75	30–34	PS–22	C

Passenger Train Lighting

Standard—ADOPTED, 1917; REVISED, 1920.

I. GENERAL.

1. *System Voltages.*—(a) In electrically lighted cars the following voltages should be used:

(b) Sixty volts (nominal) for straight storage and head-end systems.

(c) Thirty volts (nominal) for straight storage and axle-generator systems. (Individual cars.)

II. GENERATOR.

5. *Mounting.*—When facing the end of the truck on which the axle pulley is mounted, the generator pulley or sprocket shall preferably be on the right of the generator.

6. *Axle Pulley and Bushing.*—(a) A straight pulley seat shall be provided for the axle pulley.

(b) If a bushing be used, it shall preferably be secured to the axle independently of the pulley and have an external diameter throughout its length of 7½ in. and be not less than 8½ in. long.

(c) The hub of the axle pulley shall have a uniform internal diameter of 7½ in.; the length of the hub shall be 6½ in.

(d) The diameter of the axle pulley shall be as large as the construction of the car will permit, preferably 21 in. or 17 in.

9. *Size of Ball-bearings.*—On all truck-supported, ball-bearing axle generators the bearing shall be the size known commercially as No. 412.

III. BATTERIES.

10. *Design of Battery Boxes.*—(a) Battery boxes shall have interior dimensions at least as great as below:

Height in clear, 21½ in. Depth, front to back, 2 ft. 1 in.

Length of compartment to hold two standard double compartment trays, 22⅝ in.

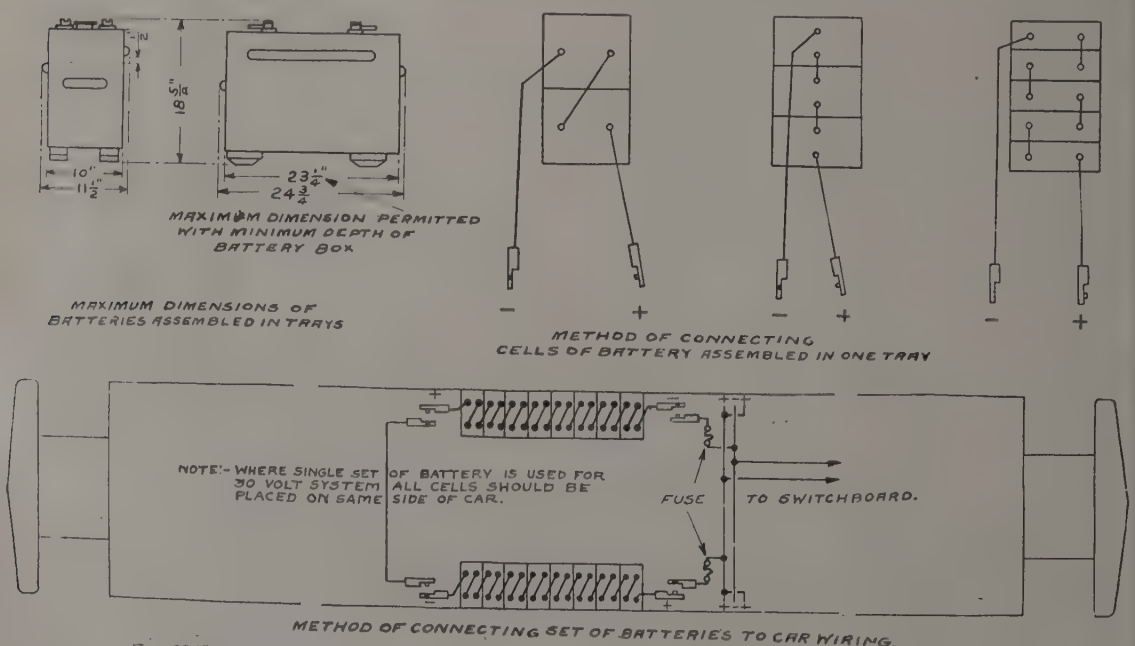

2"
10 5/8"
10"
11½"
23¼"
24¾"
MAXIMUM DIMENSION PERMITTED WITH MINIMUM DEPTH OF BATTERY BOX
MAXIMUM DIMENSIONS OF BATTERIES ASSEMBLED IN TRAYS
− +
− +
− +
METHOD OF CONNECTING CELLS OF BATTERY ASSEMBLED IN ONE TRAY
NOTE:- WHERE SINGLE SET OF BATTERY IS USED FOR 30 VOLT SYSTEM ALL CELLS SHOULD BE PLACED ON SAME SIDE OF CAR.
FUSE
TO SWITCHBOARD.
METHOD OF CONNECTING SET OF BATTERIES TO CAR WIRING.

FIG. 2265—BATTERY BOX DIMENSIONS AND METHOD OF CONNECTING BATTERIES TO CAR WIRING.

Length of compartment to hold four standard double compartment trays, 3 ft. 9¼ in.

(b) Battery boxes with two compartments, each 22⅝ in. long, or with one compartment 3 ft. 9¼ in. long, shall be designed to carry a battery weight of not less than 1600 lb.

(c) Battery boxes with four compartments, each 22⅝ in. long, or two compartments, each 3 ft. 9 ¼ in. long, shall be designed to carry a battery weight of not less than 3200 lb.

(d) That in all battery-box designs two angle irons or

straps shall extend longitudinally under the battery box located so that in case of a defective battery-box floor the trays will be supported by the said angle irons or straps. The angle irons or straps shall be attached to the car body independently of the battery box and shall be of sufficient strength in all parts to safely support the weight of battery as given in paragraphs 10 (b) and (c); plus the weight of the battery box. The angle irons or straps shall be so installed that they can be readily inspected. A construction equal to the above in strength and safety will be allowed.

12. *Trays.*—Storage batteries for car-lighting service shall be assembled in trays whose maximum dimensions shall not exceed those given on Fig 1 when used in battery box having minimum dimensions given in paragraph 10 (a).

13. *Connections.*—(a) That where two or more cells are assembled in one tray, the connections and arrangements of battery terminals shall be as in Fig. 2265.

(b) The connections between the terminals of the battery and car wiring shall be made with a connection as shown in Fig. 2265.

(c) When the Westinghouse type connector is used to connect battery to car wiring, it shall be installed as follows: At the positive terminal of the battery the male end of the connector shall be attached to the positive battery terminal lead and the female end to the car wiring. At the negative terminal of the battery the reverse connections shall be made.

(d) That each set of batteries shall be connected so that, facing the battery box, the positive terminal is at right, as shown in Fig. 2265.

14. *Charging Receptacles for Batteries.*—(a) That each electrically lighted car equipped with batteries shall be provided with two charging receptacles, as shown in Fig. 2166 so as to receive plug shown in Fig. 2266.

(b) These receptacles shall have swivel supports, as shown in Fig. 2266.

(c) These swivel supports shall be installed one on each side of the car as shown in Fig. 2265.

(d) The outer annular contact shall be connected to the positive terminal of the battery, as shown in Figs. 2265 and 2266.

IV. Wiring.

16. *Terminals, Arrangements and Identification.*—(a) The terminal connections of the generating, regulating and controlling apparatus shall be marked for identification and polarity.

(b) The positive terminals shall be at the right, when facing the board (if terminals are arranged horizontally) and at the top (if arranged vertically).

19. *Switchboards.*—(a) That each electrically lighted car shall be provided with a switchboard, upon which shall be mounted the necessary switches, fuse contacts and terminal connections.

(b) The switches and terminal connections shall be so arranged as to disconnect (when opened), and the fuses to protect the following parts, if same be used:

(1) Train line. (2) Battery. (3) Axle generator. (4) Main light switch or fuses. (5) Circuit for lamps, fans, etc.

(c) Each of the above switches or fuse contacts shall be plainly marked, designating the part controlled or protected.

(d) The terminals for the axle generator at the generator regulator panel shall be arranged so that, when open,

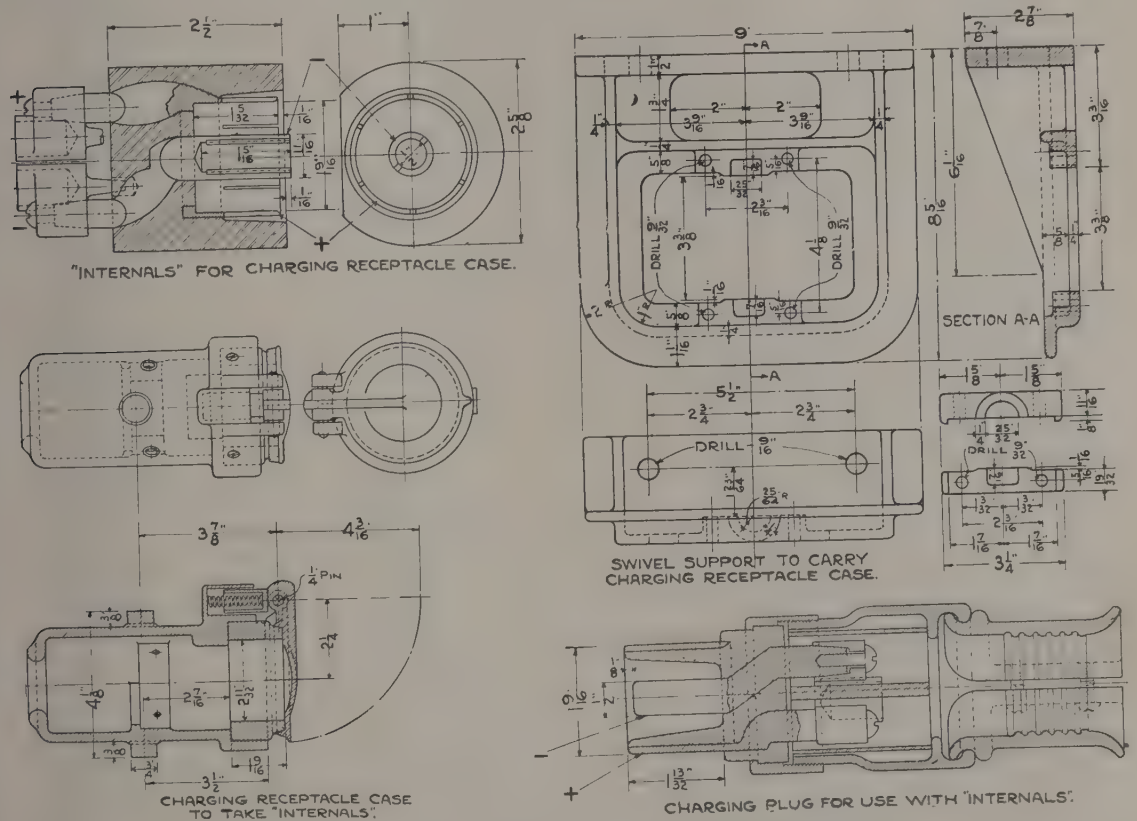

"INTERNALS" FOR CHARGING RECEPTACLE CASE.
SECTION A-A
SWIVEL SUPPORT TO CARRY CHARGING RECEPTACLE CASE.
CHARGING RECEPTACLE CASE TO TAKE "INTERNALS".
CHARGING PLUG FOR USE WITH "INTERNALS".

Fig. 2266—A. R. A. Standard for Charging Receptacles and Plugs.

they shall disconnect the positive and negative armatures and one side of the field circuit.

20. *Fuses for Wiring, Etc.*—(a) The switchboards or regulator panels of electrically lighted cars shall be provided with fuses for protection of parts given below:

(1) Train Line.—Contacts for use with open link fuses shall be provided substantially as shown in Fig. 2267, Edison screw-shell type of fuse, as shown in Fig. 2267.

(5) Axle Generator.—The positive armature to have fuse contacts suitable for a 150-ampere knife-blade, N. E. Code fuse, with a 4-in clearance space between contacts as shown in Fig. 2267.

(6) The use of a fuse in the field circuit is optional. If used, the contacts shall be suitable for a 0 to 30 ampere,

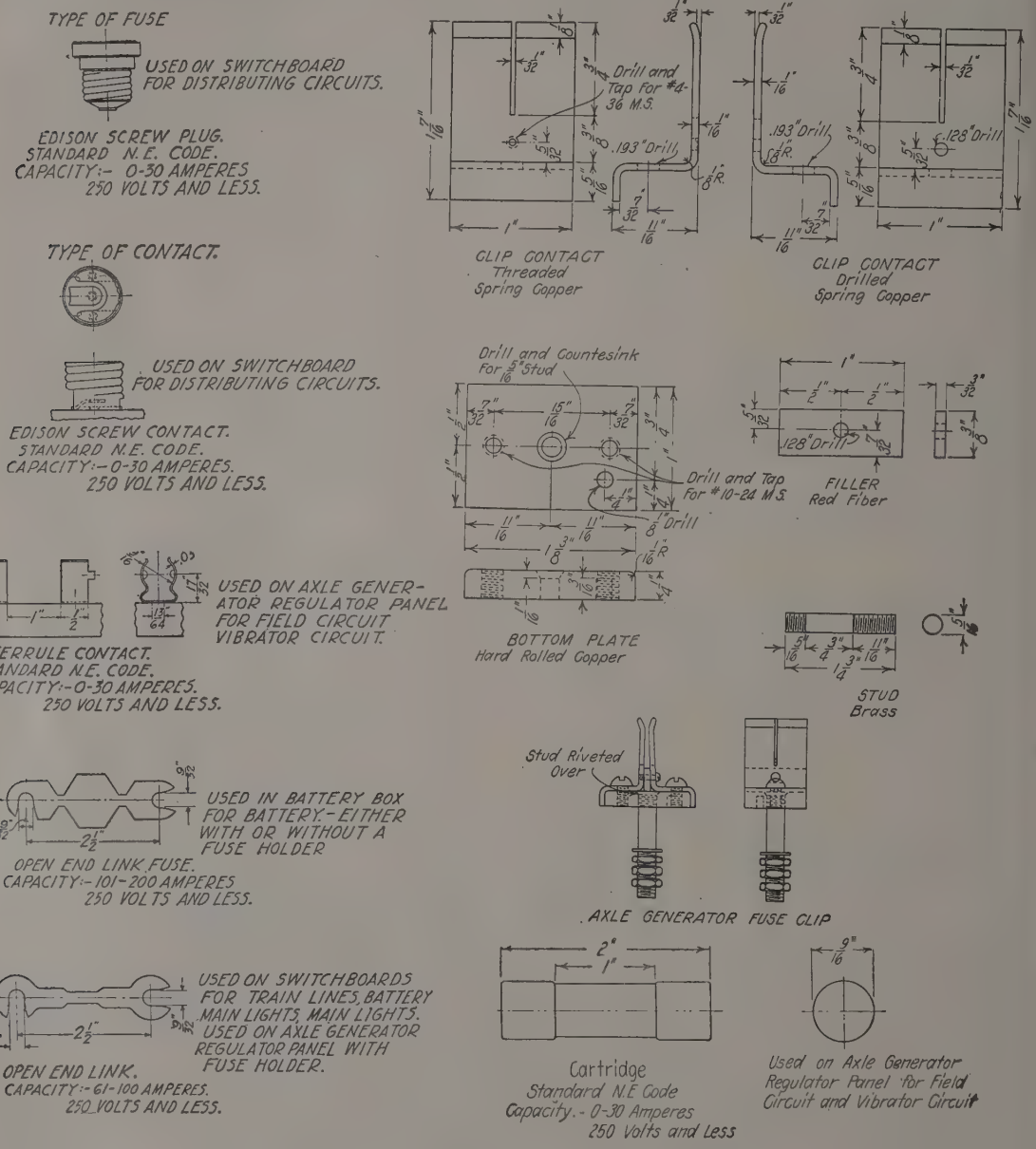

TYPE OF FUSE
USED ON SWITCHBOARD FOR DISTRIBUTING CIRCUITS.
EDISON SCREW PLUG. STANDARD N.E. CODE. CAPACITY:- 0-30 AMPERES 250 VOLTS AND LESS.
TYPE OF CONTACT.
USED ON SWITCHBOARD FOR DISTRIBUTING CIRCUITS.
EDISON SCREW CONTACT. STANDARD N.E. CODE. CAPACITY:-0-30 AMPERES. 250 VOLTS AND LESS.
USED ON AXLE GENERATOR REGULATOR PANEL FOR FIELD CIRCUIT VIBRATOR CIRCUIT.
FERRULE CONTACT. STANDARD N.E. CODE. CAPACITY:-0-30 AMPERES. 250 VOLTS AND LESS.
USED IN BATTERY BOX FOR BATTERY.- EITHER WITH OR WITHOUT A FUSE HOLDER
OPEN END LINK FUSE. CAPACITY:-101-200 AMPERES 250 VOLTS AND LESS.
USED ON SWITCHBOARDS FOR TRAIN LINES, BATTERY MAIN LIGHTS, MAIN LIGHTS. USED ON AXLE GENERATOR REGULATOR PANEL WITH FUSE HOLDER.
OPEN END LINK. CAPACITY:-61-100 AMPERES. 250 VOLTS AND LESS.
Drill and Tap for #4-36 M.S.
.193" Drill
CLIP CONTACT Threaded Spring Copper
.128" Drill
CLIP CONTACT Drilled Spring Copper
Drill and Countersink For 5/16" Stud
Drill and Tap For #10-24 M.S.
BOTTOM PLATE Hard Rolled Copper
FILLER Red Fiber
STUD Brass
Stud Riveted Over
AXLE GENERATOR FUSE CLIP
Cartridge Standard N.E Code Capacity.- 0-30 Amperes 250 Volts and Less
Used on Axle Generator Regulator Panel for Field Circuit and Vibrator Circuit

FIG. 2267—PLUGS AND CONTACTS FOR CAR LIGHTING SYSTEM.

the stud or screw to be ¼ in. in diameter, with twenty threads per in. set on 2½-in. centers.

(2) Battery.—Use of fuse optional. If fuse be used, the fuse and fuse contacts shall be same as for train line.

(3) Main Light Switch.—Use of fuse optional. If fuse be used, the fuse and fuse contacts shall be the same as for train line.

(4) Circuits.—For the distribution circuits to the lamps, fans, etc., the fuse and fuse receptacle shall be of the ferrule type, N. E. Code fuse, with 1 in. clear space between contacts as shown in Fig. 2267.

(b) All fuses on cars shall be used in the location and shall conform to the dimensions as shown in Fig. 2267.

(c) The capacity of the fuses used in the above contacts shall be such as to protect the apparatus in question.

21. *Installation of Conduit and Wire.*—The following rules shall be used for car wiring:

(a) *Conduit.*—All conduit shall conform to the require-

ients of the National Electrical Code, except that minimum ize of ⅜ in. may be used. It shall, wherever possible, be un on the interior of the car, but not exposed to view. Ends of conduit shall be cut square and the interior reamed mooth, the contour of the material from the inner to the uter wall at the ends being approximately a quarter circle. Conduits shall not "butt" in couplings. Where threads on onduit are exposed, they shall preferably be red or white eaded and painted. The conduit shall be of such size and o arranged that the wires may be pulled in after the car s completed and pulled out for repairs without it being ecessary to remove the interior finish of the car. Conduit ess than ⅜ in. shall not be used. Conduit and fittings hall be firmly and securely attached to the car body. The onduit system shall be so installed as to form a good, ontinuous electrical conductor and shall be grounded to the framework of the car. On steel or steel-underframe cars the supports of the conduit system will be considered as constituting an adequate ground. On wooden cars the conduit system shall be grounded by means of a copper wire of not less than No. 6 A. W. G., securely attached to the conduit and to some portion of the steelwork of the car that has an electrical connection with the rail, so as to form a good electrical connection at the point of attachment. The connections of the ground wire shall be exposed to view and easily accessible.

(b) *Fuse, Junction Boxes, Etc.*—Fuse, junction, outlet, connection and pull boxes exposed to the weather shall be of cast iron. The wall thickness at the bosses for the conduit shall be such as to insure at least five threads of the conduit are engaged and that the interior of the boss be rounded off so as to provide the equivalent of an outlet bushing. "Knock-out" boxes or pressed or formed steel boxes may be used when not exposed to the weather, and, when used, lock-nuts shall be used on the conduit on both sides of the box wall and an outlet bushing on the end of the conduit. Pull boxes shall be installed where, on account of the length of run or number of bends, it would otherwise be difficult to pull in the wires. Fuse boxes for the main battery fuses shall be installed as close to the terminals of the battery, both positive and negative, as possible. All boxes shall be so installed as to render the covers of same readily accessible. The covers of boxes exposed to the weather shall be applied in such a manner as to render the box "weatherproof."

(c) *Wire.*—All wires shall be insulated with Grade "A" (30 per cent Para rubber) insulation, if mineral base compound be used, according to the specification of the Association of Railway Electrical Engineers, or equivalent, and shall be double braided, or if a wax base compound be used, it shall be of a corresponding quality. No wire smaller than No. 14 A. W. G. shall be used, except for fixture work, where No. 18 A. W. G. is permissible. All wires shall be run in metal conduit. No wire shall carry, under normal operating conditions, a current in excess of the values permitted by the National Electric Code for the size of wire in question. Train line wires on cars intended for service on head-end system shall be No. 4/0 A. W. G. Train line wires on cars not intended for service on head-end system shall be No. 2 A. W. G. All wires of No. 8 or larger shall be stranded. Train line connection between cars shall be as follows:

Head-end System.—No. 2/0 A. W. G., 833 strands or more, 5-64 in. insulation and one braid.

Not for Head-end System.—No. 2 A. W. G., 133 strands or more, 4-64 in. insulation and one waterproof braid. The leads from the generator to the terminal connector on the car body shall be as follows:

Armature and Field Leads.—No 4 A. W. G., 61 strands, 4-64 in. insulation, two weatherproof braids.

(d) *Joints and Splices.*—The insulation shall be removed from the wire in such a manner that the wire shall not be cut, scored or nicked. All joints and splices shall be so made as to be both mechanically and electrically secure without the use of solder. All joints and splices shall be soldered; the soldering flux shall be free from acid. All wires joined or spliced shall be installed in such a manner that the joint or splices come in a junction box or fitting. Slack shall be left in wires at junction boxes and other outlets. Care should be taken that no sharp end of wire or solder is left to pierce the insulation and cause a ground. The joint or splice shall be covered with a rubber tape to the thickness of the original insulation, and this covered with friction tape to the overall diameter of the complete insulated wire.

Electric Train Lighting

Recommended Practice—ADOPTED, 1912; REVISED, 1920.

I. GENERAL.

2. *Descriptive Notices.*—That each electrically lighted car in steam service shall be provided with a notice located in or near the switchboard locker as follows:

A. B. & C. Railroad.
Description of Electric Light Equipment.
This car is lighted by ....V.... System.

	Gen.	Gen. Reg.	Lamp Reg.
Make			
Type			
Set for volts—max.			
Set for V. floating			
Set for amps. batty.			
Set for amps.—max.			

Pulleys.—Axle..in. dia...in. face;..in. depth of flange.
Armature ....in. dia. ....in. face.
Belt.—Length .... ft. .... in.: Width .... in.
Battery.—No. cells on car ....; No. sets in parallel ....
Amp. hr. capacity each set at 8 hr. rate. ....
Charging current each set .... normal, ...max.
Lamps.—Voltage. ....
Load.—Lights (including fans) .....amps.
Battery ..... amps.
Total ..... amps.
Train Line Wires.—No. .... (2 or 3). Size ....A. W. G.

3. *Clearances.*—(a) The axle-generator suspension shall be so designed that with car on level track the clearances shall be as great as possible, but not less than those specified below:

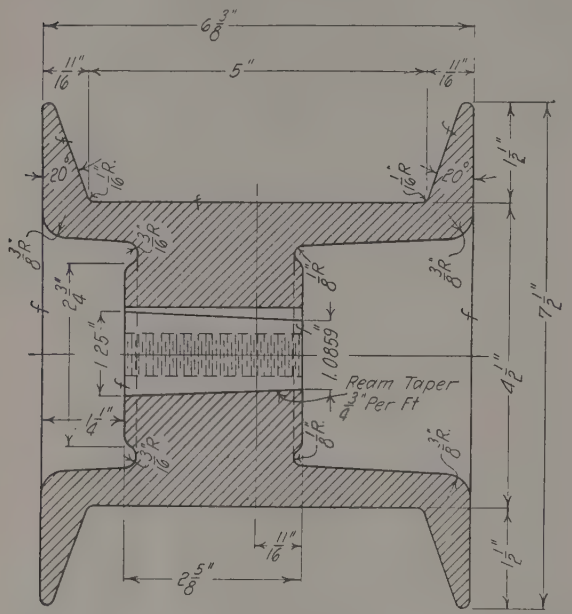
(b) From any part of the generator or suspension to the rail .....6 in

(c) On truck-suspended generators, from any part of the generator or suspension to the car body or any part attached thereto.....3½ in.

(d) With all parts of the car and axle generator, affecting the clearances, in the same condition as when new, with the minimum belt tension to drive load and with the generator in any service position with respect to the suspension and with the truck in any service position with respect to

the car body, the clearance from any part of the belt to

	End Sill		Brk. Beam.		To any other part car body
	Over. Inch.	Under. Inch.	Over. Inch.	Under. Inch.	or truck Inch.
Trk. Sprtd.....	1	1½	2½	1	½
Body Sprtd.....	1½	1½	3	1	1



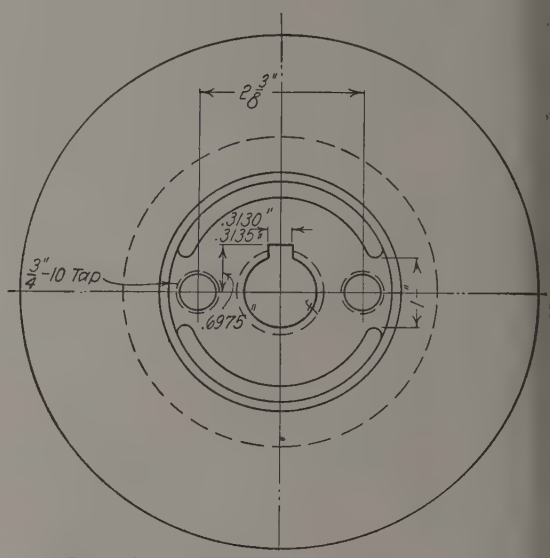


FIG. 2268—4½ IN. PULLEY FOR CONTROLLED SPEED GENERATOR.

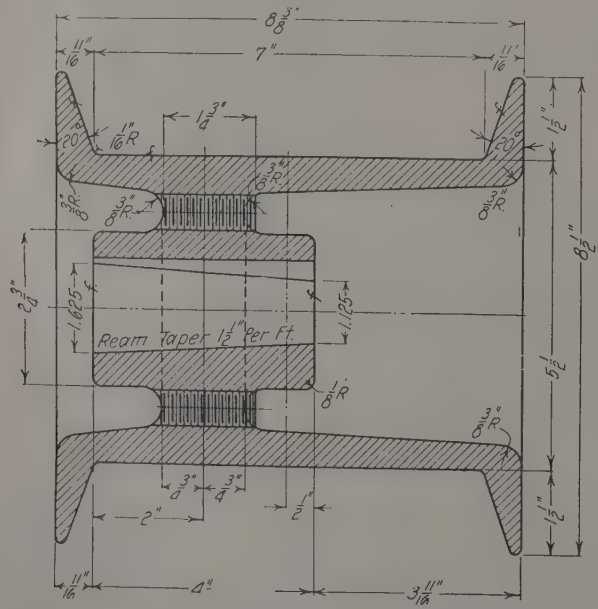
(e) With any or all parts of car and axle generator worn to the allowable limits and other conditions the same as in paragraph (d), from the belt to any part of the truck or car body.....½ in.

II. GENERATOR.

4. *Method of Testing to Determine Rating.*—(a) The generator, together with the generator and lamp regulator if used, shall be connected in a normal manner to dead load resistance in the battery and lamp circuit, and

(b) Shall be operated continuously for five hours, with commutator hand-hole covers removed, at the minimum r. p. m. that will generate rated volts at the load side of the generator regulator and carry the current, and that

(c) The net current output shall be the armature current



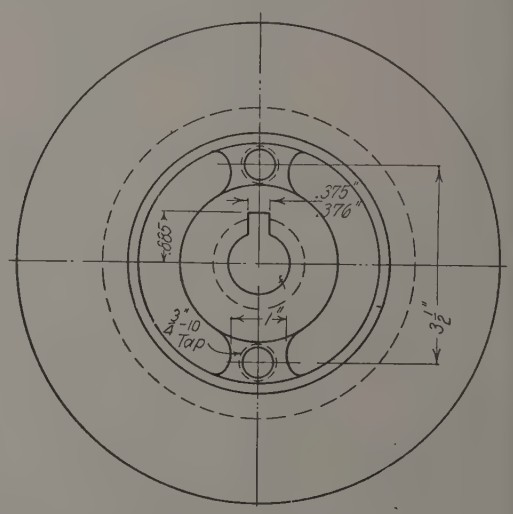


FIG. 2269—5½ IN. PULLEY FOR CONTROLLED SPEED GENERATOR.

NOTE.—As the question of obtaining the above clearances is essentially a problem of car and truck design, it is recommended that all car designers pay special attention to this feature. The chairman of this committee has been instructed to take this matter up with the other A. R. A. committees interested.

less all current consumed in the generator fields, generator regulator, and lamp regulator, if used.

4-A. *Rating.*—(a) The rating of an axle generator,

when connected and operated as above, shall be the maximum net current that the generator will carry without exceeding the following values:

	Maximum Observable Temperature	Maximum Observable Rise in Temperature
Any part of generator or regulators, except resistance units, carbon piles, commutator, brushes, brush rigging and bare copper solenoids.	105° C.	65° C.
Commutator, brushes, brush rigging, and bare copper solenoids.....	125° C.	85° C.

4-B. *Rating Test.*—The rating test shall be made at or above 15° C. ambient temperature.

5. *Badge Plate.*—A badge plate shall be securely attached to each axle generator which shall show the following:

(a) Manufacturer's name.

(b) Type number.

(c) Nominal voltage of generator (40 volts for 30-volt system and 80 volts for 60-volt system).

(d) Rating in amperes.

(e) Minimum full load speed in r. p. m.

(f) Pulley ratio —— : ——

6. *Suspensions.*—(a) In axle-generator suspensions, all supporting parts subject to wear shall have the wearing surfaces bushed.

(b) All axle generators provided with safety chains or an equivalent construction which will safely support the generator in case of failure of the suspension.

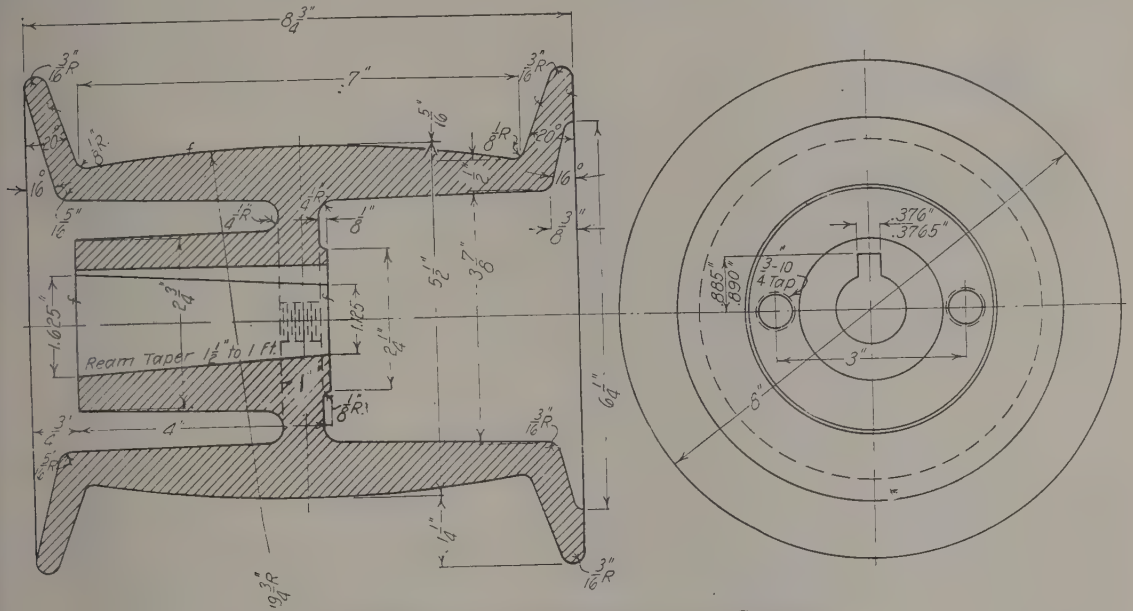


Fig. 2270—5½ in. Pulley for Free Speed Generator.

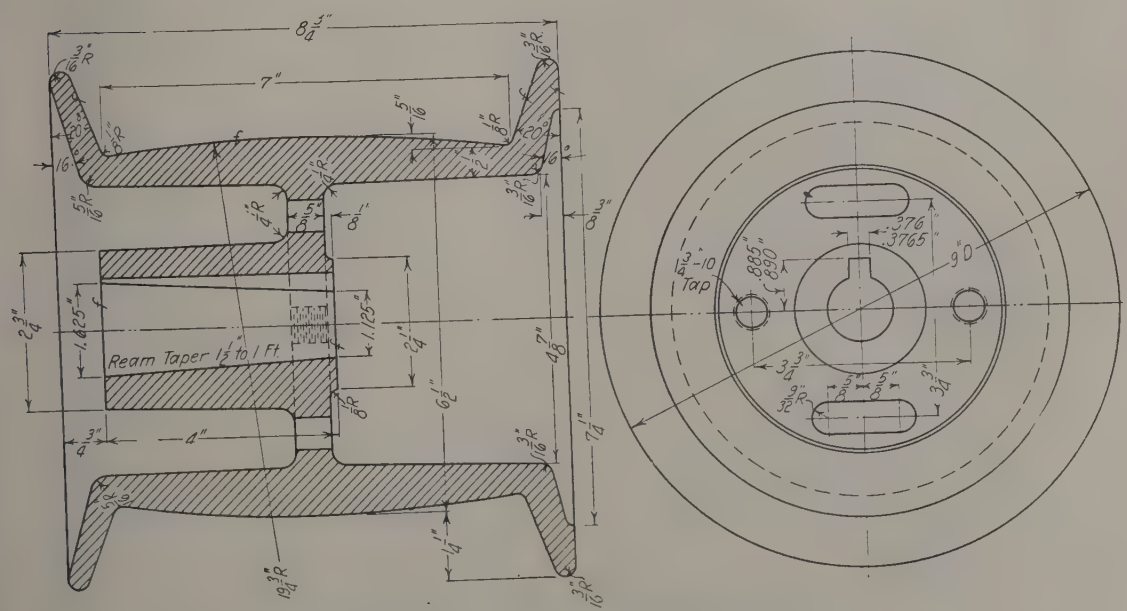


Fig. 2271—6½ in. Pulley for Free Speed Generator.

(c) In truck-supported axle generator suspensions, if side arms be used, the end to be secured to the truck frame shall extend under the transom and be secured to the side frame near the transom, and shall be securely attached to the end sill by a U bolt not less than ¾ in. in diameter, or a construction equivalent in strength.

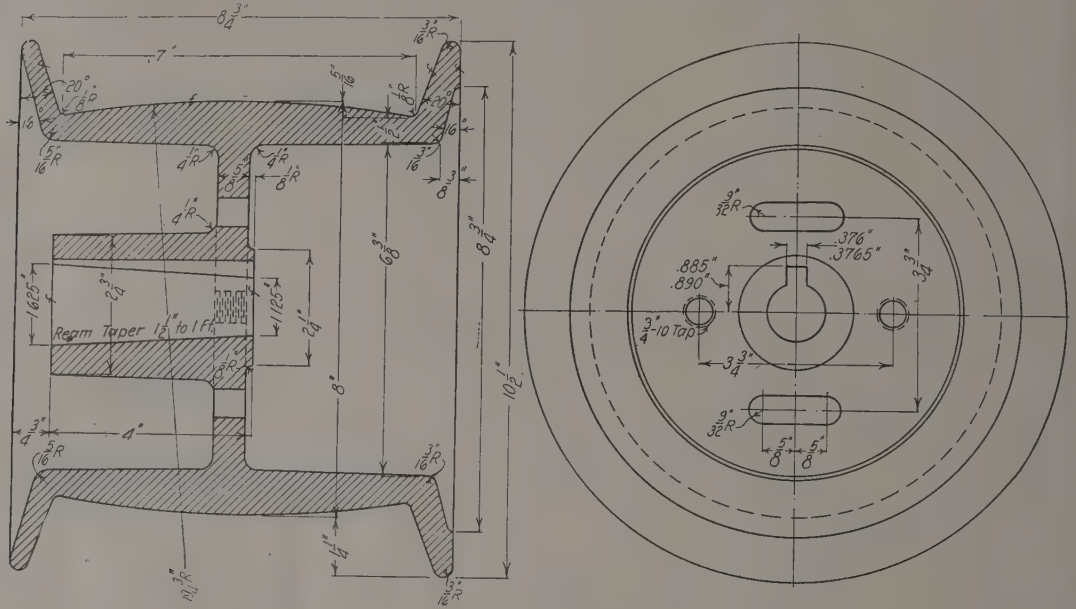


FIG. 2272—8 IN. PULLEY FOR FREE SPEED GENERATOR.

7. *Armature Pulley.*—(a) The armature pulley shall be flanged and crowned for "free speed" generators and flanged but not crowned for "controlled speed" generators.

(b) On all ball-bearing "free speed" axle generators, the armature pulley shall be in accordance with the dimensions as shown in Figs. 2270-2273.

(c) On all sleeve-bearing axle generators having armature pulleys 8 in. in diameter or larger, the armature pulley shall be in accordance with the dimensions as shown in Fig. 2276 on page 900.

(d) On all controlled speed axle generators, the armature pulley shall be in accordance with dimensions shown in Figs. 2268-2273.

8. *Armature Pulley Seat.*—(a) On all free speed ball-bearing axle generators the pulley end of the armature shaft and key shall be in accordance with the dimensions as shown at "A" in Fig. 2274.

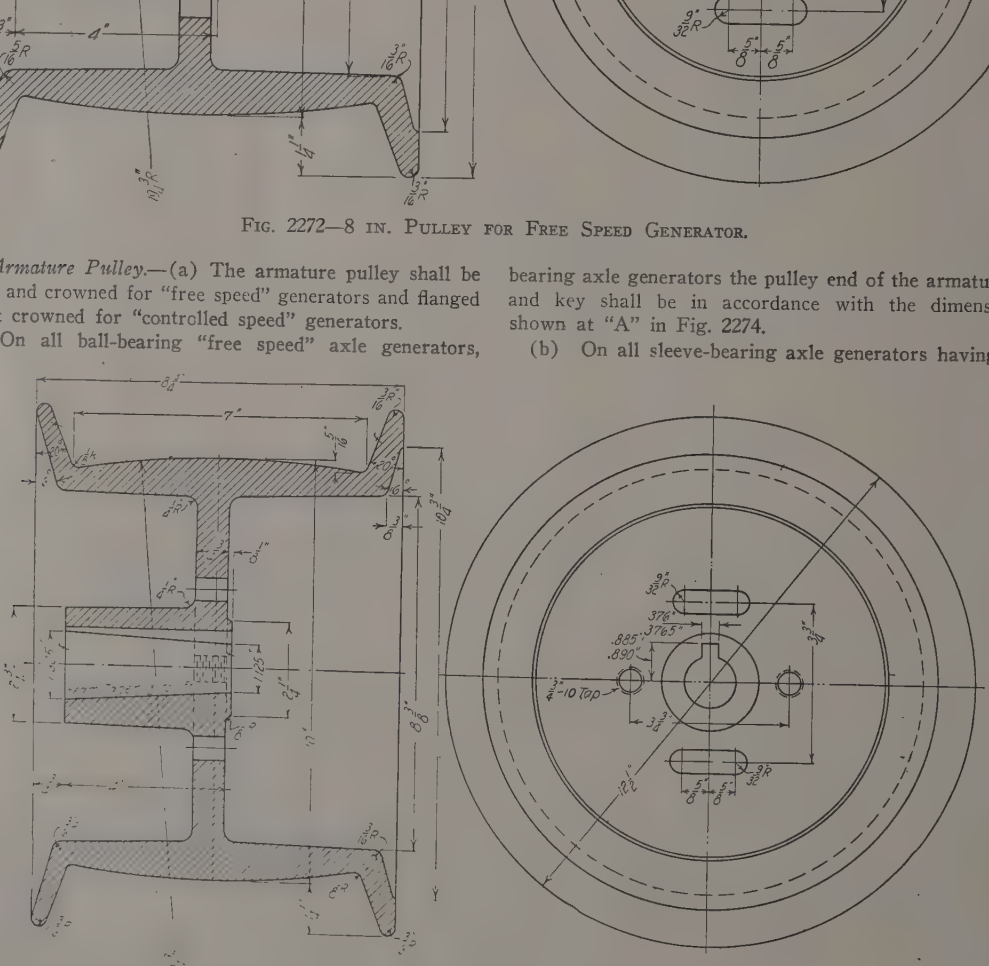


FIG. 2273—10 IN. PULLEY FOR FREE SPEED GENERATOR.

(b) On all sleeve-bearing axle generators having armature pulleys 8 in. in diameter or larger, the pulley end of the armature shaft and key shall be in accordance with the dimensions as shown at "B" in Fig. 2274.

(c) On all axle generators having armature shafts less

than 1½ in. in diameter at end of pulley seat, the pulley end of armature shaft and key shall be in accordance with the dimensions shown at "C" in Fig. 2274.

III. Batteries.

11. *Ventilation of Battery Boxes.*—(a) Each battery box shall be provided with adequate ventilation as follows:

(b) Inlet openings located on the longitudinal center line of the floor of the battery box, having a combined area of approximately 6 sq. in. for each 22⅝-in. compartment.

(c) Outlet openings located near the top of the battery box, having a combined area of approximately 6 sq. in. for each 22⅝-in. compartment.

15. *Fuses for Batteries, Etc.*—(a) That each electrically lighted car equipped with battery box or boxes shall be provided with suitable metal fuse boxes, said boxes to be mounted close to the positive and negative terminals of each set of batteries, as shown in Figs. 2265 on page 892 and 2276 on page 900.

(c) The fuse block shall be provided with contacts (1) To receive a link fuse (2) To receive a standard N. E. Code 150-ampere cartridge fuse, or (3) A fuse holder to receive a link fuse, (designed to replace the N. E. Code cartridge fuse) all as shown in Fig. 2267 on page 894.

IV. Wiring.

17. *Train Lines and Connectors.*—(a) Cars operated in head-end system trains shall be equipped with three train line wires of No. 4/0 A. W. G.

(b) Cars not operated in head-end system trains may be equipped with two train line wires of No. 2 A. W. G.

(c) All cars equipped with train lines shall have the wires terminate in train line receptacles as shown in Fig. 2278 on page 900 designed so that a standard train line connector equipped at each end with heads or plugs as shown in Fig. 2278 may be used.

(d) If only two wires are used, they shall be connected to the outside terminals, and the train line receptacle on each end of the car shall be stenciled: "NOT FOR USE ON HEAD-END SYSTEM"

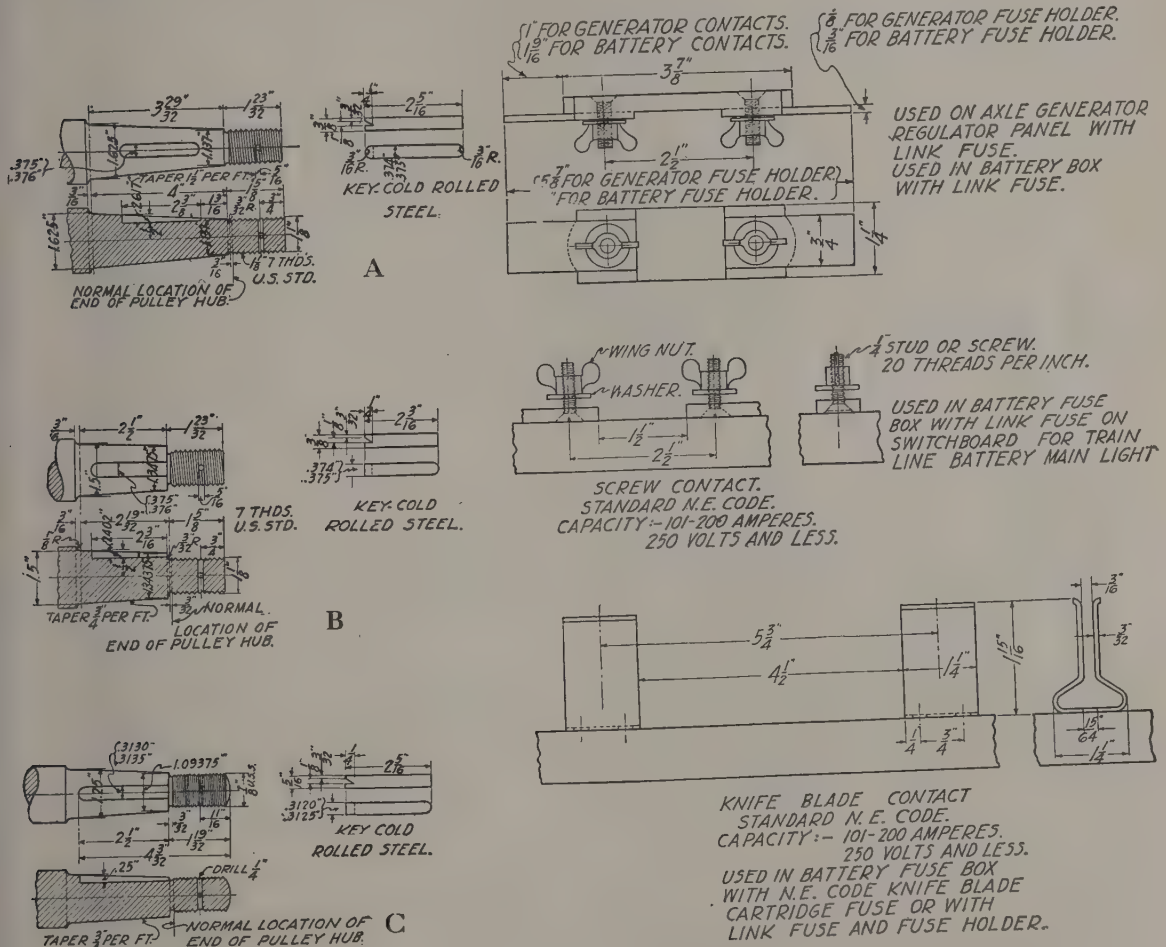


Fig. 2274—Armature Shaft Bearings.

⅛" FOR GENERATOR CONTACTS.
9/16" FOR BATTERY CONTACTS.
⅜" FOR GENERATOR FUSE HOLDER.
3/16" FOR BATTERY FUSE HOLDER.
USED ON AXLE GENERATOR REGULATOR PANEL WITH LINK FUSE.
USED IN BATTERY BOX WITH LINK FUSE.
⅜" FOR GENERATOR FUSE HOLDER.
7/16" FOR BATTERY FUSE HOLDER.
WING NUT.
WASHER.
SCREW CONTACT.
STANDARD N.E. CODE.
CAPACITY:- 101-200 AMPERES.
250 VOLTS AND LESS.
¼" STUD OR SCREW.
20 THREADS PER INCH.
USED IN BATTERY FUSE BOX WITH LINK FUSE ON SWITCHBOARD FOR TRAIN LINE BATTERY MAIN LIGHT
KNIFE BLADE CONTACT
STANDARD N. E. CODE.
CAPACITY:- 101-200 AMPERES.
250 VOLTS AND LESS.
USED IN BATTERY FUSE BOX WITH N.E. CODE KNIFE BLADE CARTRIDGE FUSE OR WITH LINK FUSE AND FUSE HOLDER.

Fig. 2275—Contacts and Fuse Holders.

(e) Where three train line wires are used, they shall be transposed, as shown in Fig. 2278.

(f) Where two train line wires are used, they shall be transposed, as shown in Fig. 2278.

(g) Train line connections in each car shall be made across battery and generator circuit.

18. *Generator Leads.*—The electrical connections between the axle generator and permanent wiring on the car shall be made in such a manner that the leads can not be transposed.

19. *Ball Bearings.*—Ball bearings used shall be of the annular ball type and of the size shown in the following table:

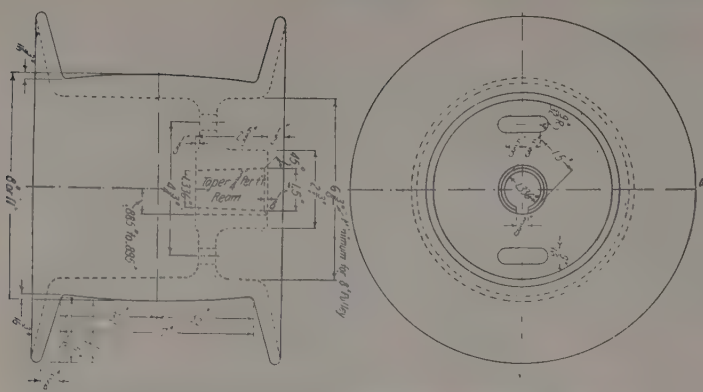

Taper 1" per ft.
Ream
Key Way
Air Inlet Holes 2" Diam.
Drill for 1/4" Stove Bolt-C.S. Head
Note Casting to be Covered With Heavy Coat of Black Gutta-Percha Asphaltum Before Applying to Box
For Steel Car
For Wood Car

Fig. 2276—Pulley for Free Speed Sleeve Bearing Generator

Fig. 2277—Battery Box Door and Ven

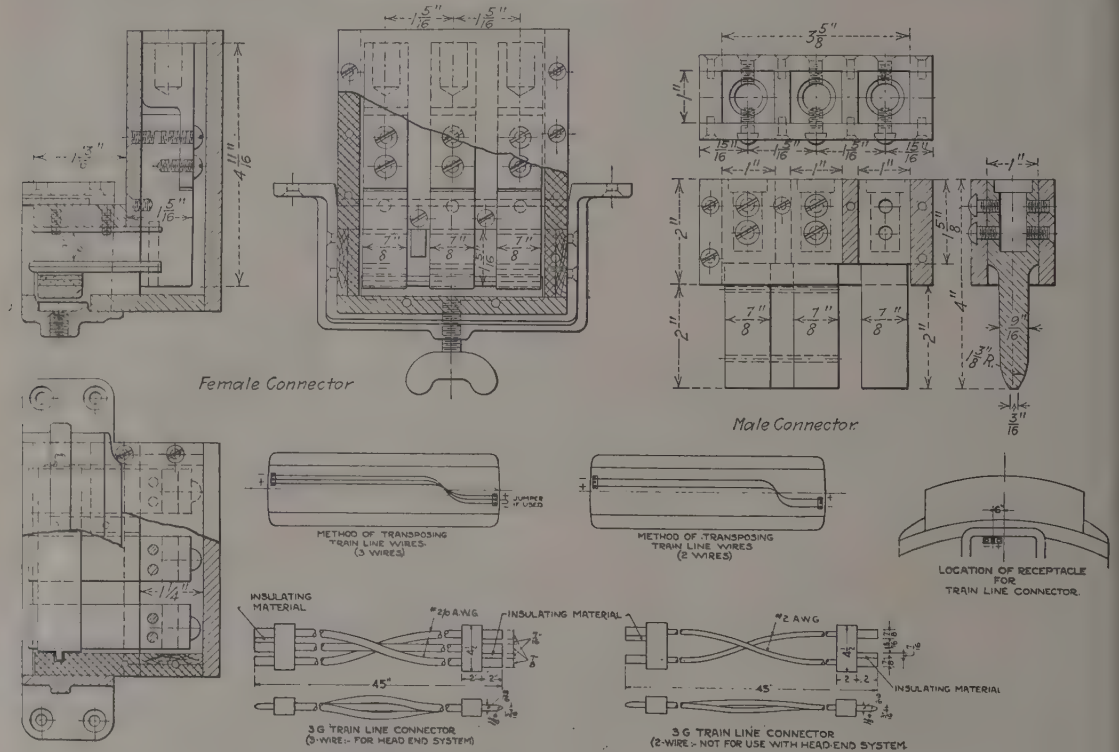

Female Connector
Male Connector
METHOD OF TRANSPOSING TRAIN LINE WIRES (3 WIRES)
METHOD OF TRANSPOSING TRAIN LINE WIRES (2 WIRES)
LOCATION OF RECEPTACLE FOR TRAIN LINE CONNECTOR.
INSULATING MATERIAL
#2 A.W.G.
45"
3 G TRAIN LINE CONNECTOR (3-WIRE:- FOR HEAD END SYSTEM)
3 G TRAIN LINE CONNECTOR (2-WIRE:- NOT FOR USE WITH HEAD-END SYSTEM.

Fig. 2278—Connectors for Train Line Wiring

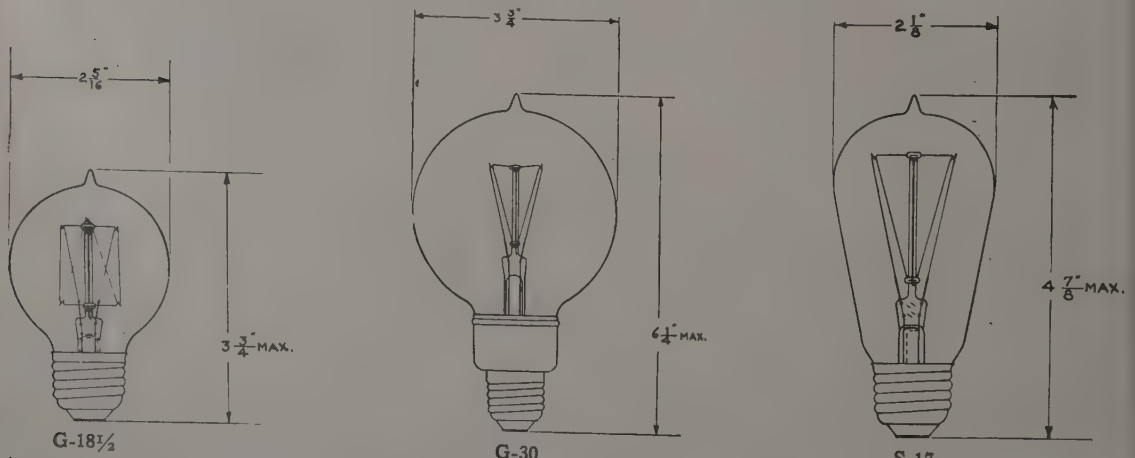


Fig. 2279—A. R. R. Recommended Practice for Electric Car Lighting—Lamps G-18½, G-30, S-17.

(j) Bearings shall be of the annular ball type and of the size specified as follows:

BODY SUSPENDED.

Truck Suspended		Width of Belt Required to Transmit Necessary Power									
		Free Speed.						Controlled Speed.			
		5 In.		4 In.		3 In.		4 In.		3 In.	
Pulley.	Comm.	Pulley.	Comm.	Pulley.	Comm.	Pulley.	Comm.	Pulley.	Comm.	Pulley	Comm.
412	412	412	*412	409	*409	407	407	312	312	307	307
...	...	...	†409	...	†407	...	...	...	†308	...	†304

*Preferred. †Alternate

IV. Lamps.

22. *Lamps.*—Standard lamps for car-lighting service shall be in accordance with the dimensions as shown on Fig. 000, A. R. A.

V. Axles.

23. *Dimensions at Pulley Fit.*—The dimensions of axles used in connection with car lighting axle driven generators shall be in accordance with A. R. A. standards.

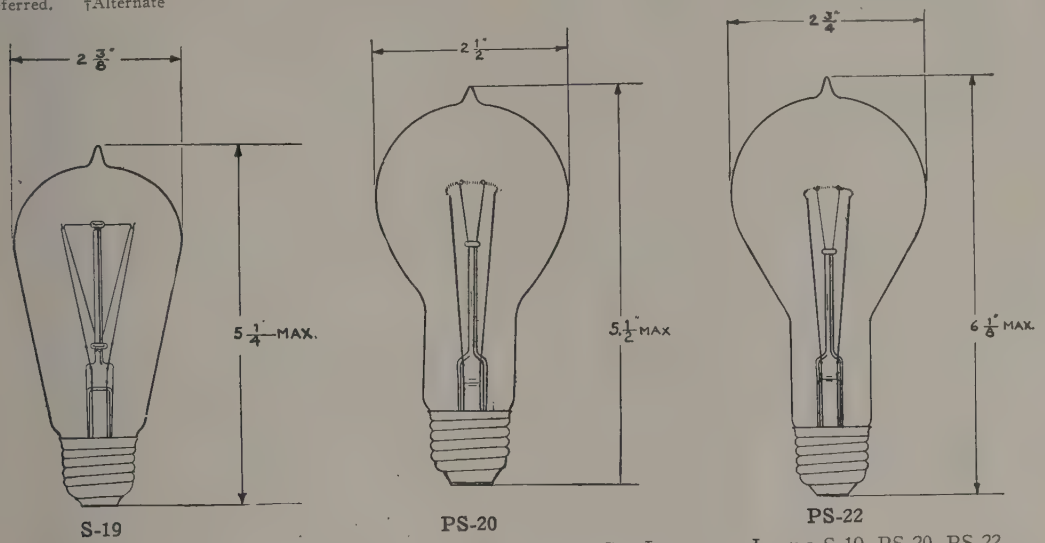


Fig. 2280—A. R. A. Recommended Practice for Electric Car Lighting—Lamps S-19, PS-20, PS-22.

Electric Train Lighting—Specifications for Axle Generators

Recommended Practice—adopted, 1920

1. *General.*—(a) This specification is intended to cover axle generator equipment for the A. B. and C. Railroad, delivery to be made f. o. b. manufacturers' works.

(b) Submission of bid will be understood to imply that the manufacturer fully understands and accepts the requirements imposed by, and will furnish apparatus which will comply with this specification.

(c) These axle generators are intended for service on cars having a total load, lamps, fans, etc., of.....amperes at 32 volts. Each car will be equipped with.....cells of battery of.....ampere hours capacity.

Note—The railroad company shall specify whether the lead-acid-lead or nickel-alkali-iron battery will be used.

(d) The generator shall carry full load at.....miles per hour. (For recommended values of minimum full load speeds, see below).

Class of Service.	Approximate Maximum Load Demand.	Ampere Hour Capacity of Battery		Ampere Capacity of Generator.	Minimum Full Load Speed M. P. H.
		Min.	Max		
Official, sleeping, parlor, mail and dining cars having heavy lighting loads, or severe operating conditions.....	50	350	600	100	26
Mail, dining cars, etc., where the lighting loads are not so heavy or the operating conditions so severe.....	35	300	350	75	26
Coaches, passenger-baggage cars, baggage cars under average operating conditions.	25	200	300	50	21
Same cars as next above operating in slow speed branch line or local service.....	25	150	225	50	16

(e) The material and workmanship shall be the best of their respective kinds.

(f) The accredited representative of the A. B. and C. Railroad shall be the sole judge, on all questions that are not capable of measurement and record, as to whether or not the apparatus complies with the specification.

(g) The apparatus to be furnished shall consist of:

Axle Generator.
Axle Generator Pulley.
Generator Leads.
Generator Lead Terminal Block (to be mounted on car body).
Generator Suspension.
Generator Regulator (with corner brackets).
Lamp Voltage Regulator (with corner brackets).
Axle Pulley.
Axle Pulley Bushing.
Belt and Fasteners.
Lamp Circuit Distributing Panel.

Note—Any item not desired shall be crossed out.

2. *Axle Generator.*—(a) The axle generator suspension lugs shall be of such design and cross section as to eliminate, as far as possible, liability to blow holes, bubbles or other manufacturing defects which may tend to weaken the material in the lug or section of frame adjacent to the lug.

The holes in the lug shall not be cored. The design and location of the lug shall be approved by the railroad company. Where there is movement of suspension links or pins in the lugs, the hole in the lugs shall be suitably bushed, the bushing being placed in the lug in such manner that it cannot be lost or move relative to the lug.

(b) The generator frame, pole pieces and end housings shall be machined so that all are in accurate alignment and

interchangeable from one generator to another of the same make, size and type.

(c) The end housings shall be machined for the ball bearings with allowance for fit as given below:

HOUSING FITS.

Bearing No.	Outside Diameter, In.			Allowance, In.	
	Nominal.	Maximum.	Minimum.	Maximum.	Minimum.
304	2.0473	2.0473	2.0465	+.0026	+.0008
307	3.1496	3.1496	3.1488	+.0026	+.0008
308	3.5433	3.5433	3.5425	+.0026	+.0008
312	3.1181	5.1181	5.1173	+.0030	+.0012
407	3.9370	3.9370	3.9362	+.0030	+.0012
409	4.7244	4.7244	4.7236	+.0033	+.0015
412	5.9055	5.9055	5.9043	+.0037	+.0015

Above allowances are based on a total tolerance of 0.0010 in. for housing bore.

(d) The armature shaft shall be annealed carbon steel having characteristics equal to or better than the following:

Carbon ..... 0.38 to 0.52 per cent.
Manganese ..... 0.40 to 0.75 per cent.
Phosphorus (not more than).... 0.05 per cent.
Sulphur (not more than)..... .. 0.05 per cent.
Tensile strength, lbs. per sq. in. (not less than) .... 80,000.
Yield Point, lbs. per sq. in. (not less than) 0.5 tensile strength.
Elongation in 2 in., per cent Inverse ratio, 1,800.000÷ tensile strength.
Elongation in 2 in. (not less than).....20 per cent.
Reduction in area (not less than).....32 per cent.

Reduction in area, per cent Inverse ratio, 2,800,000÷ tensile strength.

NOTE.—See specification annealed carbon steel.

(e) The armature shaft at the fits for the inner race of the ball bearings will preferably be ground to the diameter with allowable tolerances as given below for the size of ball bearing to be used.

SHAFT FITS

Bearing No.	Bore		Pressed Fit Allowance, In.			Sliding Fit Allowance, In.	
	Nominal	Maximum	Minimum	Maximum	Desired	Maximum	Minimum
304	0.7874	0.7876	0.7870	+.0011	+.0001 +.0003	—.0001	—.0011
307	1.3730	1.3782	1.3776	+.0012	+.0002 +.0005	—.0001	—.0011
308	1.5748	1.5750	1.5744	+.0012	+.0002 +.0005	—.0001	—.0011
312	2.3622	2.3624	2.3617	+.0015	+.0004 +.0007	—.0001	—.0012
407	1.3780	1.3782	1.3776	+.0013	+.0003 +.0006	—.0001	—.0011
409	1.7717	1.7719	1.7713	+.0014	+.0004 +.0007	—.0001	—.0011
412	2.3622	2.3624	2.3617	+.0017	+.0006 +.0010	—.0001	—.0012

Above allowances are based on a total tolerance of 0.0004 in. for draft diameter at fit.

Should the bearing be mounted on the shaft by means of an expansion device instead of a press or sliding fit, this expansion device shall be so constructed as to relatively secure the bearing to the shaft and to lock positively under any and all service conditions.

(f) The armature shaft for all axle generators at the pulley fit shall conform to the dimensions shown on Fig. 000 or 000, A. R. A.

(g) The armature shaft pulley nut shall be of the .....locking nut type. The face of the nut adjacent to the hub of the pulley shall be finished square with the axis of the thread.

(h) The armature, as a whole, shall be designed as a unit to permit the ready renewal of the shaft without disturbing any part of the winding.

(i) The commutator bars shall be hard-drawn, drop forged or cast-swedged copper with solid risers. The insulation between bars shall be high grade mica of such design and quality as will wear at the same rate as the bars. The commutator bars shall be insulated from the shell by built-up forms of high grade mica.

The commutator shall be thoroughly seasoned and securely fastened on the shell.

The armature conductors shall be of copper, insulated, preferably with American Institute of Electrical Engineers Class "B" insulation.

(j) Bearings shall be of the annular ball type of the size specified.

(k) One end bearing shall be mounted so that the bearing shall have approximately 0.01 in. play in the longitudinal direction of the shaft. The other end shall be mounted so that it shall have at least 1/16 in. play in the longitudinal direction of the shaft.

(l) The end housing shall have one or more circular U-shaped grooves machined in the bore through which the shaft passes; and felt washers, fitting the shaft snugly, shall be applied to the inner side of the commutator end housing and to both sides of the pulley end housing.

(m) The field coils shall be wound with copper, insulated, preferably with the Class "B" insulation of the American Institute of Electrical Engineers.

The field coils shall be form wound, impregnated with a suitable insulating compound to conform to established practices of electrical manufacturers, or thoroughly saturated by the dipping process with insulating material and then baked. The coils shall be covered with at least two layers of insulating tape laid with a half lap. The ends of each coil shall be marked to indicate the inner and outer ends of the coil. The coil shall be placed over the pole pieces and so held as to prevent positively any relative movement of the coil with respect to the pole piece.

(n) The mechanical clearance in the air gap shall be such that an oval feeler ½ in. wide and 0.05 in. thick can be passed at all points between the armature and pole faces.

(o) The pole changer shall be of such design as to throw completely, from one position to the other, in not more than ten revolutions of the armature shaft.

Truck Suspended		Body Suspended Width of Belt Required to Transmit Necessary Power									
		Free Speed						Controlled Speed			
		5 In.		4 In.		3 In.		4 In.		3 In.	
Pulley	Comm.	Pulley	Comm.	Pulley	Comm.	Pulley	Comm.	Pulley	Comm.	Pulley	Comm.
412	412	412	*412	409	*409	407	407	312	312	307	307
...	...	...	†409	...	†407	...	...	...	†308	...	†304

*Preferred. †Alternate.

Bearings shall conform to the following dimensions with the allowance and tolerance as given: (S. A. E. Standard).

Bearing No.	Inside Diameter, Inches			Outside Diameter, Inches			Width, Inches			Eccentricity Tolerance's, Inches	
	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Inner	Outer
304	0.7874	0.7876	0.7870	2.0473	2.0473	2.0465	0.5906	0.5906	0.5856	0.0006	0.0012
307	1.3780	1.3782	1.3776	3.1496	3.1496	3.1488	0.8268	0.8268	0.8218	0.0008	0.0012
308	1.5748	1.5750	1.5744	3.5433	3.5433	3.5425	0.9055	0.9055	0.9005	0.0008	0.0012
312	2.3622	2.3624	2.3617	5.1181	5.1181	5.1173	1.2205	1.2205	1.2155	0.0016	0.0016
407	1.3780	1.3782	1.3776	3.9370	3.9370	3.9362	0.9843	0.9843	0.9793	0.0008	0.0012
409	1.7717	1.7719	1.7713	4.7244	4.7244	4.7236	1.1417	1.1417	1.1367	0.0010	0.0016
412	2.3622	2.3624	2.3617	5.9055	5.9055	5.9043	1.3780	1.3780	1.3730	0.0010	0.0016

p) The armature pulley shall be.....in. in diameter accordance with A. R. A. Drawing No..... and ntended to be driven by a .... in. ..... ply belt from axle pulley .... in. in diameter.

q) Main generator and field leads shall be not less than in. long and shall consist of No. 4 A. W. G. cable of less than 61 strands, 4/64 in. wall of 30 per cent Para ber insulation, or equivalent, covered with two braids.

r) The generator shall be designed to generate rated tage (40 volts) at load side of generator regulator and carry full load, ... amperes (net current capacity, t is, total current generated, less all field, control and gulating current used in the generator, generator regu- or and lamp voltage regulator), at an armature speed t to exceed ..... r. p. m.

$$\frac{560}{60} \times \frac{\text{Diam. Axle Pulley} \times \text{Min. full load speed of car in miles per hour}}{\text{Diam. Armature Pulley}} = \text{r.p.m. of armature shaft.}$$

This value shall be known as the "minimum full load eed" in r. p. m. of the generator. (For recommended lues in miles per hour see table in Section 1-d.)

(s) The generator, with an armature r. p. m. of not ore than 75 per cent of the above speed, shall generate fficient voltage and current to close the automatic switch the voltage setting as given for same, this speed being nown as the "cutting in speed" in r. p. m.

(t) The generator shall be safe to operate both elec- ically and mechanically at an armature r. p. m. of

$$\frac{60}{0} \times \frac{.36}{33} \times \frac{\text{Diam. Axle Pulley} \times 75 \times \text{Factor of Safety } 1.2}{\text{Diam. Armature Pulley}} = \text{max. armature r. p. m.}$$

This value shall be known as the "maximum speed" in p. m. of the generator.

(u) At all speeds from cutting in to maximum speed, nd at all loads from zero to full rated net amperé capacity, ne generator shall operate without destructive or excessive parking at the brushes, and the armature and armature ulley shall rotate in good mechanical balance.

(v) The generator shall be capable of delivering rated et amperes within a range of 37 to 48 volts. (This re- uirement is not intended to conflict with the heat test.)

3. *Suspension.*—(a) The generators shall be ..... uspended. (The Railroad Company shall insert "truck" or body.")

(b) The suspension shall be in accordance with the fol- owing drawings of the A. B. and C. Railroad, which are ereby made a part of this specification, or they may be in ccordance with the manufacturers' standard if the railroad ompany so elect. (List drawings or cross out section ap- lying to same.)

4. *Belt Tension Device.*—(a) The belt tension device shall be in accordance with the following drawings of the A. B. and C. Railroad, which are hereby made a part of this specification, or they may be in accordance with the manufacturers' standard if the railroad company so elect. (List drawings or cross out section applying to same.)

5. *Generator Regulator.*—(a) The generator regulator panel shall be composed of a non-conducting, non-combus- tible material having a horizontal dimension of 16 in. and a thickness of at least ¾ in.

(b) The panel shall have four holes drilled in same for the supporting bolts. These holes shall be 7/16 in. in di- ameter and located 1 in. from the sides and 1 in. from the ends of the panel, giving a horizontal distance, center to center of these holes, of 14 in. (Should it be desired to use a corner bracket with the panel, same shall have the sup- porting bolt holes drilled 7/16 in. in diameter and so located that when mounted on the panel the horizontal distance between center of holes is 14 in. For attachment to the panel the corner bracket shall be drilled and tapped for a ⅜-in. bolt having 16 threads per in.)

(c) The terminals on the generator regulator panel shall be arranged so that, in a horizontal direction, the positive is at the right and in a vertical direction the positive is at the top.

(d) Each terminal shall be stamped for identification and polarity.

(e) There shall be included with the generator regulator panel, wire terminals for attachment of the wires to the panel terminals; these wire terminals being stamped to correspond to the panel terminals to which they are to be connected.

(f) The apparatus will, preferably, be so mounted on the panel that it may be removed and reapplied without it being necessary to remove the panel from its supports.

(g) The connections between the various pieces of ap- paratus on the panel shall be, so far as is possible, on the back of the panel and preferably soldered after final adjust- ment has been made.

(h) The panel shall be supported by four ⅜-in. bolts having 16 threads per inch.

(i) Fuses, fuse contacts and fuse holders shall conform to Figs. 000 and 000, A. R. A., for fuses, Figs. 000, 000 and 000 A. R. A., for fuse contact, Fig. 000, A. R. A., for use holder.

(j) The generator regulator automatic switch shall be set to close at any and all operating temperatures at not more than 34 volts, this voltage being attained by the gen- erator at not more than 75 per cent of minimum full load speed.

(k) The automatic switch must open and close without chattering, pumping, sticking, or excessive arcing.

(l) The generator regulating apparatus and battery pro- tective devices shall be of such design as to perform satis- factorily all the following functions:

1. Close the main circuit of the generator, by means of an automatic switch, in order to permit current to flow from the generator to the battery and lamps whenever the generator develops proper voltage.

2. Open the main circuit of the generator, by means of an automatic switch, in order to prevent the discharge of the battery through the generator when the r. p. m. of the armature has decreased to a point where its voltage is less than the battery voltage.

3. Automatically prevent the overloading of the generator.

4. Automatically control the rate of charge of the battery.

5. Automatically prevent overcharging the bat- tery either in amperes or ampere hours.

6. In case of open battery circuit the generator shall be able to carry the lamp load and the gen- erator regulator shall automatically prevent the rise in voltage upon the system exceeding 120 per cent of the rated generator voltage.

7. Means will preferably be provided whereby the adjustment of the regulator can readily be changed from the voltage and current suitable for a lead-acid-lead battery to the voltage and current suitable for a nickel-alkali-iron battery of the same ampere hour capacity, the voltage being capable of being varied independently in the latter case from 1.72 to 1.8 to 1.88 per cell to take care of tempera- ture conditions.

8. For any given condition of battery with any variations of speed at and above 150 per cent of minimum full load speed the regulator shall maintain regulation within 5 per cent, plus or minus, of the value for which the regulator is set for operation. This value to apply equally whether the type of regulation is potential, current, watts or any combination of same.

9. When submitting proposition, the axle generator manufacturers shall describe in detail the type of control of generator output and battery charging that they propose to furnish, submitting such curves as are necessary to afford a complete explanation.

NOTE.—Railroads may substitute for section 5-1 detailed specifications covering such type or types of regulation that they desire to consider, provided that the limits are not greater than those given in this specification.

6. *Lamp Regulator.*—(a) The lamp regulator panel shall be composed of a non-conducting, non-combustible material having a horizontal over all dimension of 16 in. and a thickness of at least ¾ in.

(b) This panel shall have four holes drilled in same for the supporting bolts. These holes shall be 7/16 in. in diameter and located 1 in. from the sides and 1 in. from the ends, giving a horizontal distance, center to center of these holes, of 14 in. (Should it be desired to use corner brackets with the panels, same shall conform to the requirements as given under "Generator Regulator.")

(c) The terminals on the panels shall be so arranged that, in a horizontal direction, the positive is at the right, and in a vertical direction the positive is at the top.

(d) Each terminal shall be stamped for identification and polarity.

(e) There shall be included with the lamp regulator panel, wire terminals for attachment of the wires to the panel terminals, these wire terminals being stamped to correspond to the panel terminals to which they are to be connected.

(f) All apparatus will preferably be so mounted on the panel that it may be removed and reapplied without it being necessary to remove the panel from its supports.

(g) The connections between the various pieces of apparatus on the panel shall be, so far as is possible, on the back of the panel and, preferably, soldered after final adjustment has been made.

(h) The panel shall be supported by four ⅜-in. bolts having 16 threads per inch.

(i) The lamp regulator shall be so designed that with the complete equipment operating in the normal manner, on bench test or in service, it will maintain the voltage across the lamp mains on the load side of the regulator under the conditions of test as specified below, within the following limits:

1. With the battery discharging and with the battery voltage 31 volts or less, the drop in voltage across the terminals of the lamp regulator, resistance shall not exceed one volt per 25 amperes flowing.

2. With armature r. p. m. increasing at an approximately uniform rate from minimum full load speed to maximum speed in not more than five minutes and again decreasing to its original value, the voltage shall be maintained at .... volts, plus or minus one volt at any current value not exceeding ..... amperes.

NOTE.—The railroad company shall fill in the blank spaces. The recommended value for the amperes is 125 per cent of the connected load.

3. With the armature r. p. m. held constant at any given speed between the limits of minimum full load speed and maximum speed, and with the current instantaneously varied by 5 ampere steps, both increasing and decreasing, the voltage shall be maintained at .... volts, plus or minus one volt.

4. Conditions 2 and 3 shall be complied with under any condition of charge of battery.

NOTE.—Insert value at which it is desired voltage shall be maintained

7. *Net Ampere Capacity.*—(a) The generator shall have a net ampere capacity of .... amperes. (Net ampere capacity equals total current generated less all current used by fields control, generator regulator and lamp regulator. For recommended values see Section 1-d.)

8. *Heat Test.*—(a) Connect the generator, generator regulator and lamp regulator (if used) in the normal manner, using rheostat or lamp bank in the battery and lamp circuits.

(b) Remove hand hole covers and operate generator continuously for five hours at the armature r. p. m. corresponding to minimum full load speed with the generator delivering continuously .... net amperes at 40 volts.

(c) Under the above conditions, and with temperatures measured by the thermometer method, no part shall at any time attain a temperature higher than the values given in the table.

	Insulation A. I. E. E. Classification			
	Class "A"		Class "B"	
Part of Apparatus	Maximum Observable Temperature, Degrees C.	Maximum Observable Rise in Temperature, Degrees C.	Maximum Observable Temperature, Degrees C.	Maximum Observable Rise in Temperature Degrees C.
Any part of generator regulator, except resistance units, carbon piles, commutator, brushes, brush rigging and bare copper solenoids...	105	65	125	85
Commutator, brushes, brush rigging and bare copper solenoids.....	125	85	125	85

(d) Bearings.—Maximum observable temperature 65° C.

(e) The net ampere capacity shall be determined by the maximum net amperes that can be generated without the above temperatures being exceeded.

9. *Insulation Test.*—(a) Immediately after the heat test all parts of the equipment shall withstand, without breakdown, an alternating potential of 1,000 volts, applied between conductors and ground, for a period of one minute, all metallic parts except conductors being grounded.

10. *Badge Plate.*—(a) Each generator shall have attached to it a badge plate on which the following information shall be shown:

1. Manufacturer's name.
2. Manufacturer's type and serial number.
3. Nominal voltage.
4. Rating in amperes.
5. Minimum full load speed in r. p. m.
6. Pulley ratio.

NOTE.—The railroad company shall specify whether these blanks are to be filled in with the actual pulley diameter which it is intended to use or with the pulley ratio, the diameter of the armature pulley being taken as one.

11. *Rejection.*—The A. B. & C. Railroad reserves the right to reject:

(a) Any equipment, or part thereof, that fails to comply

with the requirements of the specification when inspected at time of delivery.

(b) Any equipment, or part thereof, that is defective in any way (material, workmanship or details of design) which might reasonably have been overlooked when approving the plans.

(c) Any equipment, or part thereof, that is responsible for an excessive number of failures in service, or that is found to be defective in material or workmanship within one year of date of delivery.

12. *Patents.*—(a) The manufacturer shall insure the A. B. & C. Railroad against any and every loss arising from claim that the apparatus, as furnished, infringes patents not owned or controlled by the manufacturer and shall furnish the A. B. & C. Railroad, when requested, a satisfactory bond to cover such contingency.

13. *Guarantee.*—(a) The manufacturer shall correct, without charge to the A. B. & C. Railroad, any defect due to design, material or workmanship which develops within one year from date of delivery of the equipment.

14. *Data.*—(a) Dimension drawings in as full detail as may be necessary to afford thorough understanding of the equipment offered shall be submitted to and approved by the A. B. & C. Railroad before manufacture is begun.

15. *Shipment.*—(a) No equipment shall be shipped until same has been accepted by the A. B. & C. Railroad or inspection waived and shipment authorized.

NOTE.—The railroad company when requesting bids shall fill in all blanks indicated thus .....

Direct Drive Equipment

Efforts have been made to design an efficient positive or direct drive for axle generators and, while this type of apparatus has not yet been developed satisfactorily, there has been considerable progress made.

The advantages of such a form of drive are: Decreased liability of failure of drive, resulting in: Decreased liability of failure of light; less deterioration of battery—undercharging of battery on account of the belt slipping, and sulphating because of the battery becoming discharged and standing in that condition.

Decreased liability of having train detentions; and less liability of annoyance to passengers, from flickering of lights caused by belt slipping; and no failure of lights due to loss of belt.

Positive drive under all conditions of weather; elimination of belt tension devices; simplification of suspension with consequent reduction in first cost and cost of maintenance of these parts of the equipment.

The disadvantages of such a form of drive are: Increase in first cost of drive and in cost of application; increase in length of time of train detention when drive fails; and difficulty in testing generator by motoring. To be really successful, the direct drive should, in addition to its advantages over the belt drive, be capable of being operated at a total cost comparable with the cost of operating the belt drive.

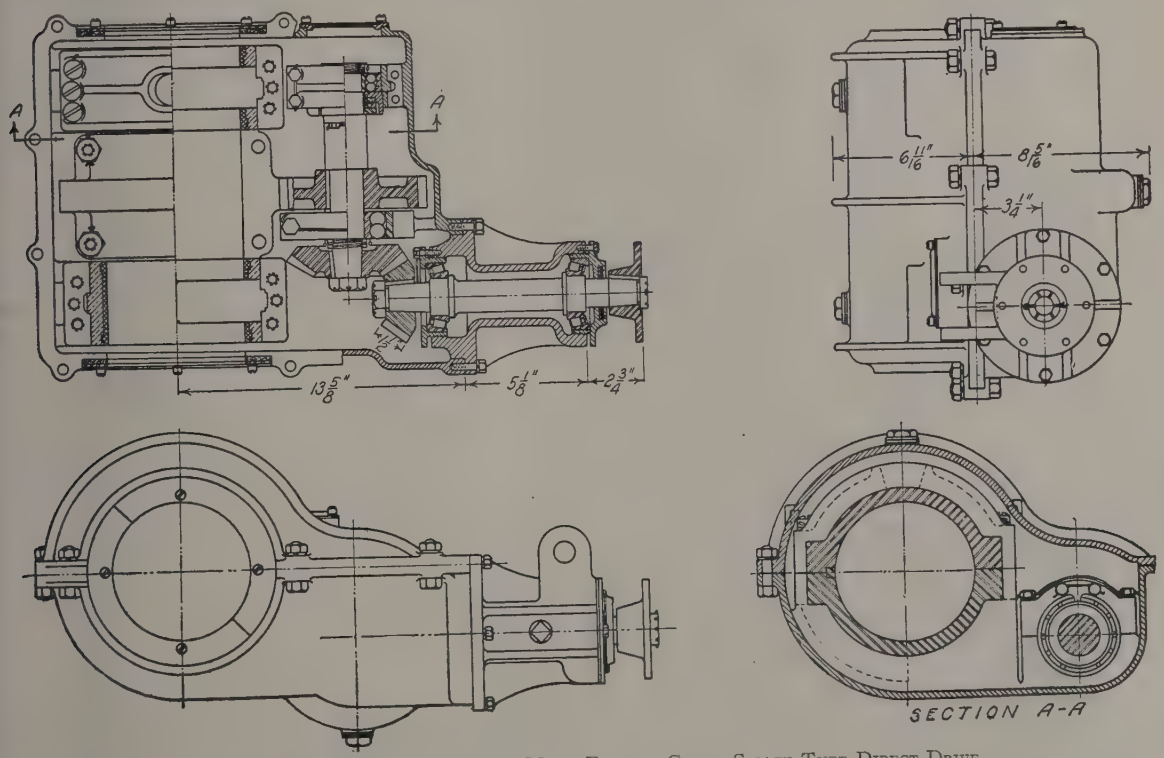


FIG. 2281—ASSEMBLY DRAWING OF MAIN PART OF GOULD SHAFT TYPE DIRECT DRIVE.

The "Gould" Shaft Drive

The "Gould" Shaft Drive, shown in Fig. 2281 requires the use of a special axle. A circular key ½ in. wide and ¼ in. high is machined on the axle midway between the two bearing fits 4½ in. long. A second key ½ in. by ½ in. and 5¼ in. long is fitted in the keyway cut in the axle parallel

with its axis. The first key acts to center the split gear on the axle and the second serves to drive the gear. The bearing fits on the axle serve as a seat for the gear box.

A 52-tooth spur gear mounted on the axle meshes with a 36-tooth spur pinion mounted on a shaft, which is parallel to the axle in the gear box and is carried on ball bearings. On this shaft is a 28-tooth bevel gear, meshing with a 20-tooth bevel pinion on a second shaft perpendicular to the

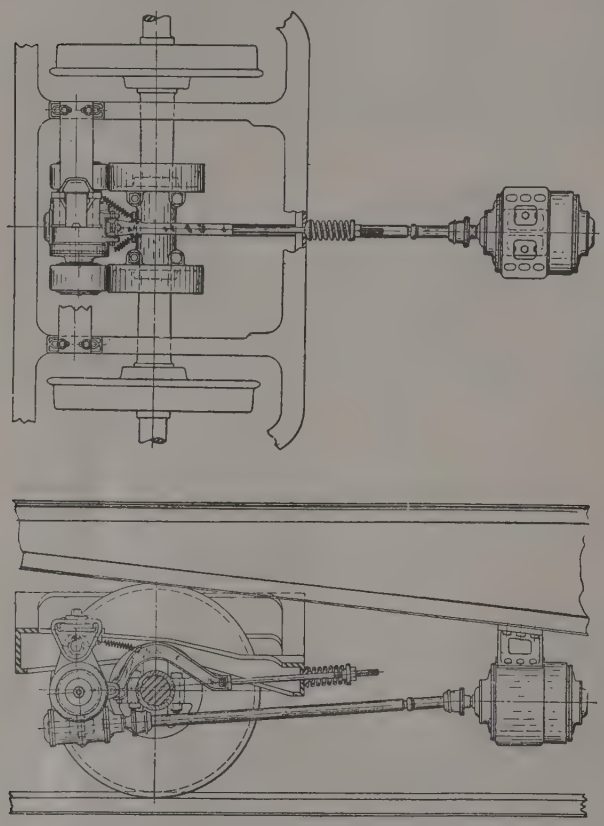


FIG. 2282—PLAN AND SIDE ELEVATION OF "U. S. L." DIRECT DRIVE.

axle. This second shaft serves to drive the gear. The bearings fits on the axle and at the outboard end carries one part of a universal coupling.

The gear box is split on the horizontal diameter of the axle and is prevented from turning by a member which connects the end of the gear box to the end frame of the truck.

A telescoping shaft, carrying on one end the balance of the first universal joint and on the other end a portion of a second universal joint, serves to transmit the power to the armature shaft.

Mounted on the armature shaft is a safety device consisting of a coupling carrying a shear pin so that if the generator becomes damaged in any way that will throw an excessive load on the drive, this pin will shear, permitting the drive to run free. This safety device also forms the balance of the second universal coupling. Disconnecting this safety device permits the generator to be operated as a motor for testing purposes.

The generator is mounted rigidly on the under frame of the car body with the armature shaft parallel with the longitudinal axis of the car.

Provision is made whereby the position of the bevel pinion can be adjusted so as to maintain the pitch lines of the bevel gears and pinion in contact.

"U. S. L." Drive

The "U. S. L." Drive, as shown in Fig. 2282, consists of a 17-in. split steel pulley secured to a standard car truck axle by means of through bolts.

These pulleys drive, by contact, two 10-in. pulleys or friction wheels which are made of rubber tires molded on steel rims, the rims being pressed on the center hub of the pulley; the tires are the standard tire as used on industrial automobile trucks.

The pulleys are mounted on the ends of a short shaft, parallel to the axle, this shaft being supported by two sets of ball bearings which are carried from housing pivoting about a horizontal cylindrical bar in a position approximately vertically above the pulley shaft.

The bar is supported by a steel casting mounted on a member which is supported by the truck frame; the casting is arranged so that it will pivot in a horizontal plane about a bolt, equalizing the pressure of the friction wheels on the pulleys.

At the center of the shaft carrying the friction wheels a worm wheel is mounted which meshes with a worm mounted on a second shaft perpendicular to the axle. The second shaft is also carried on the ball bearings which are mounted in a casting bolted to the casting forming the housing for the worm wheel.

This second shaft is connected by means of a universal joint to an extension shaft provided with a sliding joint, and this in turn is connected to the armature shaft by a second universal joint.

The worm shaft is connected to the shaft of the axle generator, which is mounted longitudinally under the car body by means of two universal couplings and an extension shaft with a sliding joint.

Pressure between the pulleys and friction wheels is assured by a bar, attached to the housing midway between the pulley, curved so as to pass over the axle. The bar extends beyond the end sill of the truck and has a thread cut on the end. Beyond the truck frame the bar passes through a helical spring and the pressure between the pulley and friction wheel is adjusted by the amount of compression that takes place in this spring.

This drive has been operating for some time in experimental service in the shop, but has never been used in service on the road.

"Safety Drive"

The "Safety" direct-drive consists of two axle bushings, mounted on the axle a little inside the wheel fit. Each bushing carries a collar to which eye bolts are secured. The eye bolts are connected by means of a helical spring, normally under tension, to a lug on a hollow shaft, the springs being approximately parallel with the longitudinal axis of the axle.

This hollow shaft has a sufficient internal diameter to permit the axle to move freely without fouling the shaft; the shaft is split and is supported at each end by the outer race-ways of four ball bearings, the inner raceways of which are mounted on short shafts carried by the gear housing.

The gear housing is split and is carried by seats turned

on each end of the hollow shaft, and is prevented from turning by lugs attached to cross bars fastened to the axle generator suspension irons.

Mounted on the hollow shaft is a split gear meshing with a pinion which is mounted on a short shaft parallel to the axle and carried on ball bearings.

Mounted upon this short shaft is a bevel gear meshing with a pinion mounted on a second shaft, which also is carried on ball bearings and is perpendicular to the axle of the truck.

This second shaft is connected to the armature shaft by means of a split coupling, no universal joints being provided, as the generator is carried on suspension irons attached to the truck frame.

This drive does not require a special axle; no provision has been made for maintaining the pitch circles of the bevel gear and pinion in contact. This drive has never been used in actual service.

Cost of Belt Drive

In order to determine what the cost of operating a belt drive might be, the A. R. A. Committee on Car Lighting, in 1922, presented the accompanying data as furnished by various railroads, from which it will be noted that the mileage per belt varies from 5,132 to 84,775 miles and that the average percentage of renewals per belt per month varies from 5.8 to 85.6

The data on belts given in the table varies widely on several different railroads but, as a guide to arrive at a figure which might represent the cost of operating, the following tabulation is approximate:

ASSUMPTIONS

Miles service per belt	10,000
Miles service per month per car	5,000
Length, width and ply of belt	14 ft. 0 in. by 4 in. by 5-ply
Cost per foot of belt	$0.4725
Type of belt fastener	Crescent
Cost of fasteners per belt	$0.155
Axle pulley bushing life, cost	20 yrs. $4.95
Axle pulley life, cost	10 yrs. 18.00
Armature pulley life, cost	3 yrs. 12.00
Armature pulley times turned, cost per turning	3 yrs. .90
Labor to cut and apply belt, time, cost	20 min. .28
Difference in cost of suspension, including belt tension device	75.00

Cost per year based on above Assumptions.

OPERATION

6 14 ft. 0 in. by 4 in. by 5-ply belt, at $0.4725 per ft.	$39.69	
6 sets of fasteners, at $0.155 per belt	.93	
6 by 20 minutes for application belt, at $0.85 per hour	1.70	
Cost of one turning of armature pulley	.90	
		$43.22

DEPRECIATION

Axle pulley bushing, $0.05 by $4.95	$0.25	
Axle pulley, $0.10 by $18.00	1.80	
Armature pulley, $0.33 by $12.00	4.00	
		$6.05

INTEREST

Axle pulley bushing at	$4.95	
Axle pulley at	18.00	
Armature pulley at	12.00	
Belt at	2.84	
Fasteners at	.06	
Difference in cost of suspension	75.00	
Interest at $0.06 on $112.85		$6.77
Total		$56.04

DATA ON BELTS—BODY HUNG GENERATORS

	1 K. W.			2 K. W.				3 K. W.									
Railroad	N Y C	N & W	A C L	N Y C	N Y C	N Y C	N Y C	B & O	B & O	B & O	D L & W	I C	I C	I C	A C L	A C L	A C L
Make of Generator	Safety	U.S.L.	Safety	Safety	U.S.L.	Gould	Gould	Safety	Stone Franklin	U.S.L.	Gould	Safety	Gould	Gould	Safety	U.S.L.	Stone Franklin
No. of generators in service	26	70	6	2	77	33	84	60	92	50	129	126	84	237	11	10	7
Type of suspension	N Y C	N & W	.....	N Y C	N Y C	N Y C	N Y C	und. frame	Stone	U.S.L.	.....	und. frame	Gould	I C	.....	.....	.....
Width of belt, in.	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4	4	4
Plies of belt	4	4	5	4	4	4	4	5	4	5	5	4	4	4	5	5	4
Av. length of belt, ft.-in.	15	15	13	15	14-7	14-7	14-7	14-5	15	14-9	.....	13-6	13-6	14	14-6	13	13
Type of fastener	C	W	C	C	C	C	C	W	W	C	C, W	W	W	C, W	C	C	W
Diam. of axle pulley, in.	19	17	17	19	19	19	19	17	17	17	18	17	17	20	17	17	17
Diam. of armature pulley, in.	8	6.5	5.5	8	10	8	8	5.5	5.5	8	.....	5.5	8	11	5.5	8	5.5
Belt renewals in % of cars equipped:																	
October, 1919	8	.....	.....	.....	26	39	30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
November, 1919	38	.....	.....	.....	47	42	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
December, 1919	46	.....	.....	.....	100	85	64	120	69	58	.....	35.5	31.6	13	.....	.....	.....
January, 1920	70	5.4	50	50	205	218	140	113	69	42	40.5	120	74	57	64	80	29
February, 1920	35	8.6	66	50	102	106	75	77	67	70	30.5	65	61	24	64	240	43
March, 1920	27	7.3	50	.....	58	63	69	62	64	42	31	67	44	19	73	150	85
April, 1920	15	8.6	16	.....	48	60	41.5	93	70	30	14	43	51	24	110	20	100
May, 1920	35	7.3	66	.....	31	30	31	113	54	48	8.5	47	45	12	45	30	29
June, 1920	15	5.4	84	.....	38	30	21.5	125	61	38	21.6	55	45	19	64	50	29
July, 1920	23	4.3	33	.....	36	36	22.5	88	48	36	31	54	57	22	91	70	29
August, 1920	42	5.4	0	50	40	27	28.5	62	73	58	19.4	50	61	23	100	20	14
September, 1920	11	2.7	33	50	41	60	21.5	75	44	28	4.7	51	55	19	54	20	29
October, 1920	.....	1.3	0	.....	.....	.....	.....	50	55	10	3.9	57	52	23	54	70	29
November, 1920	.....	5.4	66	.....	.....	.....	.....	50	76	26	16.2	64	44	20	110	50	43
December, 1920	.....	7.3	33	.....	.....	.....	.....	.....	.....	.....	17	.....	.....	.....	128	50	43
Total belts applied	95	49	30	4	593	264	463	617	694	244	307	894	520	655	105	85	35
Av. % renewals per month	30.4	5.8	41.7	16.7	64.2	66.6	45.9	85.6	62.7	40.7	19.8	59.1	51.5	23	79.5	70.8	41.6
Av. miles per belt	13,759	84,775	.....	5,132	8,929	7,822	7,257	.....	.....	.....	.....	17,000	20,000	44,000	.....	.....	.....

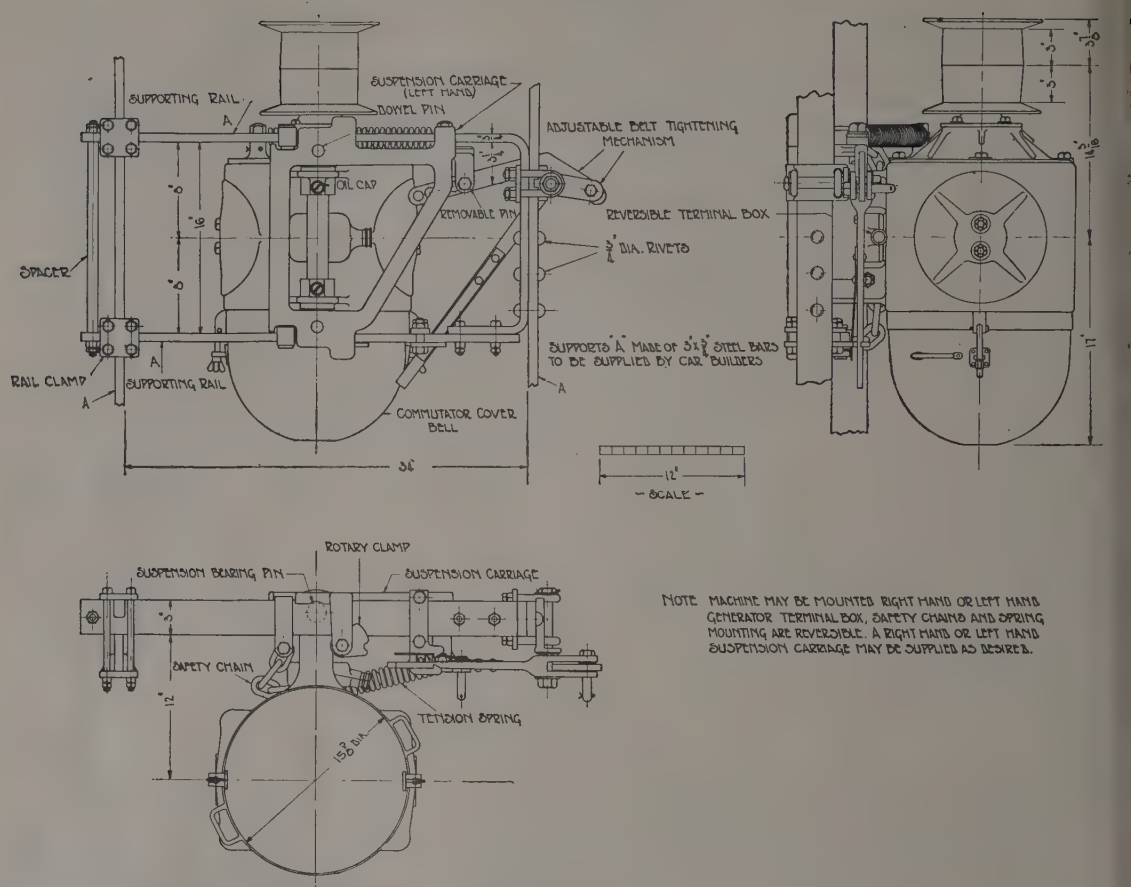

SUSPENSION CARRIAGE (LEFT HAND)
DOWEL PIN
SUPPORTING RAIL
ADJUSTABLE BELT TIGHTENING MECHANISM
OIL CAP
REMOVABLE PIN
REVERSIBLE TERMINAL BOX
DIA. RIVETS
SPACER
SUPPORTS "A" MADE OF 5x1/2" STEEL BARS TO BE SUPPLIED BY CAR BUILDERS
RAIL CLAMP
SUPPORTING RAIL
COMMUTATOR COVER BELL
SCALE
ROTARY CLAMP
SUSPENSION BEARING PIN
SUSPENSION CARRIAGE
SAFETY CHAIN
TENSION SPRING
NOTE MACHINE MAY BE MOUNTED RIGHT HAND OR LEFT HAND GENERATOR TERMINAL BOX, SAFETY CHAINS AND SPRING MOUNTING ARE REVERSIBLE. A RIGHT HAND OR LEFT HAND SUSPENSION CARRIAGE MAY BE SUPPLIED AS DESIRED.

Fig. 2283—Body-Hung Type of Suspension for E. S. B. Car Lighting System.

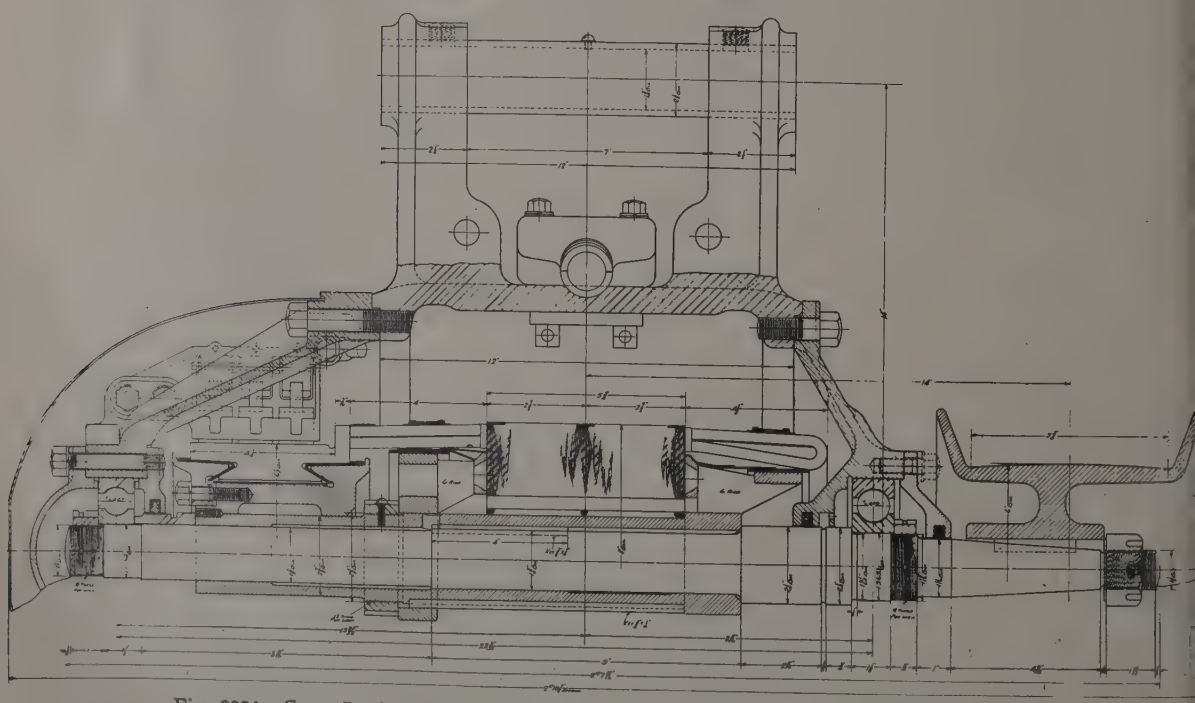


Fig. 2284—Cross Section of Body-Hung Type of Generator for E. S. B. Car Lighting System.
The Electric Storage Battery Company.
(*See also Pages* 909-911)

Exide Constant Voltage Axle Lighting System

Simplicity is the outstanding feature of the Exide Constant voltage axle lighting system. The generator is of the Rosenberg type and develops the same polarity with either direction of rotation, requiring no pole changer.

Constant voltage field control is secured by means of resistance units having special temperature co-efficients, permanently connected into a Wheatstone bridge. There are no moving parts in the control panel such as carbon piles, dash pots, pivots, levers, moving or vibrating contacts.

An automatic switch closes in response to very small difference of voltage between generator and battery, insuring positive action, absolutely free from arching and chattering, causing not the slightest flicker at the lamps.

No lamp regulator is required, the voltage of the generator being held close to the normal floating voltage of the battery by means of the constant potential control.

The switch board measures 18 in. by 15 in.

The generator is carried either by the truck or the car-body.

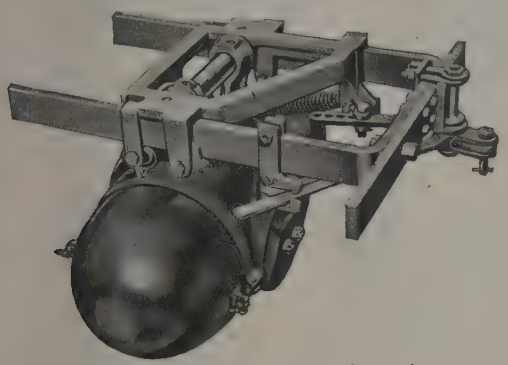


Fig. 2285—Body Hung Axle Generator

The truck suspension consists of two interchangeable loop bars suspended from two bearing pins, free to turn in steel bushings clamped in the bearing saddles, and adjustable longitudinally along the side bars. There is no wear except at these two bearings, and these (two pins and two bushings) are easily and cheaply renewed. There is no motion or wear at the feet of the machine which are solidly clamped to the loop bars. Permanent belt alignment insures long belt life—80,000 to 90,000 miles per belt.

The body hung suspension consists of a cast-steel carriage adjustable longitudinally along two horizontal bars attached to the under-frame of the car. From this carriage the generator is supported on a 1¾ in. diameter bearing pin passing through a tubular steel bushing 12 in. long carried by the supporting lugs cast integrally with the field frame. Belt tension is controlled by a tension spring and is adjusted by sliding the carriage along its supporting bars by means of a hand lever. The tension on the belt may be quickly applied or relieved which is of considerable advantage in repairing belts. The carriage may, by means of the hand lever be moved to a new position farther away from the axle thus doing away with the necessity of shortening a belt that has stretched.

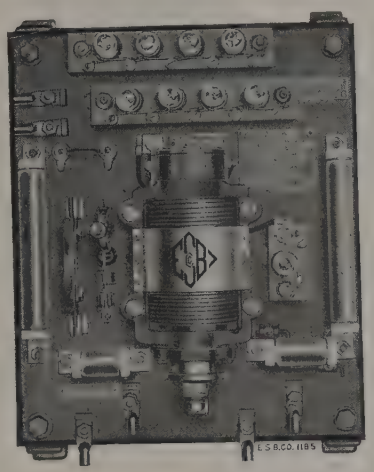


Fig. 2286—Axle Lighting Switchboard

There are many desirable features in the operation of this system. No adjustments are necessary. The apparatus will automatically adjust itself to various conditions of load and service, the generator output varying to meet the requirements.

There is no excessive overcharging of the battery and no appreciable gassing. This prolongs the life of the plates.

The cost of inspection is reduced to a minimum. The simplicity of the apparatus is such as to require but little attention. By means of a test switch, the inspector can determine the condition of the control circuits.

Reversal of polarity, whether caused by crossed leads from battery or generator or otherwise, is immediately and automatically corrected as soon as the generator starts up.

The charging rate is automatically adjusted to the condition of the battery. A considerably discharged battery will be rapidly charged at the maximum safe output of the generator. A fully charged battery will receive just sufficient trickling charge to keep it full, but will recharge rapidly for a few minutes after a short discharge until the current taken out has been restored.

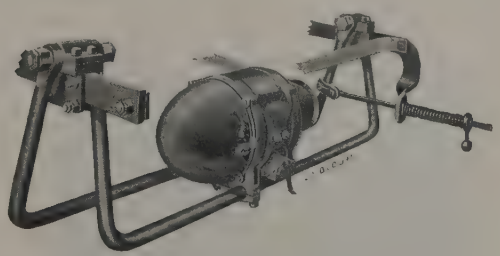


Fig. 2287—Truck Suspension Axle Generator

There is no leakage of current from the battery when the generator is shut down. There are no polarizing or "teaser" coils taking current from the battery when the car is standing.

The highest quality of material and workmanship are used throughout, insuring low maintenance cost and long life.

For other products and branch offices, see classified and alphabetical indexes.

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA, PA.

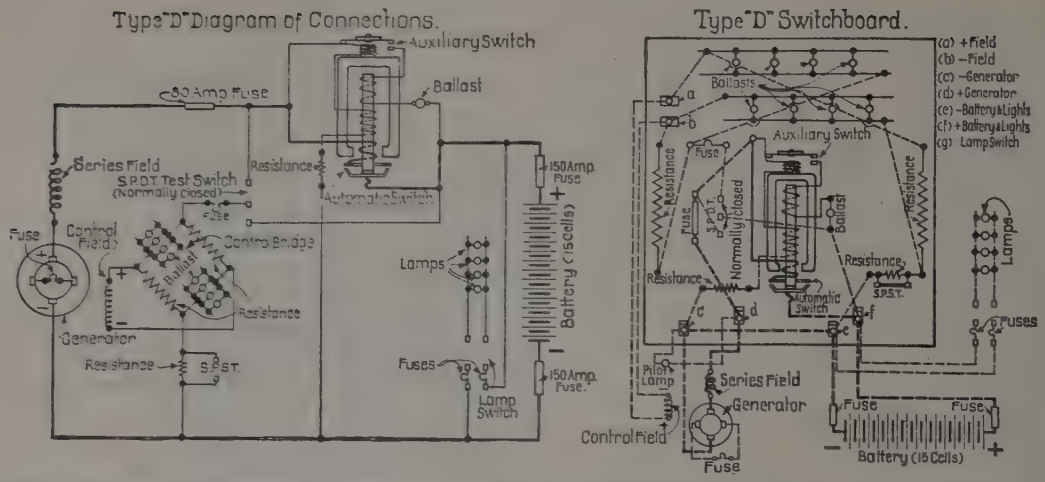


Fig. 2288— Type "D" Diagram of Connections and Type "D" Switchboard for E. S. B. Car Lighting System.

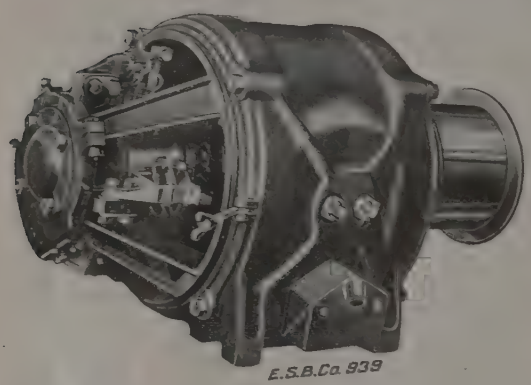


Fig. 2289—E. S. B. Truck Type Generator, Cover Removed.

Fig. 2290— Alloy Vent Cap.

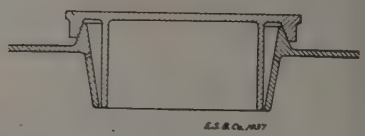
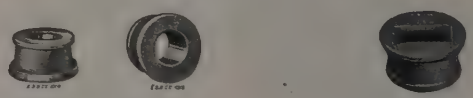


Fig. 2291—Section of Cover through Vent Cap.



Positive or Negative, for Round Post

Negative for Rectangular Post

Fg. 2292—Soft Rubber Terminal Post Bushings.

Fig. 2293—Storage Battery—Two-Cell Unit—for E. S. B. Car Lighting System.

Fig. 2294—Two-Cell Unit Showing Interior Construction.

The Electric Storage Battery Company.

(*See also Pages* 909, 911.)

The Exide Car Lighting Storage Battery

The Exide Car Lighting battery in the Giant compound rubber jar can be used with any railway car lighting system. It is essentially different in material, design and construction from what is generally termed the lead battery. The component parts are the Manchester positive plate, the Box negative plate, and the wood separators.

The Manchester positive plate has a grid of cast lead-antimony alloy which possesses important characteristics. This alloy resists the forming action of the electric current during charge and discharge. It cannot be converted into lead-peroxide and is, therefore, permanent throughout the entire life of the plate. Being

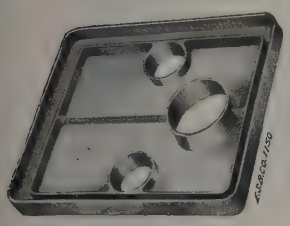


Fig. 2295—Double Flange Alloy Cover

Fig. 2296—"Giant" Jar

very rigid, it resists the mechanical strains which occur and retains its original shape without growth or buckling. The Manchester grid provides the necessary support for the active material and a conducting metal for carrying the current to and from all parts of the plate during charge and discharge.

The grid is provided with circular openings slightly tapered toward the center into which are forced by hydraulic pressure the buttons of soft lead that constitute the active portion of the

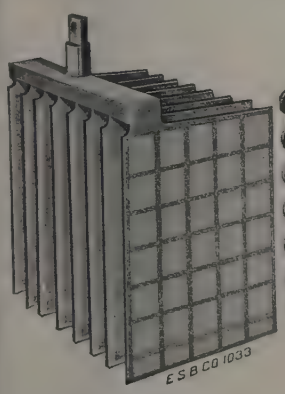


Fig. 2297—Box Negative Group

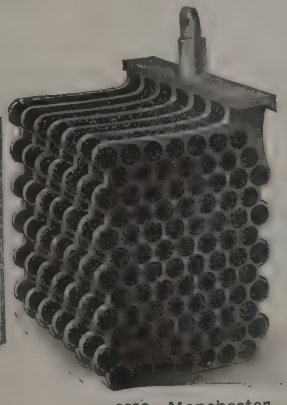


Fig. 2298—Manchester Positive Group

plate. These buttons are formed of strips of pure lead corrugated transversely and rolled into a spiral. After being forced into the grid, they are subjected to an electro-chemical forming action which expands the buttons and locks them into place. Any tendency to "grow" merely locks them tighter in the grid without distorting the latter and thus the entire electrolytic action is confined to the buttons.

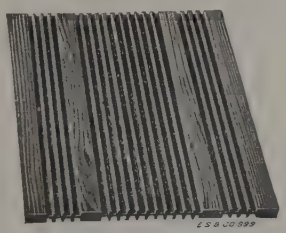


Fig. 2299— Wood Separator

The negative plate is the well known box type grid, and consists of horizontal and vertical ribs spaced about one inch apart forming pockets closed by perforated sheet lead. The grid and the active material are not necessarily of the same composition, but each is designed of the material best suited for the functions that it is to perform. The grid remains rigid and inactive, whereas the active material keeps exceedingly porous and spongy. This results in a permanent negative plate whose capacity is well maintained.

The grids are assembled into positive and negative groups by lead-burning them to the plate strap and terminal post. This plate-strap is designed to give maximum rigidity at the junc-

Fig. 2300—Manchester Button

tion with the plate lug, and an apron is provided at the back to hold the separators in place. Great care is exercised in grouping the grids to avoid the possibility of loose plates, due to shock and vibration incident to car lighting service. The work is done in accurate gages, to insure each plate resting on the plate support in the bottom of the jar and at the same time bringing the post in proper alignment with the cover openings.

The wood separators, specially designed for car lighting service, are used between the plates. They are of heavy section, grooved on both sides, with wide ribs on either vertical edge and at two intermediate points where the separator rests on the plate supports. This construction allows the plates to be effectively separated throughout their entire surface and at the same time permits ample and rapid diffusion of the acid. Short circuits and dead cells are avoided.

The Manchester plate, with its resistance to buckling and swelling, makes possible the use of the "Giant" compound rubber jar for standard car lighting systems. As there is no pressure from inside to strain the jar, a long life is assured and the lightness of the rubber jar is an added advantage when handling the battery.

The Exide battery in the Giant jar makes a combination well adapted for use in a car lighting system, and will operate the entire period between car shoppings without attention except for flushings, which can be accomplished without removing the cell from the battery box.

For other products and branch offices, see classified and alphabetical indexes.

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA, PA.

The Edison Alkaline Storage Battery

The Edison principle of storage battery design permits an all-steel construction, and the production of a battery of great ruggedness, long life, light weight and absolute freedom from disease. There is nothing about it to bend, buckle or crack. About the only care necessary is to keep the cells clean and to keep the solution-level above the tops of the plates. These are some of the characteristics of the Edison battery which have been strong factors in establishing the Edison feature of low cost of battery maintenance and operation.

The Edison Alkaline Storage Battery is the only battery built of steel. It is the only storage battery having an alkaline solution and using active materials of nickel hydrate —positive—and iron oxide —negative. This construction and principle cause Edison Alkaline Storage Batteries to possess advantages that are distinctly individual. In addition to the saving in weight there is a big saving in the cost of maintenance and operation. The electro-chemical principle of Edison batteries makes them absolutely free from disease. There are no sulphated plates to require special treatment. The manner in which the active materials are held in perforated steel tubes and pockets eliminates the washing out of sediment. The sturdy steel construction of the plates assembled in a steel container leaves nothing about the Edison battery to buckle or crack. Hydrometer readings to determine the gravity of the alkaline solution are not necessary except at long intervals of service. The changing of electrolyte in the Edison Battery is only required at periods of from three to five years. This does not necessitate the removal of the battery to a battery house, as the renewal of the electrolyte can be made beside the car in about one hour.

This exemption of the Edison battery from an annual retirement to a battery house for cleaning and repairs makes extra sets—incident to the care of many other types of batteries—unnecessary and is another Edison saving in maintenance and operation. In fact, the use of Edison batteries would eliminate the necessity for, and therefore, the expense of, a battery house.

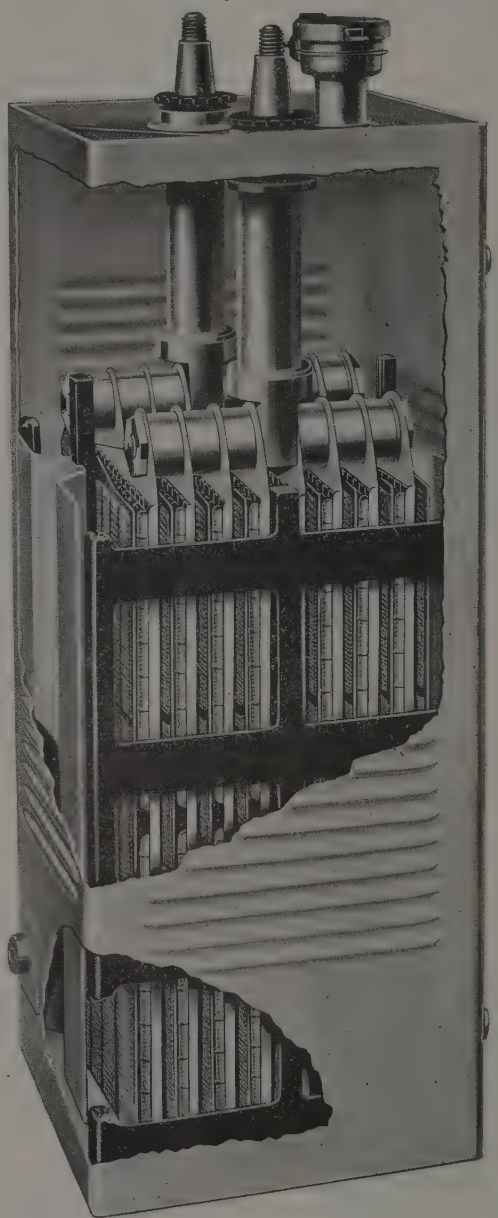


Fig. 2301—The HW Edison Alkaline Cell Cut Away to Show the All-Steel Construction

The cost of handling batteries at terminals is an expense that can be greatly reduced by the use of Edison equipment. These batteries, assembled in three-cell trays, weigh only 100 lb. and can be easily carried by one man, whereas, in many cases, two or three men are required to handle a double compartment tray of batteries, weighing about 350 lb.

The Edison construction and principle permits of a comparatively light battery having compact dimensions and which is entirely free from sulphation or any kindred disease. There is no possibility of buckling or growing plates, and as it requires neither frequent hydrometer readings or any internal cleaning, the amount of attention necessary for perfect battery service is slight. Further distinctive advantages are due to its unbreakable steel container, the absence of spare parts and the fact that it may be discharged to zero and suffer no injury.

The details of Edison Battery construction make plain the reasons for its ability to stand the hardest kind of service. The positive plate is made up of perforated steel tubes that are mounted on a nickel-plated steel grid and pressed into permanent position by hydraulic pressure. Each tube is filled with alternate layers of the active material—nickel hydrate and pure flake nickel. The negative plate is made up of perforated steel pockets, each loaded with iron oxide.

The life of any storage battery is generally computed from the number of complete cycles of charge and discharge which it is able to develop. The number of such cycles obtained depends upon the care exercised to keep the battery in good con-

For other products and branch offices, see classified and alphabetical indexes.

EDISON STORAGE BATTERY COMPANY, ORANGE, N. J.

The Edison Alkaline Storage Battery *Cont'd.*

dition and upon such service requirements as would tend to allow the battery to be operated according to the most approved methods.

The operating requirements of train lighting service are far from ideal for the battery. Transportation conditions are such that batteries are sometimes completely discharged and allowed to remain in that condition for long periods and are also very much overcharged at times, both of which conditions cause injurious diseases, impossible in an alkaline battery.

Edison batteries have been in service more than 12 years and are still giving more than rated capacity.

The economy to be effected by a reduction in the weight of railroad cars and their appurtenances is obvious. In comparison with many other storage batteries of equal voltage and ampere hour capacity, the Edison Alkaline Battery will effect a saving of approximately 2,000 lb. battery weight on 30-volt equipment and about 4,000 lb. battery weight on a 60-volt installation. A further advantage possessed by the Edison Alkaline Storage Battery is due to the fact that the entire equipment may be located in a compartment on one side of a car without imposing an objectionable unbalanced load upon the car springs.

Temperature fluctuation does not injure the Edison battery. For short, infrequent periods it will withstand severe heating better than an ordinary type. It is for this reason that numerous batteries have come through fires without damage except to the rubber parts and the wooden trays.

In January, 1914, Canada experienced the severest cold weather in 38 years, and yet 42 Edison-equipped cars gave service that completely dispelled all fear of the effects on the batteries. The road on which these batteries are used has since doubled its Edison equipment and three other Canadian railroads have adopted Edison batteries.

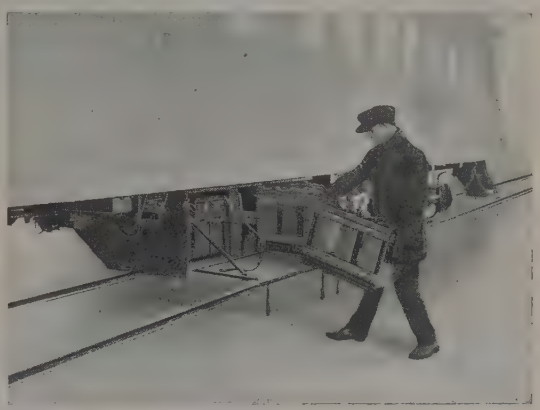


Fig. 2302—Edison Batteries assembled in three cell trays weigh only 100 pounds, and can be handled by one man

From the operating man's point of view, care of storage batteries has always been a big item. For this reason the brevity and simplicity of the instructions for the care and operation of Edison Alkaline Storage Batteries, as set forth in instruction book No. 850X, will be appreciated. These may be condensed to three simple rules:

(1) Add distilled water enough to keep the solution level above the tops of the plates at all times. This simple and inexpensive operation is by far the most important of the instructions; its careful observance will result in maximum life and efficiency.

(2) Replace electrolyte with fresh solution at long intervals, probably about three or five years.

(3) Keep the outside of each cell reasonably clean and dry.

DATA ON EDISON TRAIN LIGHTING BATTERIES

The new H.W. Type Edison car lighting cells have plates the same size and design as the regular Edison high type cells, but are assembled in larger containers and therefore have greater space for solution permitting of working batteries for longer periods without adding water.

Type	A-4H	A-4HW	A-6H	A-6HW	A-8H	A-8HW	A-10H	A-10HW	A-12H
Rated Capacity, ampere-hours	150	150*	225	225*	300	300*	375	375*	450
Charging rate for 7 hours, amperes	30	30	45	45	60	60	75	75	90
Discharging rate for 8 hours, amperes	18.75	18.75	28	28	37.5	37.5	47	47	56.25
Average discharge voltage per cell	1.24	1.24*	1.24	1.24*	1.24	1.24*	1.24	1.24*	1.24
" " " 25 cells	31	31*	31	31*	31	31*	31	31*	31
" " " 50 "	62	62*	62	62*	62	62*	62	62*	62
Weight single cell complete, pounds	16.3	20.5	22.6	28.4	30.7	36.0	38.3	43.7	46.9
Weight complete battery including trays, etc., per cell, pounds	19.4	23.6	25.7	32.2	34.5	43.7	46	50.8	54
Weight 25 cell battery, pounds	485	590	643	805	863	1092.5	1150	1270	1350
" 50 " " "	970	1180	1285	1610	1725	2185	2300	2540	2700
CELL DIMENSIONS. INCHES:									
Length (determined by number of plates)	2.64	3.80	3.80	5.03	5.03	6.15	6.15	7.39	7.39
Width	5.13	5.13	5.13	5.20	5.20	5.45	5.45	5.45	5.45
Height, container	15.13	15.13	15.13	15.25	15.25	15.25	15.25	15.35	15.35
Height, over all	16.13	16.13	16.13	16.66	16.66	16.66	16.66	17.16	17.16
**STANDARD TRAY DIMENSIONS:									
Width over all, inches	7.25	7.25	7.25	7.06	7.06	7.75	7.75	9.06	9.06
Height " " "	18.12	18.12	18.12	18.12	18.12	18.12	18.12	18.62	18.62
Length " 3 cell Tray, inches	24.70	24.70	24.70	24.70	24.70	24.62	24.62	24.62	24.62
" " 4 " " "	24.70	24.70	24.70	28.00	31.37	28.00	28.00	28.00	28.00
" " 5 " " "	24.70	24.70	24.70	31.37	31.37	36.00	36.00	36.00	36.00

*Subject to revision on account of improved characteristics and capacity.

**These trays are built to fit the standard battery compartments on passenger cars.

But, injurious temperatures seldom exist in train lighting service, for the rates are almost never very high and ventilation is usually sufficient in warm weather. In the matter of low temperatures, storage batteries are self warming—still air is a good heat insulator—a battery surrounded by still air keeps sufficiently warm for satisfactory operation.

For other products and branch offices, see classified and alphabetical indexes.

EDISON STORAGE BATTERY COMPANY, ORANGE, N. J.

Fig. 2303—Twenty-five Cells Type A-8 H; Weight 863 lb., Complete.

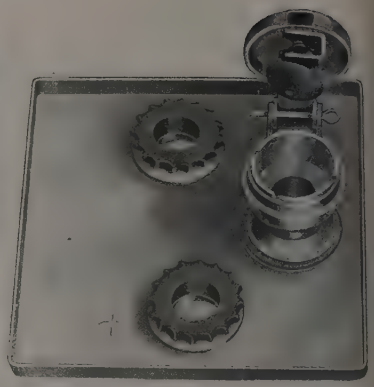


Fig. 2304—Cell Cover, Showing Filling Aperture and Check Valve.

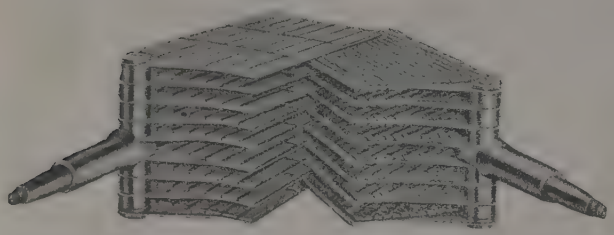


Fig. 2305—Negative and Positive Plates Mounted on Nickel-Plated Steel Grid.

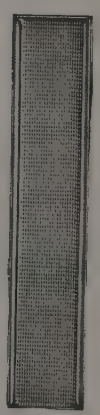


Fig. 2306—Perforated Nickel-Plated Steel Negative Pocket, Loaded with Iron Oxide.

Fig. 2307—Perforated Nickel Plated Steel Positive Tube.

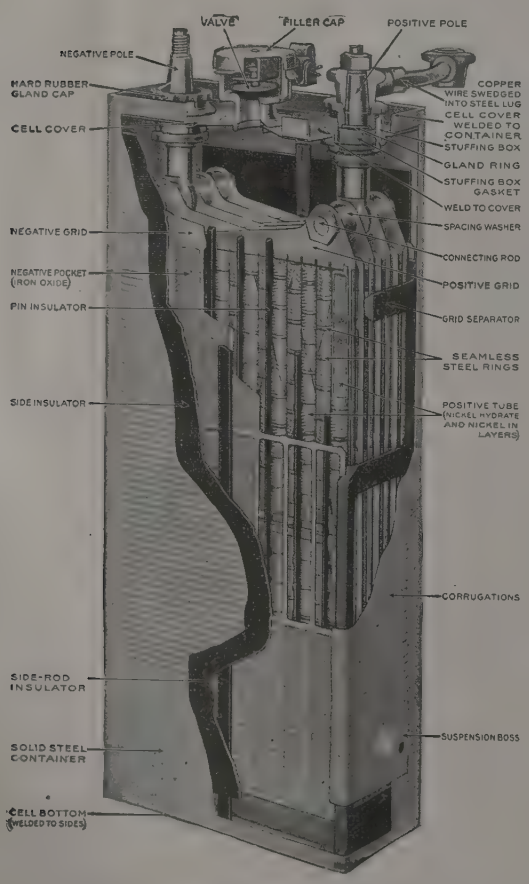


Fig. 2308—The Edison Alkaline Storage Cell Showing the Various Parts.

Fig. 2309—Edison A-8 H Train Lighting Cells in Tray.

Edison Storage Battery Company.

(*See also Pages* 912, 913.)

Fig. 2310—F Lamp Regulator.

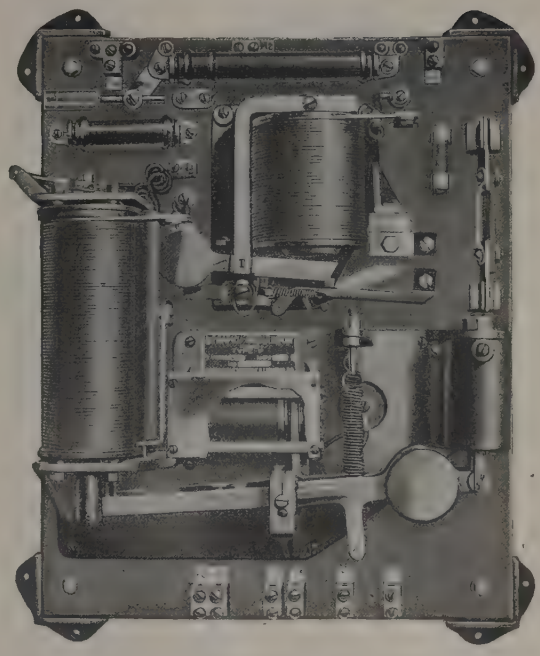


Fig. 2311—Type F Dynamo Regulator.

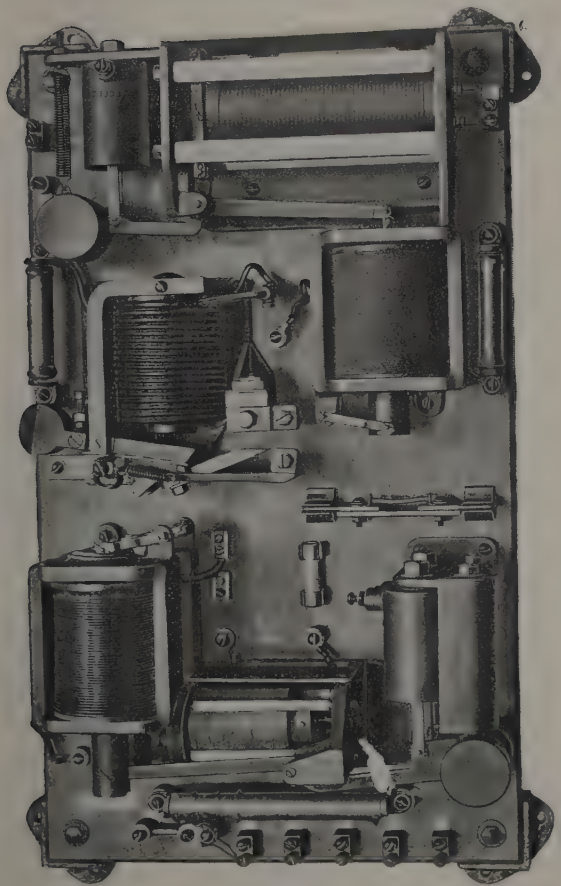


Fig. 2312—F-1 Combined Dynamo and Lamp Regulators.

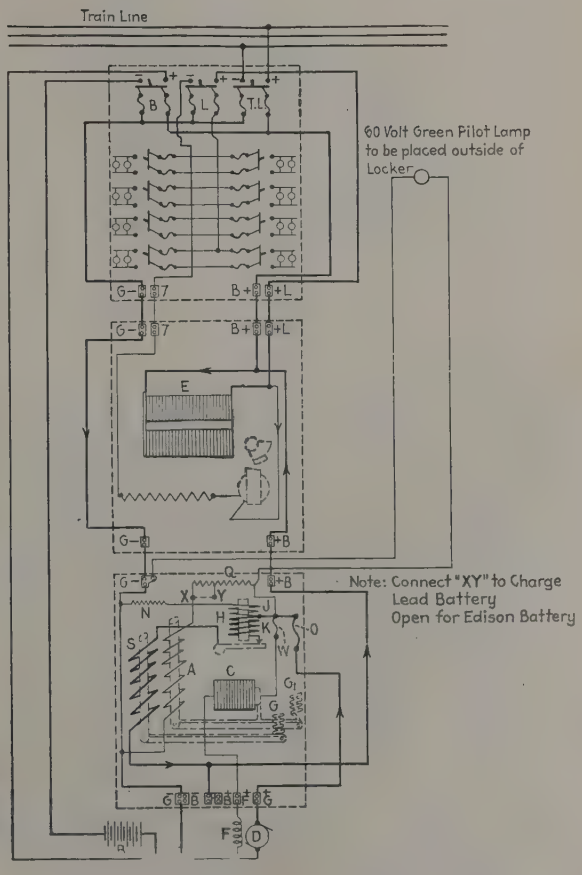


Fig. 2313—Wiring Diagram of 40-Volt Type "F" Regulators.

Safety Car Heating & Lighting Company.

(See also Page 917.)

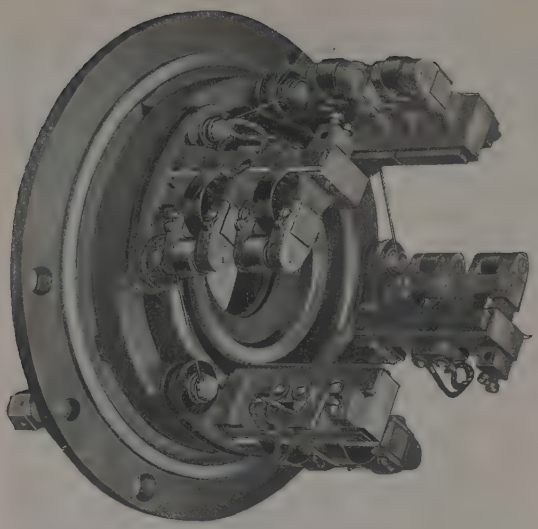


Fig. 2314—Pole Changer Brush Rigging.

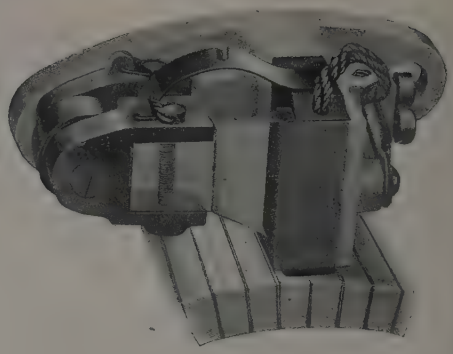


Fig. 2315—Brush Box and Brush Pressure Spring.

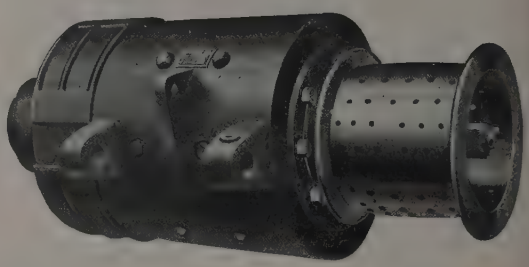


Fig. 2316—Truck Dynamo.

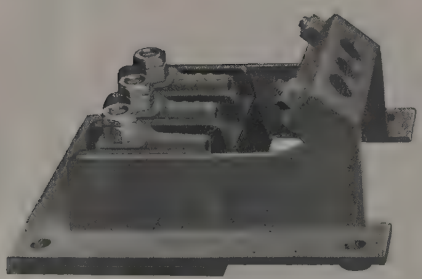


Fig. 2317—Terminal Block No. 23489.

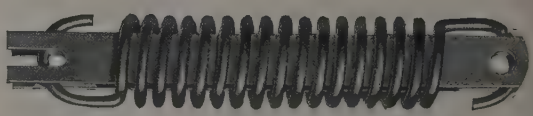


Fig. 2318—Tension Spring for Underframe Suspension.

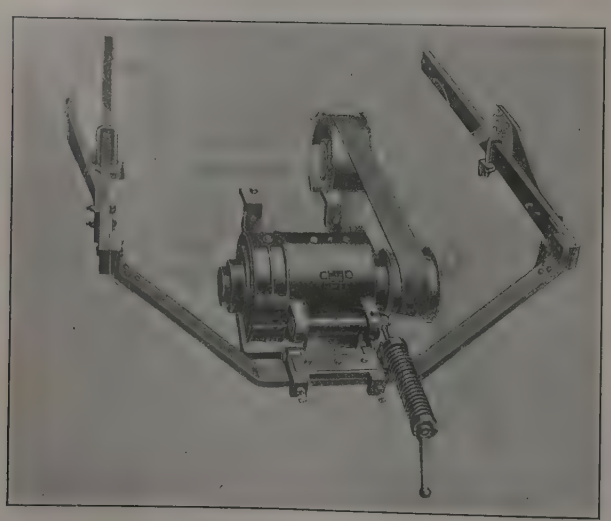


Fig. 2319—Dynamo Truck Suspension.

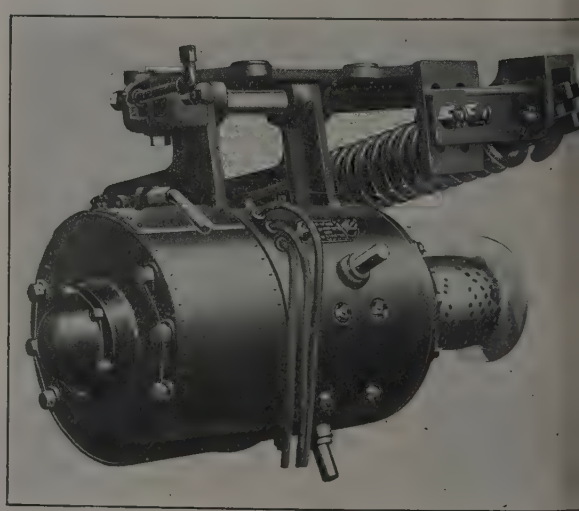


Fig. 2320—"Underframe" Dynamo and Suspension.

Safety Car Heating & Lighting Company.

(*See also Page* 917)

Safety Electric Light Underframe System

The "Underframe" car lighting electric equipment has the generator suspended from the underframe or body of the car, instead of from the car truck. This method of suspension has eliminated many structural difficulties arising from the present designs of steel trucks and steel car bodies having the deep center sill.

The advantages of this type of suspension, as demonstrated in actual service, are: Reduction of about 60 per cent in combined weight of generator and suspension; removal of three-fourths of a ton of overbalancing weight directly from the car truck; increased clearances between the end sill or brake rigging and belt and increased clearances between generator and track—see Fig. 2321.

Moving parts of the suspension are located out of danger from ice, snow, flying ballast and dripping condensation from the traps of steam heating systems.

The decrease in wear of generator and suspension parts is very marked. Increased accessibility for inspection and repairs is obtained; an inspection can be made without getting between the rails beneath the car. Ease of installation is also obtained; this type of equipment accommodates itself to the standard positions of brake rigging and other parts beneath the car.

With the body-hung generators, the changing angle between car and truck as well as the variable distance between centers of car axle and dynamo shaft must be taken care of. This is accomplished in the "Underframe" system by a simple belt tension device which utilizes the weight of the generator, working in conjunction with a tension spring; the parts are so designed that the sum of these two varying factors is constant. Excessive belt tension is prevented and belt slippage is minimized.

Where truck suspended generators are preferred, the Safety Company furnishes an equipment of this type which is simple, gives maximum strength and permits easy access to all parts. Lubrication of all parts subject to wear is provided by grease pockets needing no adjustments by the car builder.

Safety Generator and Lamp Regulators protect the generator from overload, prevent overcharge of batteries, and maintain a constant lamp voltage irrespective of changes in speed and battery condition. Simplicity and automatic reliability mark these Safety Regulators, proved by long service records.

The "Putnam" Battery, a new type of lead storage battery, has been devised and is being manufactured by the Safety Car Heating and Lighting Company. The positive and negative plates are made up of several leaves of C. P. lead; each leaf being milled so that it consists of several groups of parallel cylindrical rods. With this construction the tendency of active material being displaced from base lead is reduced to a minimum, buckling of plates is eliminated, and the largest possible amount of reserve lead is retained after the original formation and with a minimum total weight of plate.

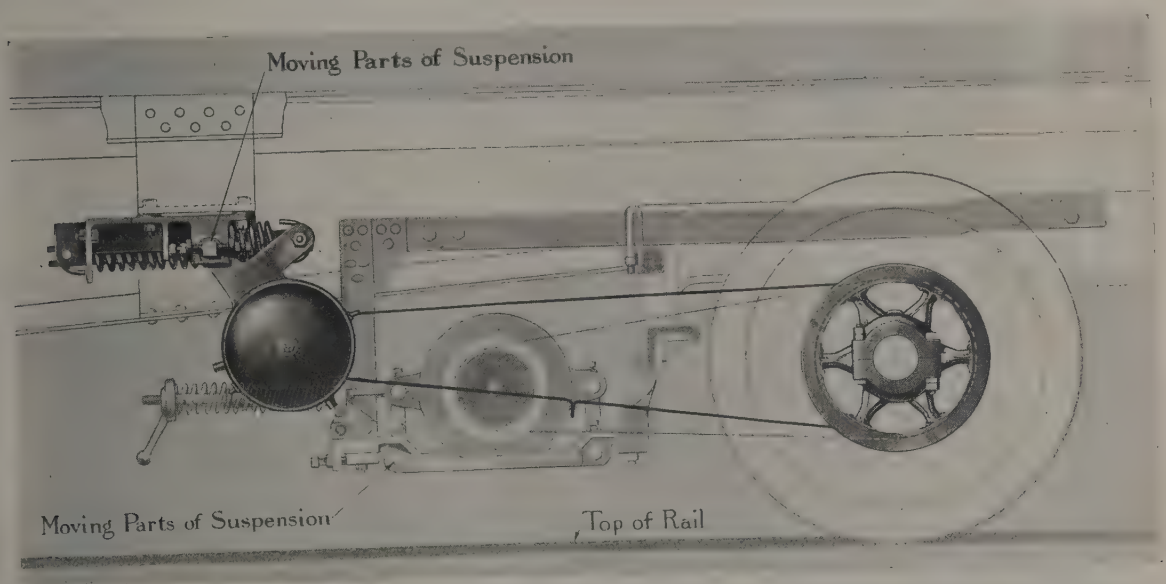


Fig. 2321—A Graphical Comparison of Size, Simplicity and Clearance Between "Underframe" Equipment and Equipment Mounted on the Car Truck

Pintsch Mantle Light Equipment has been developed by the Safety Company to a very high degree of simplicity and reliability. Its advantages are low cost of installation, low operating costs, minimum weight of equipment, simplicity of operation.

The Company also manufactures a complete line of electric and gas lighting fixtures for railroad service, together with ventilating and exhaust fans of improved types, electric water heaters, and electric water coolers.

For other products and branch offices, see classified and alphabetical indexes.

THE SAFETY CAR HEATING AND LIGHTING CO., NEW YORK, N. Y.

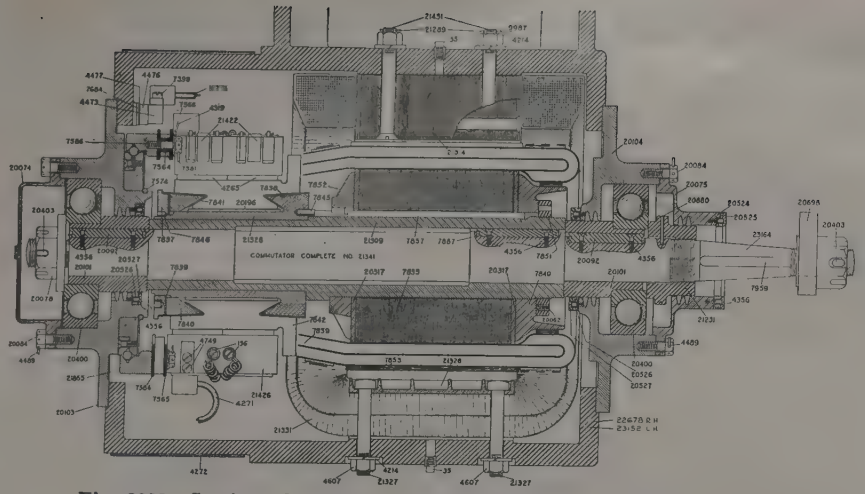


Fig. 2322—Section of Safety "Under-Frame" Generator No. 23175.

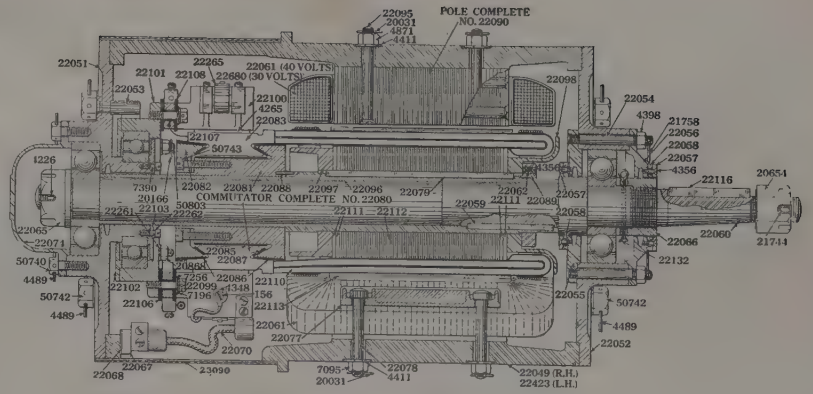


Fig. 2323—Section of Safety "Under-Frame" Generator No. 22050.

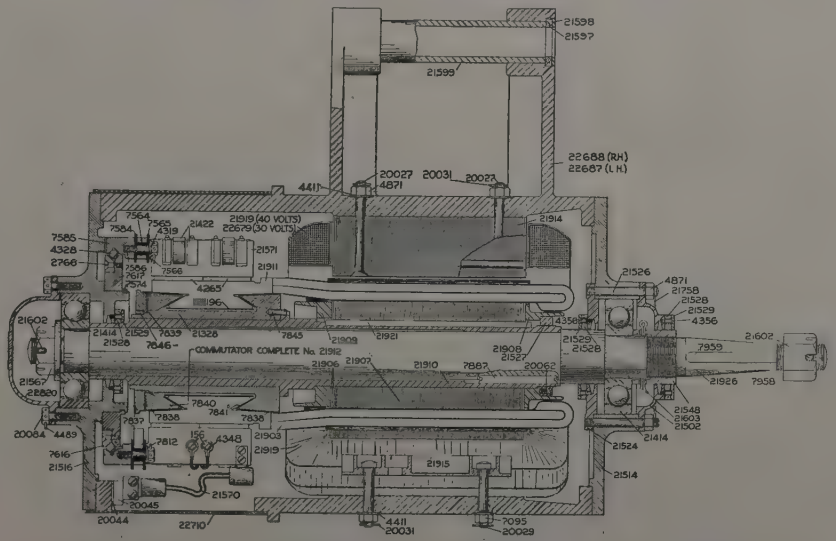


Fig. 2324—Section of Safety "Under-Frame" Generator No. 21900.

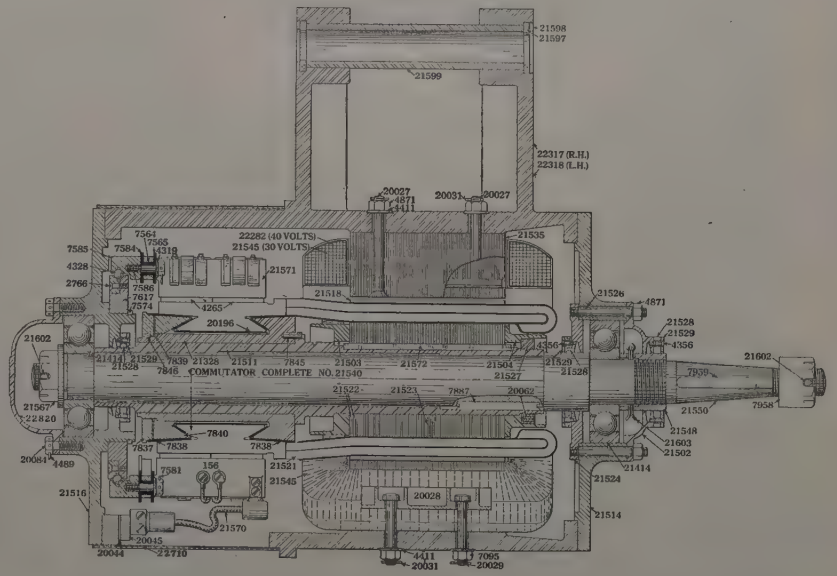


Fig. 2325—Section of 3 KW. Safety "Under-Frame" Generator No. 21510.

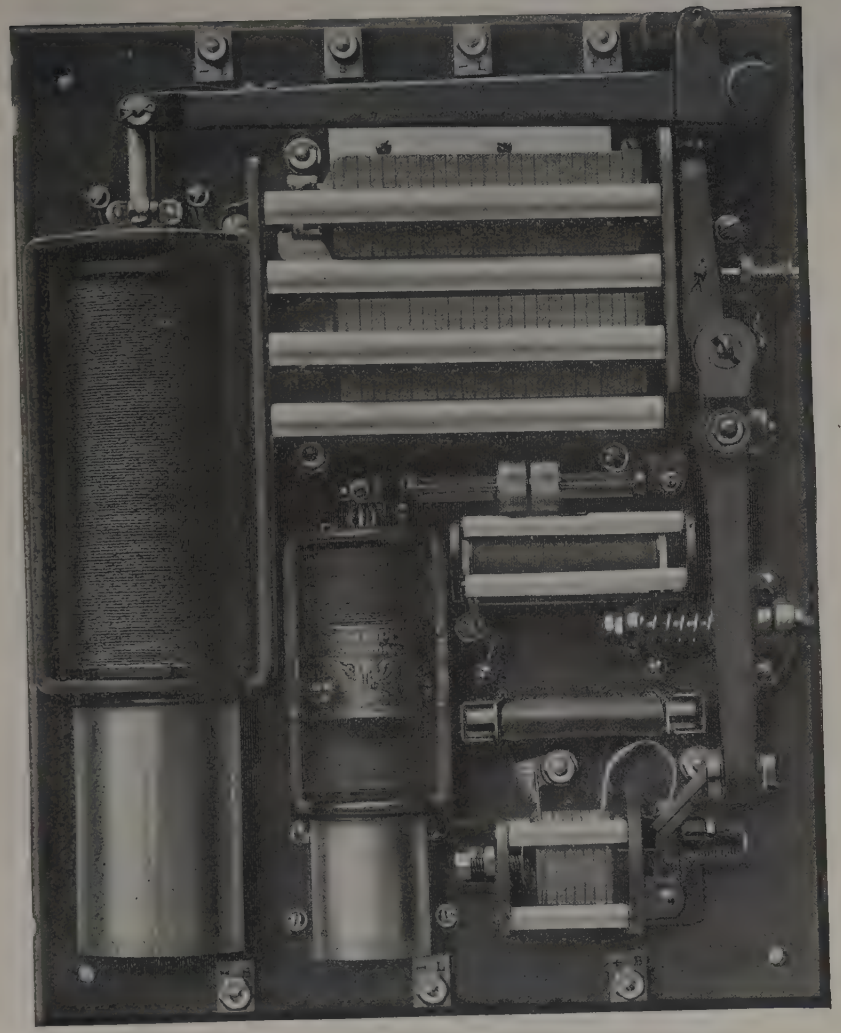


Fig. 2326—Lamp Regulator Panel, Types "M" and "M2."

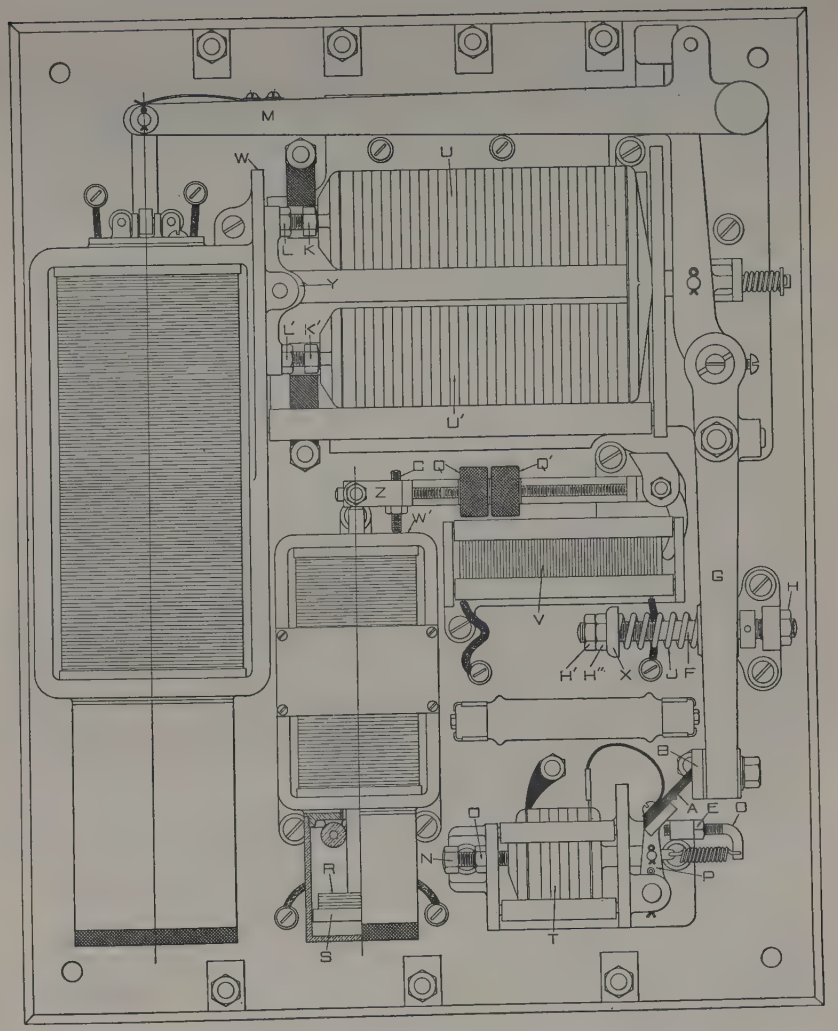


Fig. 2327—Outline for Setting, Types "M" and "M2," Lamp Regulator.

Gould Coupler Company.

(*See also Page* 955.)

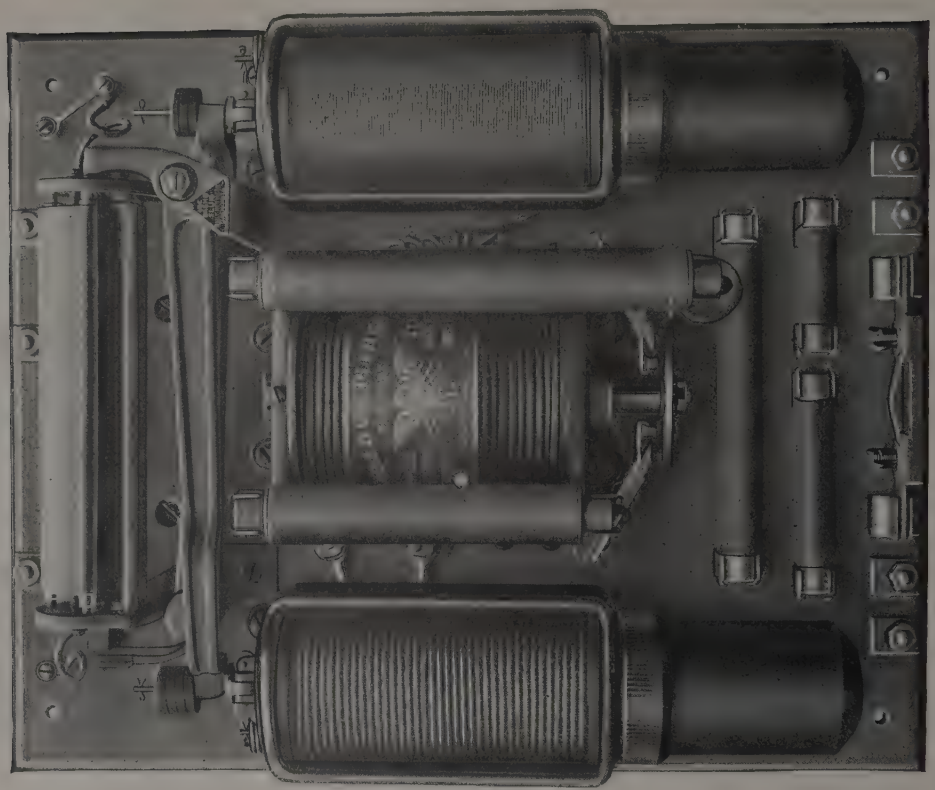


Fig. 2329—Combination Generator Regulator and Lamp Regulator Panel Type "A9." (See Fig. 2507.)

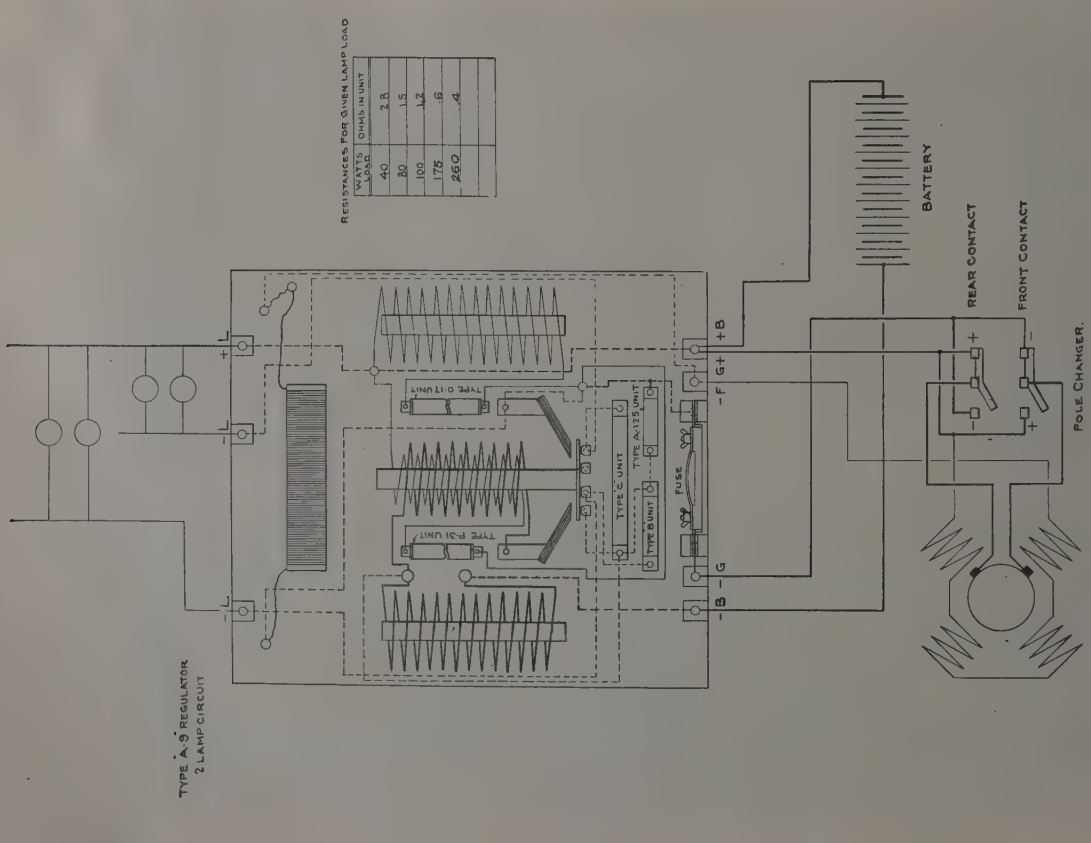
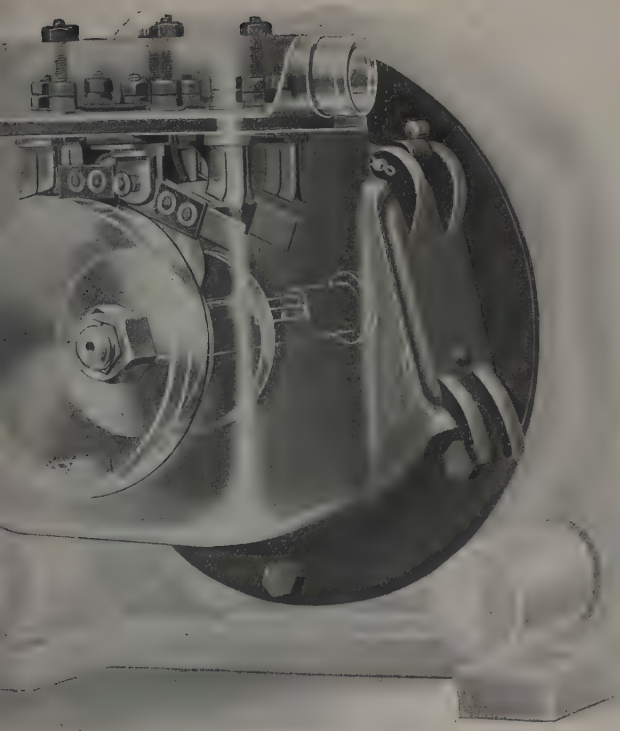


Fig. 2328—Wiring Diagram, Type "A9," Combination Generator Regulator and



:30—Phantom View of Pole Changer with Armature Rotating in Clockwise Direction, Trip About to Throw Pole Changer Switch so as to Reverse Connections.

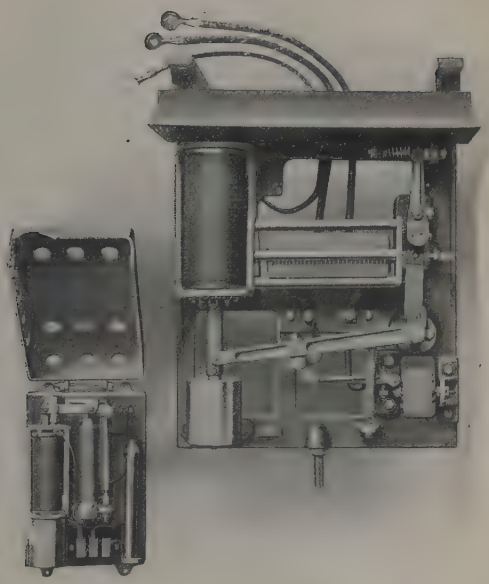
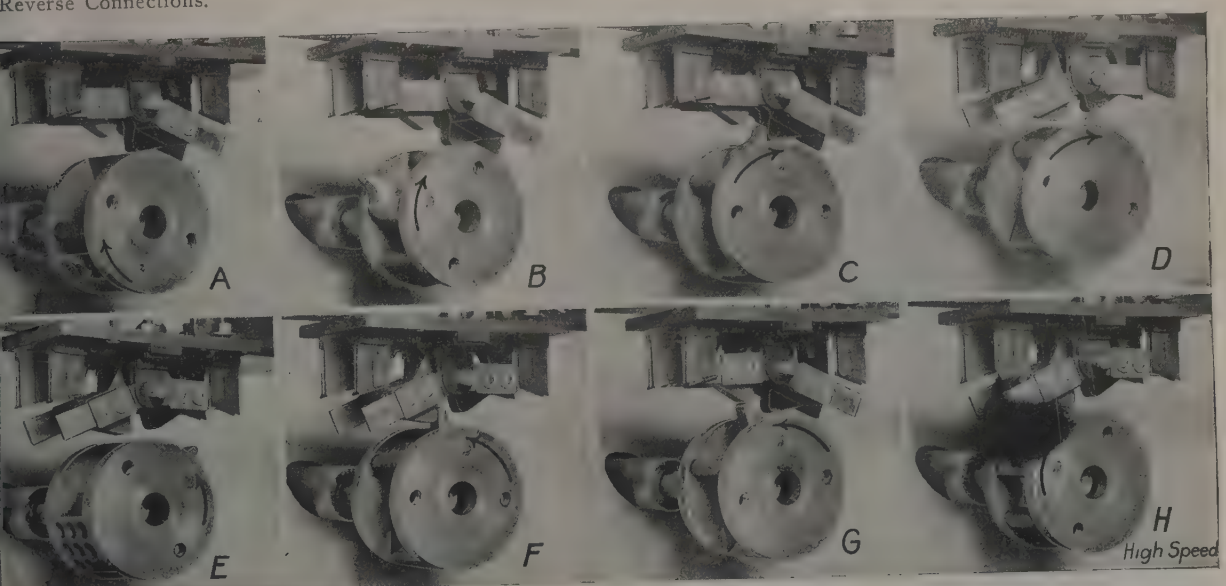


Fig. 2331—Lamp Regulator, Type "B," and Multiplier, for Outside Mounting.



g. 2232—Movie of Pole Changer in Action. Figs. A, B, C and D show the various steps of the pole changer action in throwing the pole changer switch. Armature is revolving in the direction as shown. In **A** the trip hangs evenly balanced at the bottom; in **B** it has been carried upward, but the right hand end of the trip striking the shaft tilts it slightly as shown. In **C** the trip is engaging with the projecting lug at the rear of the switch on the right side. In **D** the trip has thrown over the reverse switch and passes the projecting lug of the switch. Views **E, F** and **G** shows the pole changer operation when the direction of motion is reversed as shown. In **E** the tip of the trip is shown tilted, the left hand end then bearing on the shaft; in F, the trip has just engaged the front projecting lug at the left side of the switch, and in **G**, the trip has just thrown the switch and trip is passing the projecting lug. In **H**, the trip is shown evenly balanced by the centrifugal force when operating at high speed. The trip remains in this position without any tilt whatever, when operating at a speed of above four miles per hour.

Gould Coupler Company.

(*See also Page* 955.)

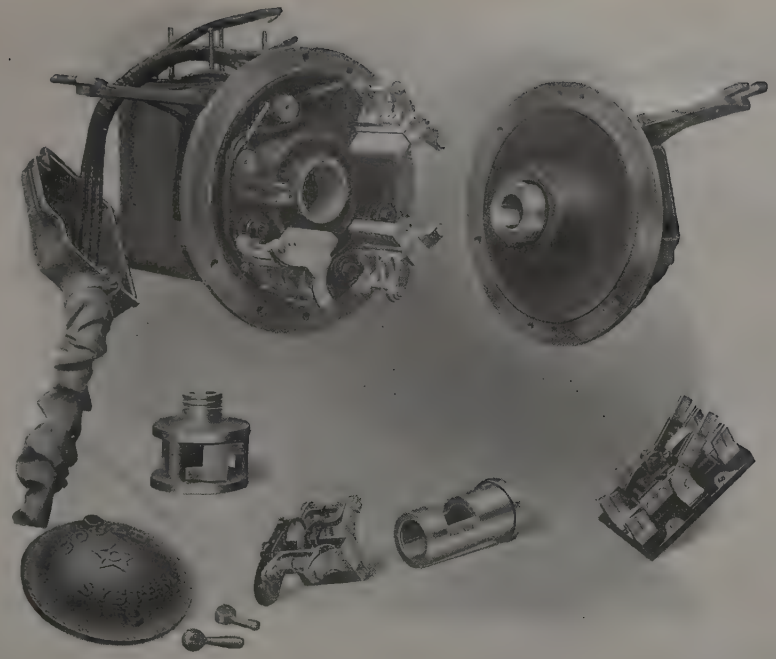


Fig. 2333—Commutator End Housing Plain Bearing, Waste Packed Type, Pulley End Housing, Trip Carrier with Trip, Commutator End Cap, Lever Nuts, Brush Holder with Brushes, Bearing and Pole Changer Switch.

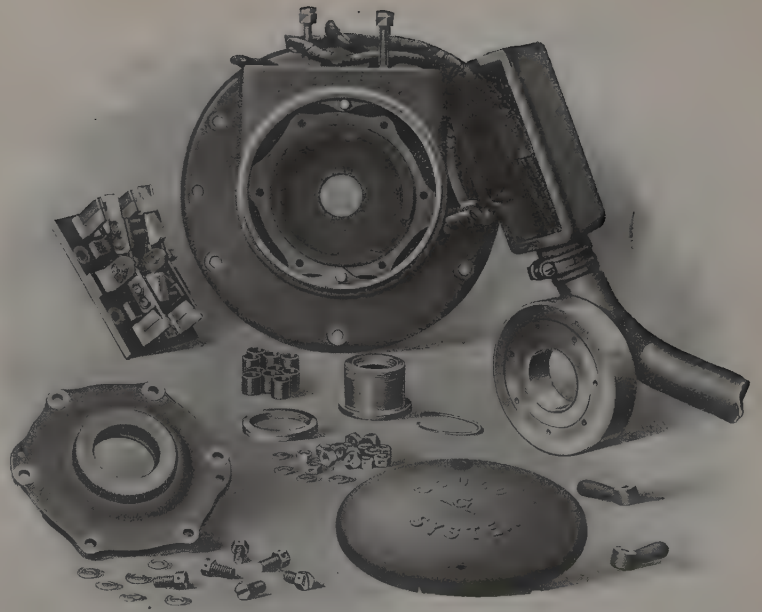


Fig. 2334—Commutator End Housing Ball Bearing Generator, Pole Changer Switch, Ball Bearing, Bearing Plate and End Cap.

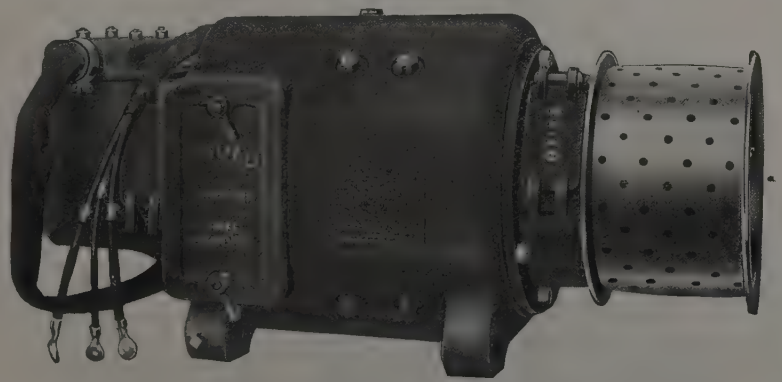


Fig. 2335—Plain Bearing, Waste Packed Generator, Type "B."

Fig. 2336—Ball Bearing Generator Type "BB."

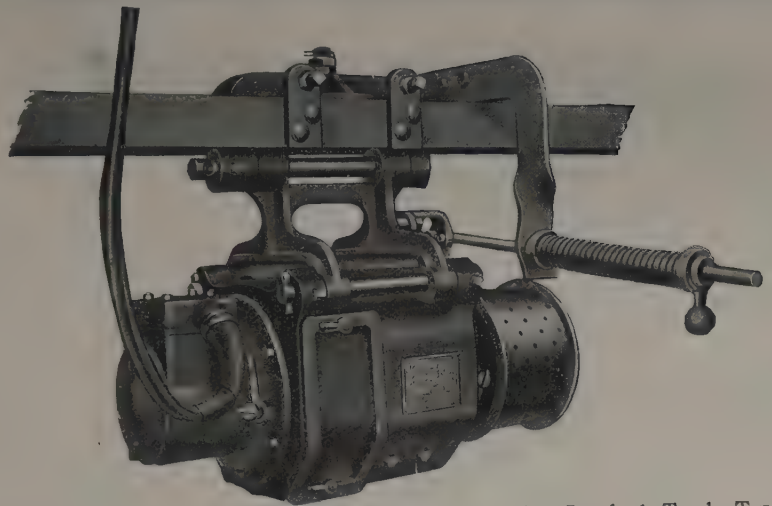


Fig. 2337—Adapter Type Body Suspension Used with Standard Truck Type Magnet Frame. Gould Coupler Company.
(*See also Page* 955)

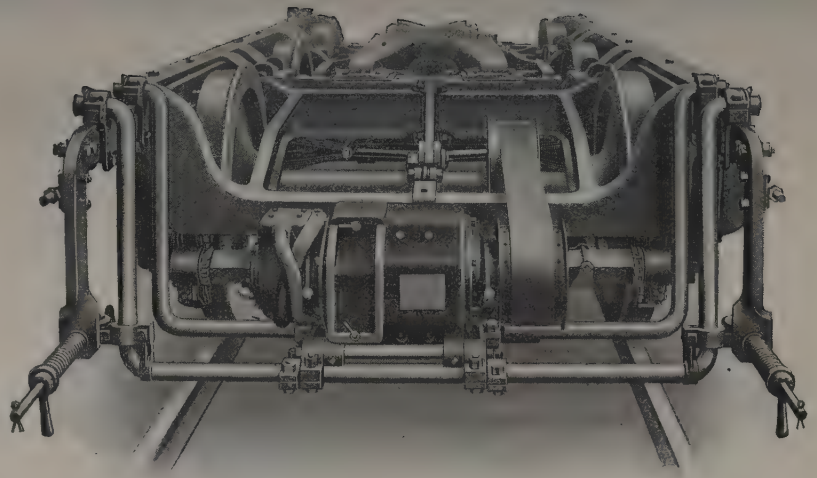


Fig. 2338—Link Type Truck Suspension. Gould Coupler Company.
(*See also Page* 955)

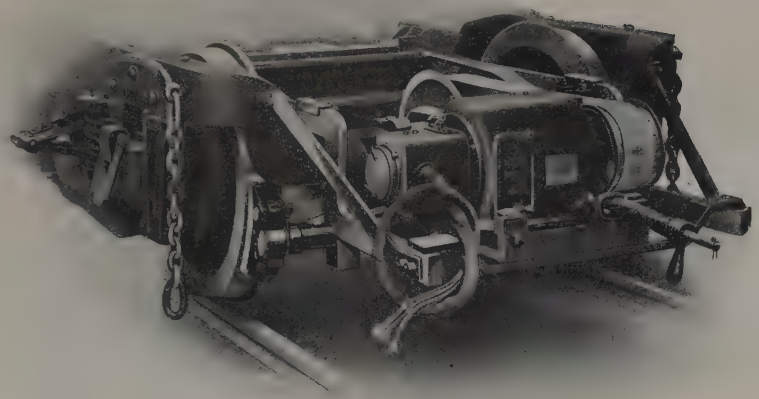


Fig. 2339—Drop Type Truck Suspension. Gould Coupler Company.
(*See also Page* 955)

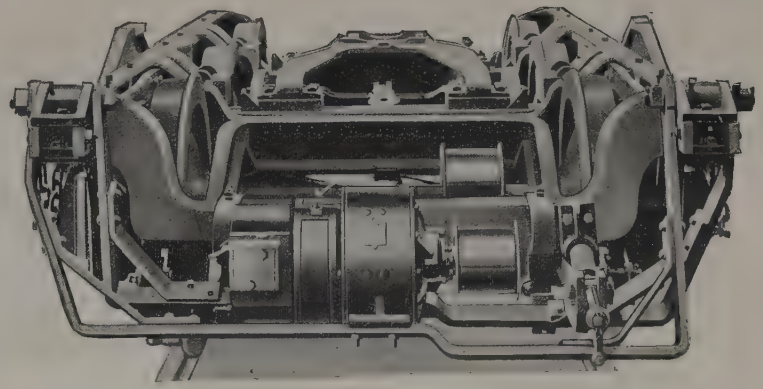


Fig. 2340—Two-Point Swinging Suspension on Commonwealth Truck. Electro Dynamic Company.

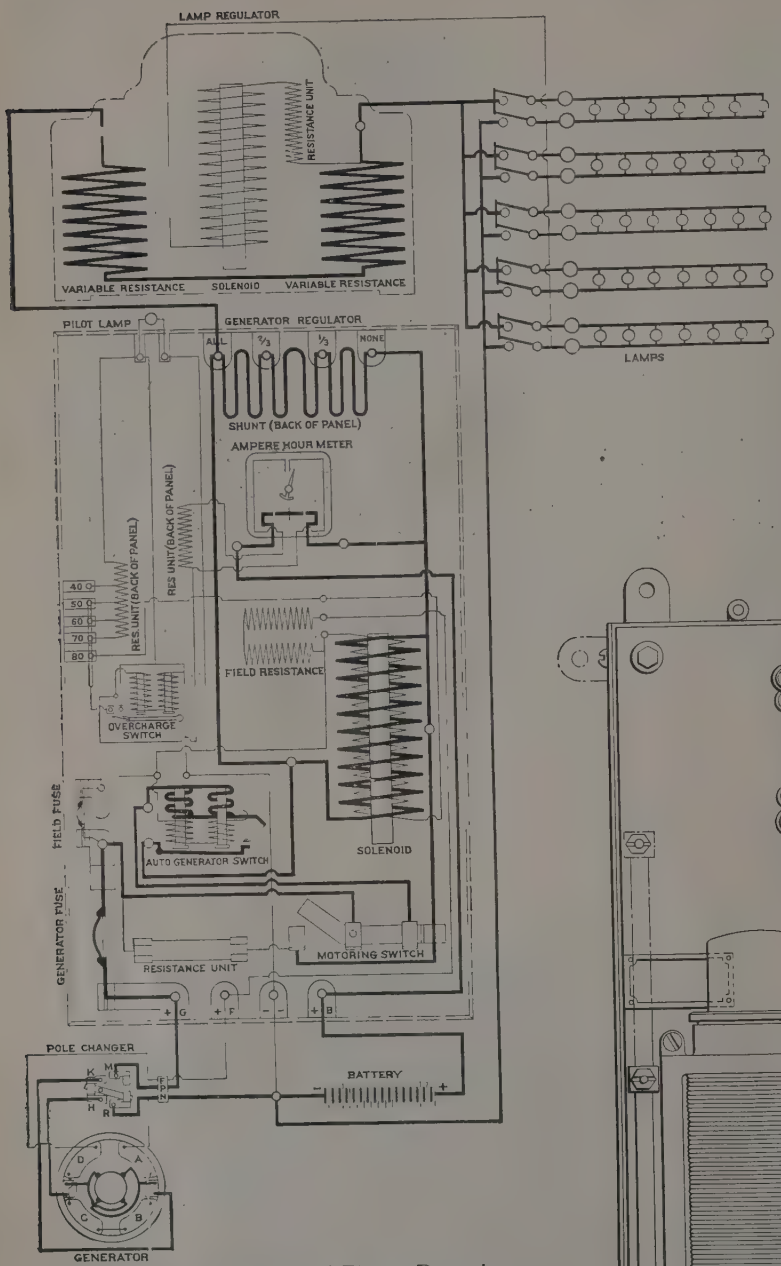


Fig. 2341—Wiring Diagram of Electro Dynamic Axle Light System. Electro Dynamic Company.

Fig. 2343—Axle Pulley. Electro Dynamic Company.

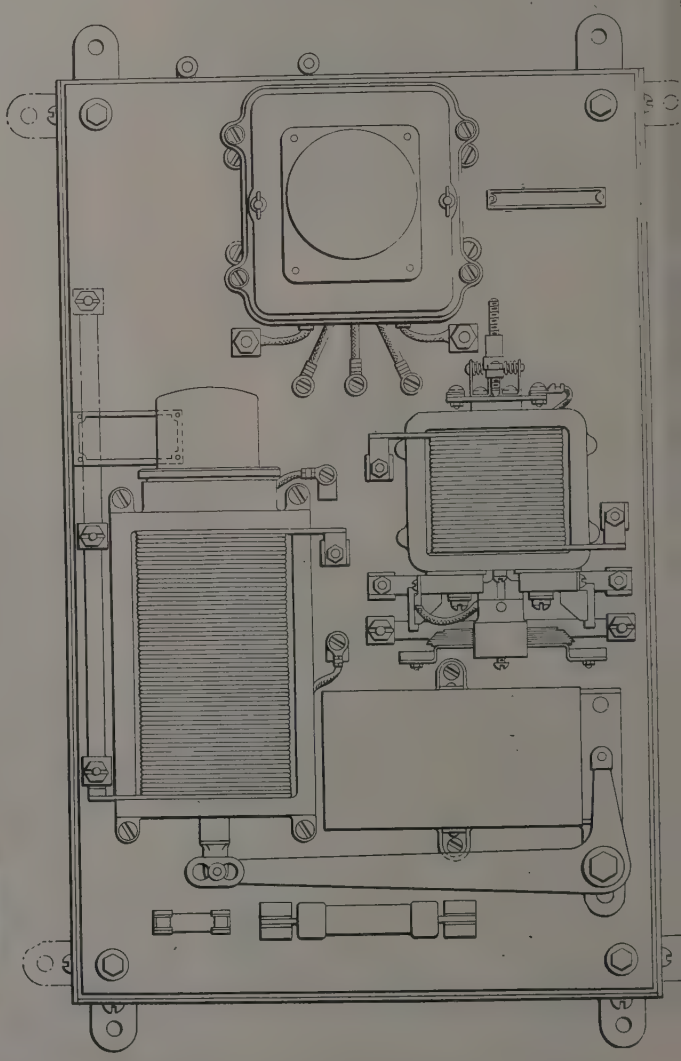


Fig. 2344—Type C Panel with Ampere Hour Meter. U. S. Light and Heat Corporation.

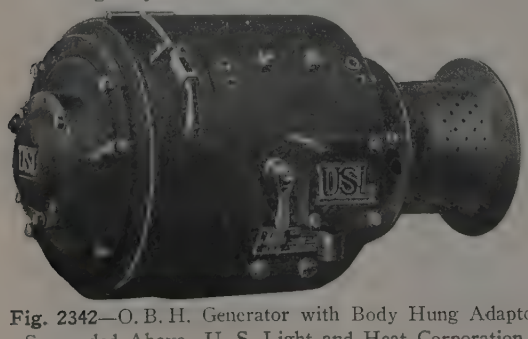


Fig. 2342—O. B. H. Generator with Body Hung Adaptor Suspended Above. U. S. Light and Heat Corporation.

(See also Page 925)

USL Car Lighting Devices and Storage Batteries

The various car lighting devices manufactured by the U. S. Light and Heat Corporation consist of generators, suspensions, regulator panels with and without ampere-hour-meter control, lamp regulators, distributing panels, together with Plante and pasted type lead storage batteries.

The USL Generator with universal frame for body or truck mounting is shown in Fig. 2345.

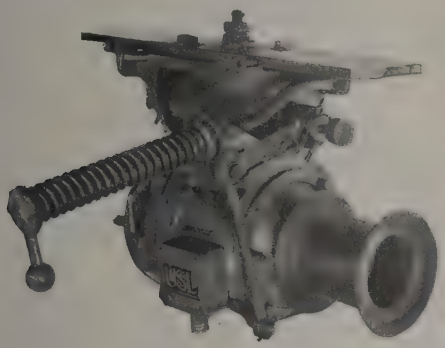


Fig. 2345—USL Generator with Universal Frame for Body or Truck Mounting

This machine is the result of a prolonged and careful study of car lighting requirements. It embodies many features of great value in railway service, including complete accessibility, simplicity of construction, together with every facility for making rapid inspection and repairs. The field is shunt-wound, four-pole and iron-clad; a drum type armature is used with fireproof insulated windings; commutation is sparkless, hand hole covers are dust tight and ball bearings are employed throughout.

USL Plante Storage Batteries—Fig. 2546—have a wide reputation for uniform excellence of construction and general reliability. They are designed with specially swaged plates made from a

Fig. 2346—USL Storage Battery

single blank of the most dense and chemically pure rolled lead. The special USL swaging process to which these plates are subjected, exerts a gradual and equally distributed pressure which forms a strong, durable plate of large reserve capacity. All USL Plante Storage Batteries are equipped with plates of this character; they are of vital importance in the production of a satisfactory railway car lighting battery of high efficiency and having maximum capacity over an extended period of service.

The Type-C-Regulator Panel shown in Fig. 2347 has a slate base upon which the various regulating devices are mounted. These consist of a generator regulator, an automatic switch and an ampere-hour meter.

The Generator Regulator has a carbon pile rheostat, in series with the shunt field winding, controlled by a solenoid and a balanced lever mechanism,

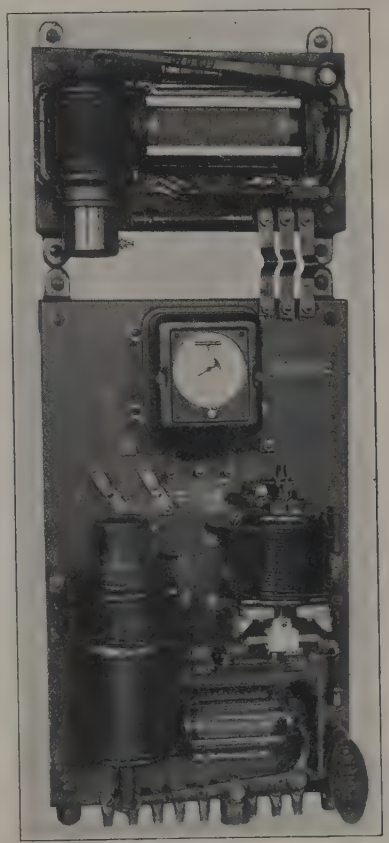


Fig. 2347—USL Type C Regulator Panel

whereby the resistance of the field circuit may be varied according to requirements.

The Automatic Switch makes and breaks the connection between the generator and the lighting system whenever the generator voltage is respectively above or below that of the system.

The Ampere-Hour Meter measures the ampere-hours charged into or discharged from the battery, and acts to reduce the generator voltage to a floating value, so that input to the battery ceases when it is fully charged. This prevents overcharging which causes the plates to buckle and rapidly disintegrate, and also causes rapid evaporation of the electrolyte necessitating frequent flushing. Operating records of more than 7,000 equipments show that ampere-hour meter protection may double and even treble the life of a storage battery.

For other products and branch offices, see classified and alphabetical indexes.

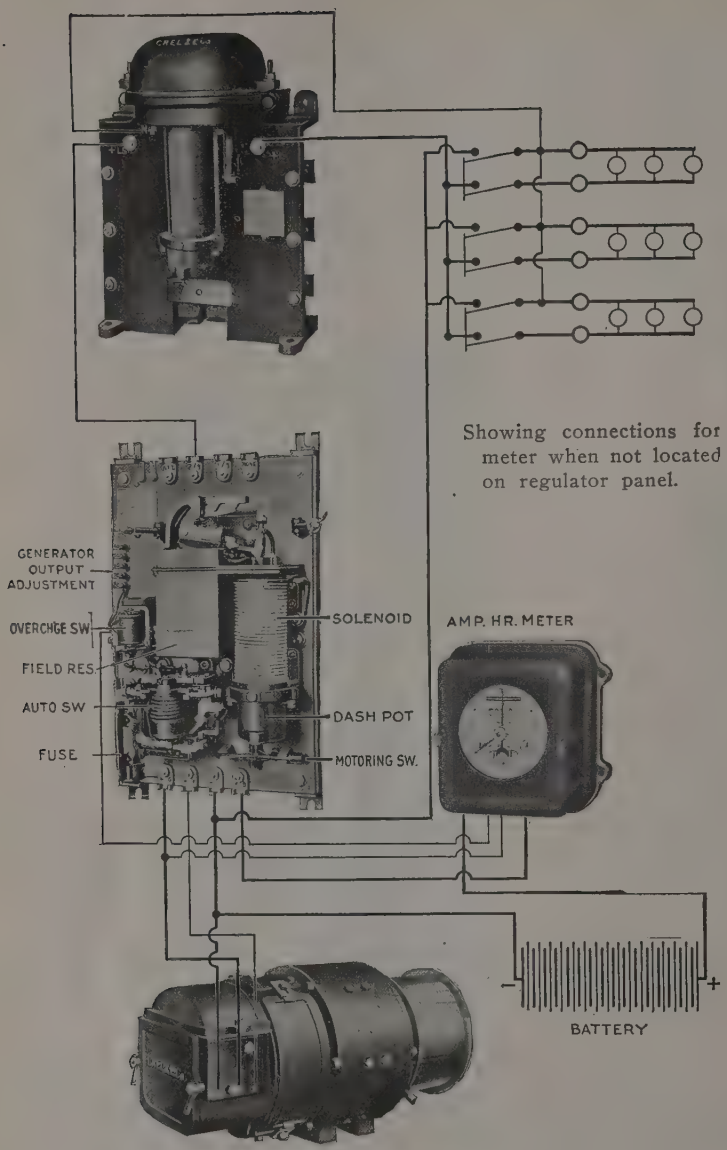


Fig. 2348— Diagram of Connections on a Car Between Dynamo, Batteries and Regulators.

Fig. 2349— Type L-3 Regulator Ampere-Hour Meter Control.

Fig. 2351—Axle Pulley Bushing.

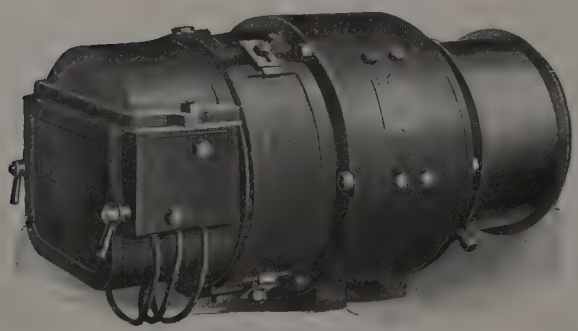


Fig. 2350— Type D-5 Generator.

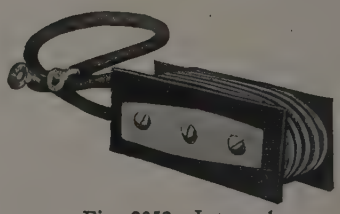
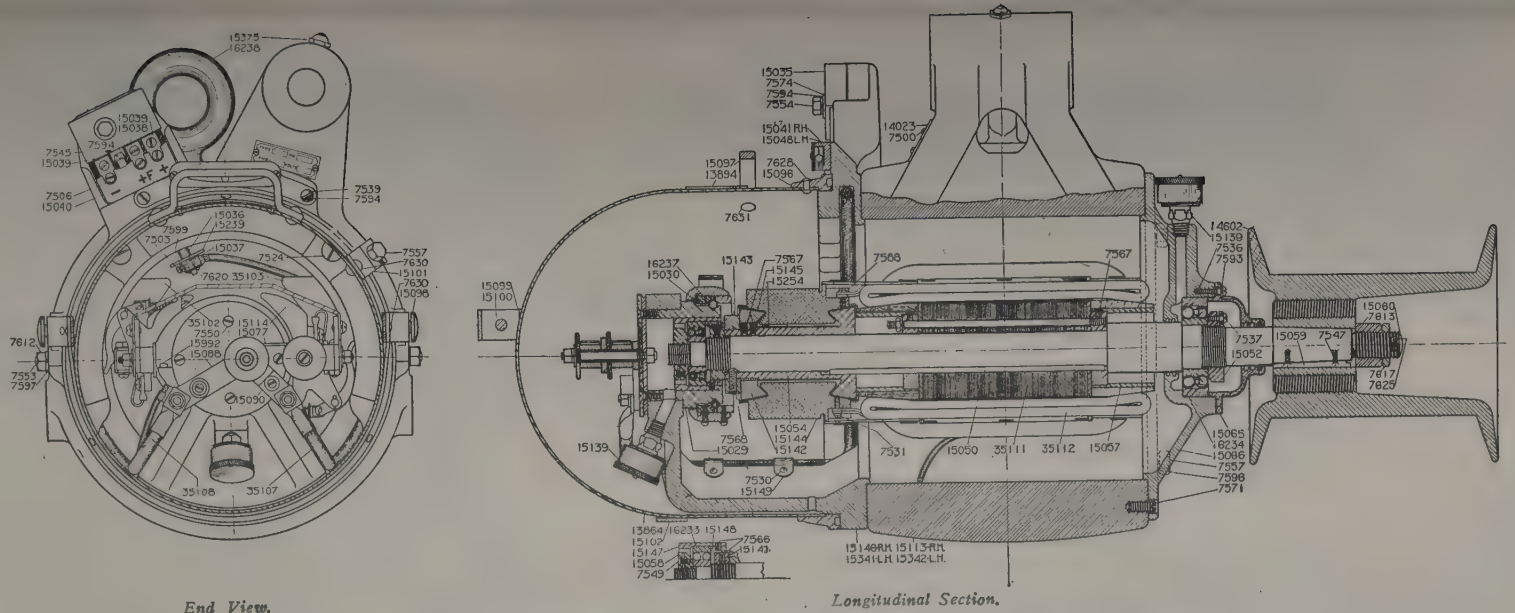


Fig. 2352—Interpole.

Electro Dynamic Company.



End View. *Longitudinal Section.*

Fig. 2353—T-35 Generator, 40-Volt, 40-Ampere Complete for Stone-Franklin Lighting Equipment.

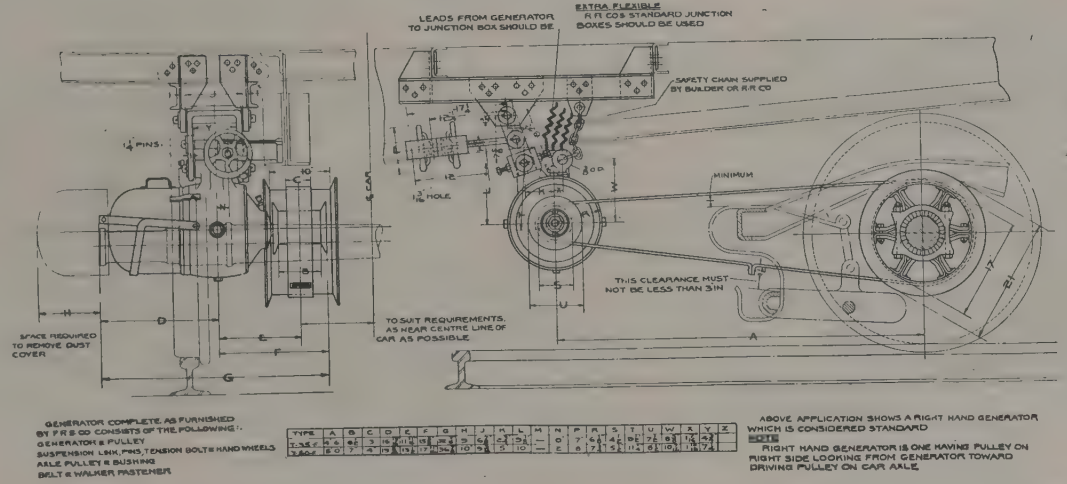

LEADS FROM GENERATOR TO JUNCTION BOX SHOULD BE
EXTRA FLEXIBLE
R.R. CO'S STANDARD JUNCTION BOXES SHOULD BE USED
SAFETY CHAIN SUPPLIED BY BUILDER OR R.R. CO
1/4 PINS
1 3/16 HOLE
MINIMUM
THIS CLEARANCE MUST NOT BE LESS THAN 3IN
TO SUIT REQUIREMENTS. AS NEAR CENTRE LINE OF CAR AS POSSIBLE
SPACE REQUIRED TO REMOVE DUST COVER
GENERATOR COMPLETE AS FURNISHED BY F.R.S. CO CONSISTS OF THE FOLLOWING:
GENERATOR & PULLEY
SUSPENSION LINK, PINS, TENSION BOLT & HAND WHEELS
AXLE PULLEY & BUSHING
BELT & WALKER FASTENER
ABOVE APPLICATION SHOWS A RIGHT HAND GENERATOR WHICH IS CONSIDERED STANDARD
NOTE
RIGHT HAND GENERATOR IS ONE HAVING PULLEY ON RIGHT SIDE LOOKING FROM GENERATOR TOWARD DRIVING PULLEY ON CAR AXLE

Fig. 2354—Stone-Franklin Standard Application Drawing No. 15,300.

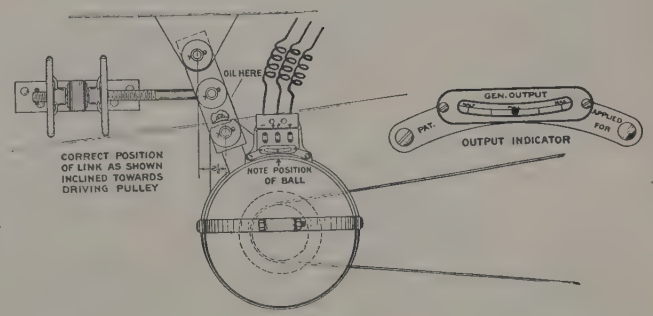
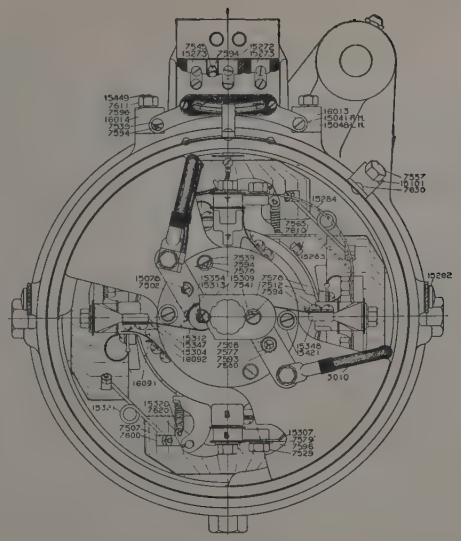
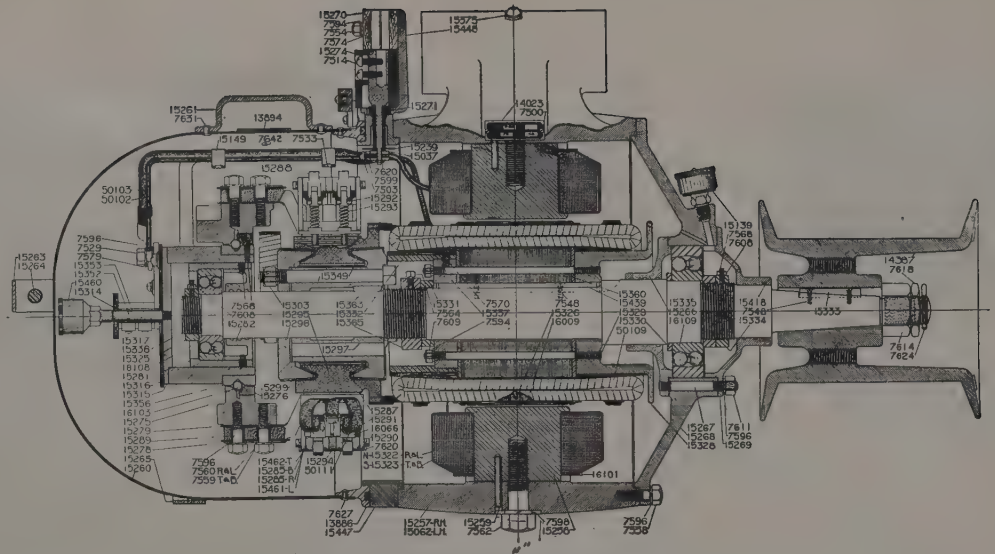


Fig. 2355—Belt Adjustment for Correct Generator Output.

Stone-Franklin Company.



End View.



Longitudinal Section.

Fig. 2356—T-50 Generator, 40-Volt 75-Ampere, Complete for Stone-Franklin Lighting Equipment.

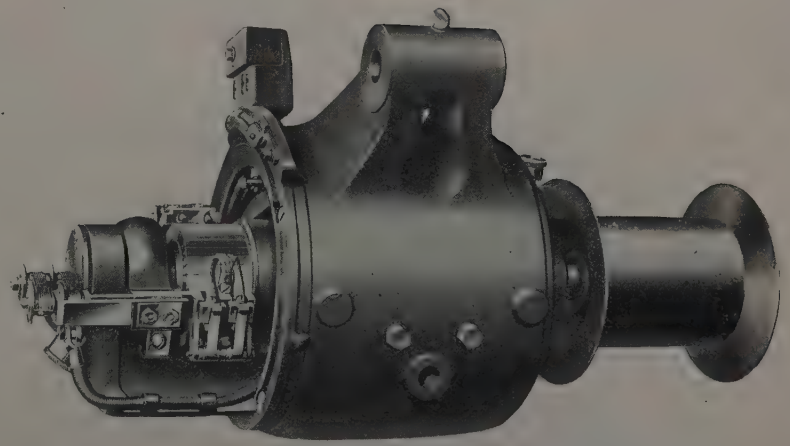


Fig. 2358—T-35 Generator with Dust Cover Removed.

Fig. 2359—One-Light Pendant, No. 22720

Fig. 2360—One-Light Pendant.

Fig. 2361—One-Light Pendant, No. 23100.

Fig. 2362—One-Light Pendant, No. 10010

Fig. 2363—One-Light Pendant, No. 10120.

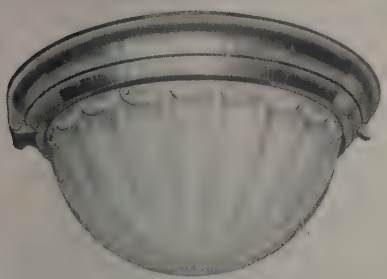


Fig. 2364—One-LightCenter, Fixture No. 22,670.

Fig. 2365—Pendant No. 7760.

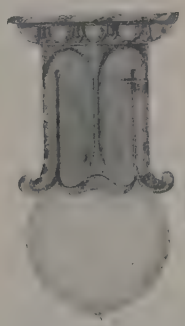


Fig. 2366—Pendant No. 7620.

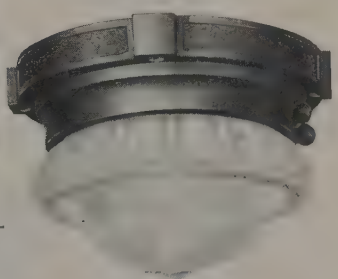


Fig. 2367—One-Light Pendant, No. 23120.

Fig. 2368—Bracket Lamp, No. 9990.

Fig. 2371—Four-Light Chandelier.

Fig. 2369—Bracket Lamp, No. 10000.

Fig. 2370—One-Light Center, Fixture No. 16000.

Fig. 2372—Bracket Lamp No. 23150.

Fig. 2373—One Light Center Fixture.

Fig. 2374—One Light Chandelier.

Fig. 2375—One Light Center Fixture.

Fig. 2376—Bracket Lamp No. 7260.

Closed.

Open.

Fig. 2377—One Light Center Fixture, No. 23130.

Fig. 2378—Bracket Lamp.

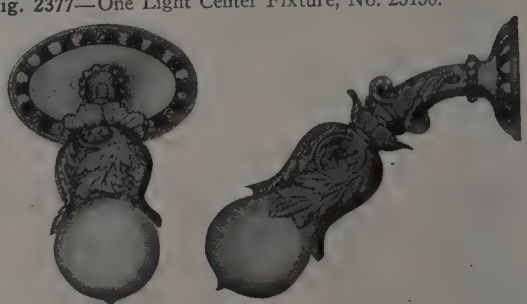
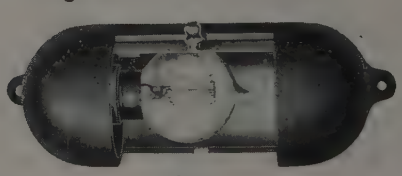


Fig. 2379—Bracket Lamp No. 9230.

Closed.



Open.

Fig. 2380—Berth Lamp No. 22770.

The Adams and Westlake Company.

(See also Page 954)

Fig. 2381—Moonstone Doric Reflector and Hemisphere. The Jefferson Glass Company.

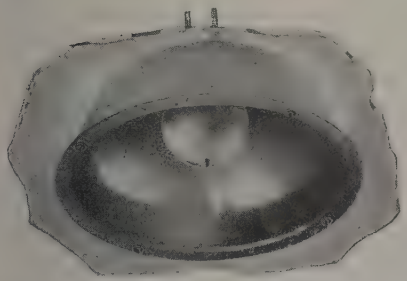


Fig. 2382—Vestibule Fixture. No. 18880 Adams & Westlake Company.

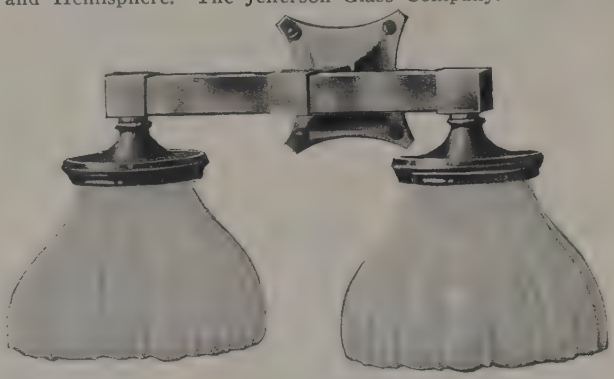


Fig. 2383—Two Light Bracket Lamp. Adams & Westlake Company.

Closed.

Open.

Fig. 2384—Berth Lamp No. 9600. Adams & Westlake Company.

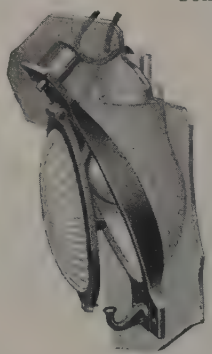


Fig. 2385—Berth Lamp No. 23070. Adams & Westlake Company.

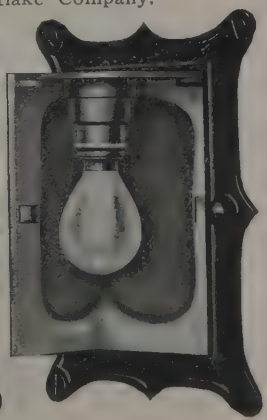
Fig. 2386—Berth Lamp No. 22900.

Closed.

Open.

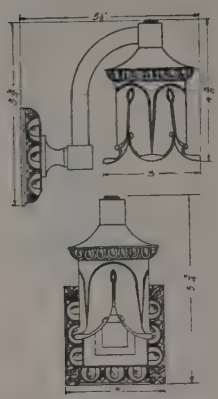
Fig. 2387—Berth Lamp No. 10540. Adams & Westlake Company.

Closed.

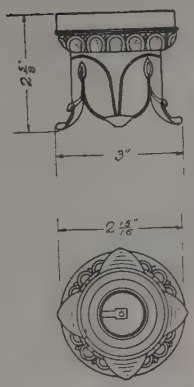


Open.

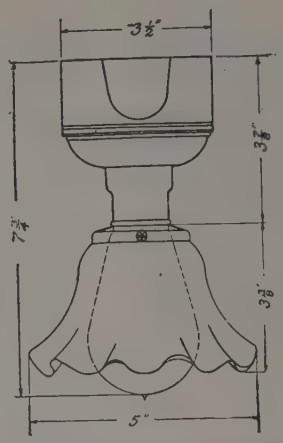
Fig. 2388—Berth Lamp. Adams & Westlake Company.



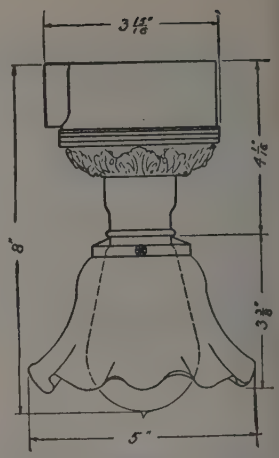
No. 548—Embossed Single Bracket.



No. 549—Embossed Pendant.



No. 544—Plain Ceiling Pendant with Box for Conduit Wiring Complete with Opal Shade.



No. 545 — Embossed Ceiling Pendant with Box for Conduit Wiring Complete with Opal Shade.

Fig. 2389—Bracket and Pendant Electric Lamps. F. H. Lovell & Company.

Fig. 2390 — No. 152 Ceiling Fixture. Dayton Mfg. Company.

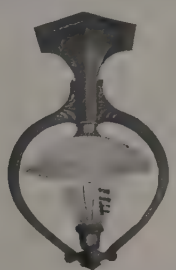


Fig. 2391 — No. 167 Chandelier. Dayton Mfg. Company.

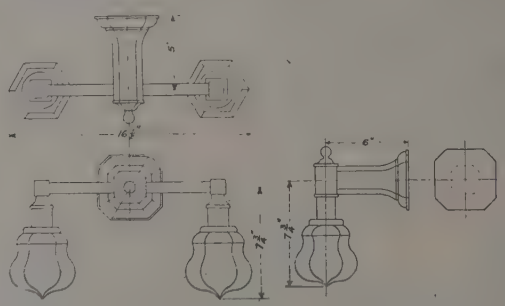


Fig. 2392—Double and Single Bracket Lamps. F. H. Lovell & Company.

Fig. 2393—Dining Car Table Lamp. Dayton Mfg. Co.

Fig. 2394—No. 133 Ceiling Fixture. Dayton Manufacturing Company.

Fig. 2395—No. 149 Ceiling Fixture. Dayton Manufacturing Company.

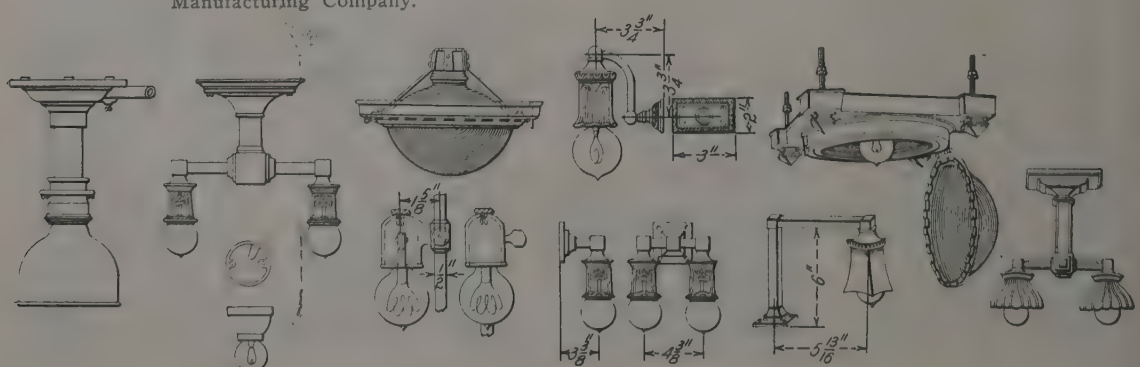


Fig. 2396—Miscellaneous Electric Lamps. Dayton Manufacturing Company.

(See also Page 956)

Fig. 2397—Lamp No. 3694.

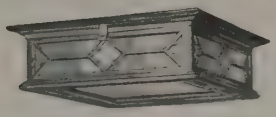


Fig. 2398—Lamp No. 9367.

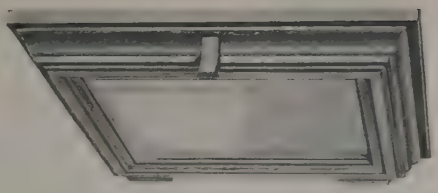


Fig. 2399—Deck Lamp No. 8113.

Fig. 2400—Electric Deck Fixture No. 19129.

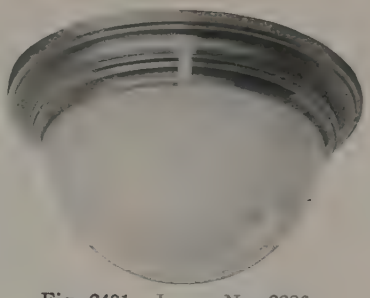


Fig. 2401—Lamp No. 2283.

Fig. 2402—Electric Center Fixture No. 19206.

Fig. 2403—Electric Pendant No. 9700.

Fig. 2404—Lamp No. 8350.

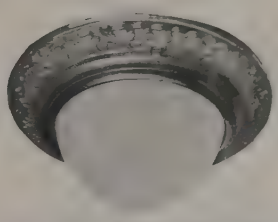


Fig. 2405—Lamp No. 8105.

Fig. 2406—Deck Lamp No. 9050.

Fig. 2407—Vestibule Lamp No. 8406.

Fig. 2408—Platform Lamp.

Fig. 2409—Vestibule Lamp No. 9060.

Fig. 2410—Electric Table Lamp. No. 2453.

Fig. 2411—Table Lamp No. 9860.

Fig. 2412—Electric Fixture No. 19211 for Baggage Car.

No. 19205 No. 19215

Fig. 2413—Electric Fixtures for Postal Car.

Safety Car Heating & Lighting Company

(*See also Page* 935.)

Fig. 2414 — Electric Center Fixture No. 19069.

Fig. 2415—Lamp No. 3880.

Fig. 2416—Lamp No. 3875.

Fig. 2417—Lamp No. 19057.

Fig. 2418—Deck Lamp No. 19078.

Fig. 2419—Pendant No. 3846.

Fig. 2420—Lamp No. 3960.

Fig. 2421 — Deck Lamp No. 19032 With Reflector No. 18678.

Fig. 2422—Fixture No. 19155.

Fig. 2424—Electric Lamp for Condulet.

Fig. 2423—Bracket Lamp No. 8080.

Fig. 2427—Lamp No. 19007.

Fig. 2425—Pendant No. 1749.

Fig. 2426—Pendant No. 9115.

Fig. 2428—Lamp No. 8645.

Fig. 2429—Electric Center Fixture No. 9470.

Fig. 2430—Lamp No. 9385.

Safety Car Heating & Lighting Company

(See also Page 935)

Safety Car Lighting Fixtures

Car lighting fixtures designed and built especially to withstand heavy vibration and other severe conditions are essential in modern railway service. Safety Car Lighting Fixtures meet these requirements and maintain the light source and the reflector in proper relation for correct and efficient illumination. In the Safety Photometric Laboratory not only are designs of fixtures and reflectors under constant study, but also the placing and spacing of lighting units in various styles of cars. This laboratory research work is supplemented by constant contact with actual car lighting problems in railway service.

Fig. 2431—Electric Pendant No. 8185

Fifi. 2432—Electric Bracket No. 8183

The Safety Shade Holder is a simple and dependable device using a series of flexible metal fingers engaging the neck of the reflector firmly but with enough flexibility to absorb vibrations and to permit expansion of the reflector. A metal locking ring, easily and quickly operated, permits inserting or removing the shade. More than 300,000 of these Safety Shade Holders are in use.

Fig. 2433—Electric Semi-Indirect Lighting Fixture No. 19127

All Safety Fixtures which may—from the nature of their location—require occasional refinishing, are so arranged that the exterior may be removed without disturbing electric or gas connections, or interior frames. This facilitates inspection and maintenance.

The Safety Electric Lamp Socket and the Safety Pintsch Mantle have been developed to a high degree of simplicity and reliability by years of experiment, and are equal to the most severe service.

Constant laboratory research on practically every known type of light reflecting and diffusing media have produced the Safety line of glass and metal reflectors, and bowls—all of which have come to be railway standards. A recent development for postal car lighting is the Alukali reflector, made of aluminum with a special reflecting surface.

Fig. 2434—Electric Center Fixture No. 19260

The Safety Engineering Department is ready at all times to give expert counsel on car lighting problems—either by the use of standard fixtures from the unusually complete Safety line, or by the design of special fixtures to meet unusual conditions.

Electric Fans for railway passenger cars are also manufactured by the Safety Car Heating and Lighting Company. The proportions of passenger car interiors impose conditions which the ordinary commercial electric fan does not satisfy. To meet these requirements, a special type of ceiling fan has been devised, on entirely new principles, which circulates air just where required for comfort without causing excessive drafts at any point. In addition to this type of ceiling fan, the Safety Company also offers a variety of electric bracket fans and electric exhaust fans. The armatures and other parts of the motors are interchangeable throughout this complete line of fans.

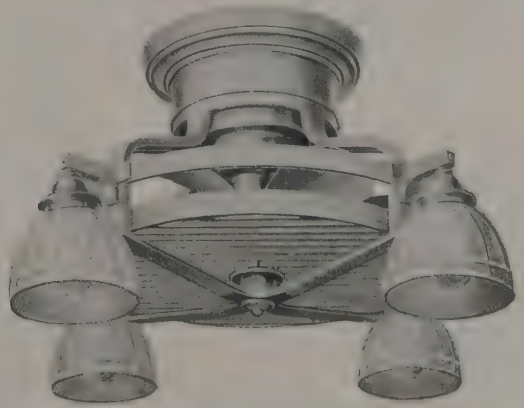


Fig. 2435—Combination Fan and Lighting Fixture No. 19140-C

A combined Electric Fan and Lighting Fixture, as shown in Fig. 2435, has also been developed by the Safety Car Heating and Lighting Company. This equipment provides lighting and ventilating facilities in a compact unit, which embodies the advantageous features of other Safety fixtures and at the same time avoids the overcrowding of the car ceiling.

For other products and branch offices, see classified and alphabetical indexes.

Fig. 2436—Bracket Lamp No. 8373.

Fig. 2437—Bracket Lamp No. 8183 With Base Switch.

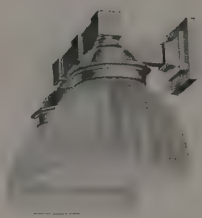


Fig. 2438—Bracket Lamp No. 8184.

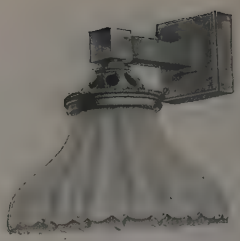


Fig. 2439—Bracket Lamp No. 2305.

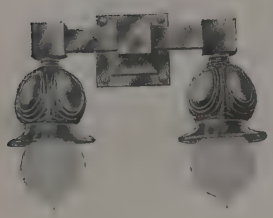


Fig. 2440—Two-Light Bracket.

Fig. 2441—Bracket Lamp No. 19075.

Fig. 2442—Bracket Lamp No. 1785.

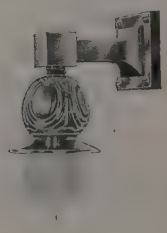


Fig. 2443—One-Light Bracket.

Fig. 2444—Bracket Lamp No. 8249.

Fig. 2445—Bracket Lamp No. 19026.

Fig. 2446—Bracket Lamp No. 3845.

Fig. 2447—Bracket Lamp No. 8960.

Fig. 2448—Berth Lamp No. 3862.

Fig. 2449—Berth Lamp. No. 19195.

Fig. 2450—Platform Lamp.

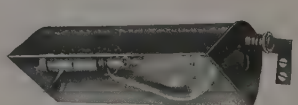


Fig. 2451—Desk Lamp No. 2149L.

Fig. 2452—Berth Lamp No. 2485.

Fig. 2453—Corner Berth Lamp.

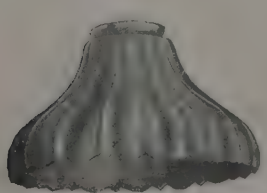


Fig. 2454—Pressed Glass Shade No. 2346.

Fig. 2455—Reflector No. 8391.

Fig. 2456—Opal Bowl No. 8439.

Safety Car Heating & Lighting Company

(See also Page 935.)

Fig. 2457—Alukali Reflector No. 51270.

Fig. 2458—Candle-Lamp Chimney No. 234.

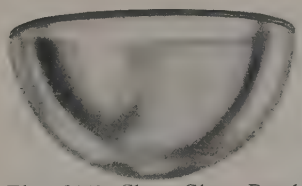


Fig. 2459—Clear Glass Bowl No. 596.

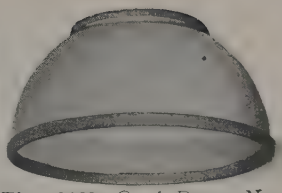


Fig. 2460—Opal Dome No. 1326.

Fig. 2461—Alukali Reflector.
No. 51260 No. 51240

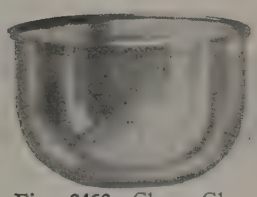


Fig. 2462—Clear Glass Bowl No. 100.

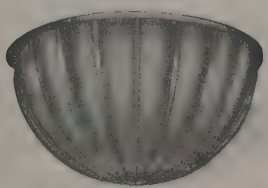


Fig. 2463—Opal Bowl.
No. 51854—10″.
No. 51855—12″.

Fig. 2464—Frosted Bowl, 9-in. No. 3320.

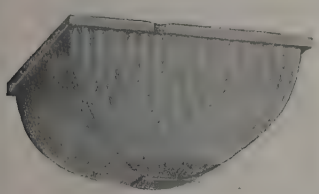


Fig. 2465—Bowl No. 8159.

Fig. 2466—Prismatic Reflector. No. 18246.

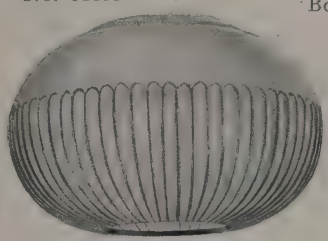


Fig. 2467—Corona Bowl No. 3425.

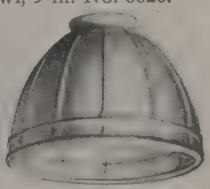


Fig. 2468—Opal Reflector.
No. 18630
No. 18637
No. 18638

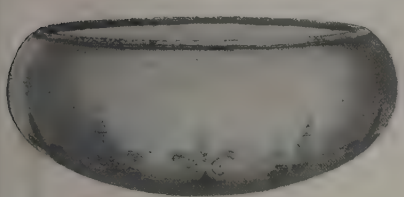


Fig. 2469—Etched Bowl No. 9799.

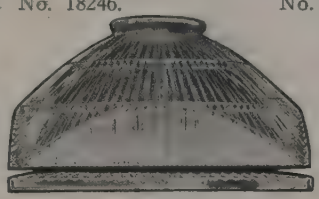


Fig. 2470—Prismatic Reflector Plate Unit No. 18371.

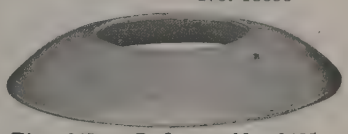


Fig. 2471— Reflector No. 9425.

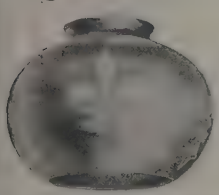


Fig. 2472—Etched Shade No. 9757.

Fig. 2473—Prismatic Bowl No. 18053.

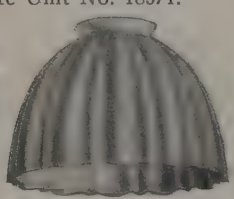


Fig. 2474—Shade No. 9011.

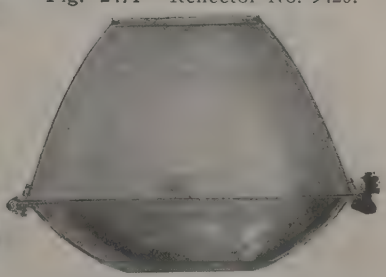


Fig. 2475—Alukali Reflector Bowl Unit, No. 51250, Pintsch Mantle Lamps.

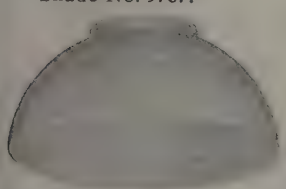


Fig. 2476—Opal Shade No. 104.

Fig. 2477—Shade No. 8261.

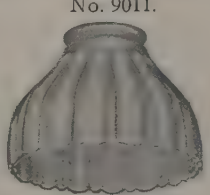


Fig. 2478—Reflector No. 3797.

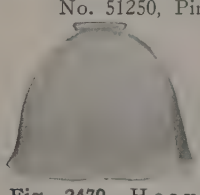


Fig. 2479—Heavy Density Opal Reflector No. 18678.

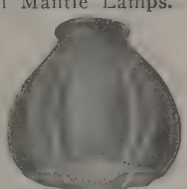


Fig. 2480—Shade No. 3990.

Fig. 2481—Opal Shade No. 3116.

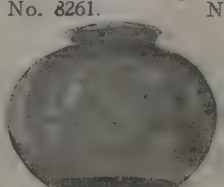


Fig. 2482—Shade No. 3847.

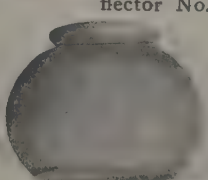


Fig. 2483—Opal Shade No. 102.

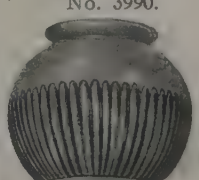


Fig. 2484—Bowl No. 8025.

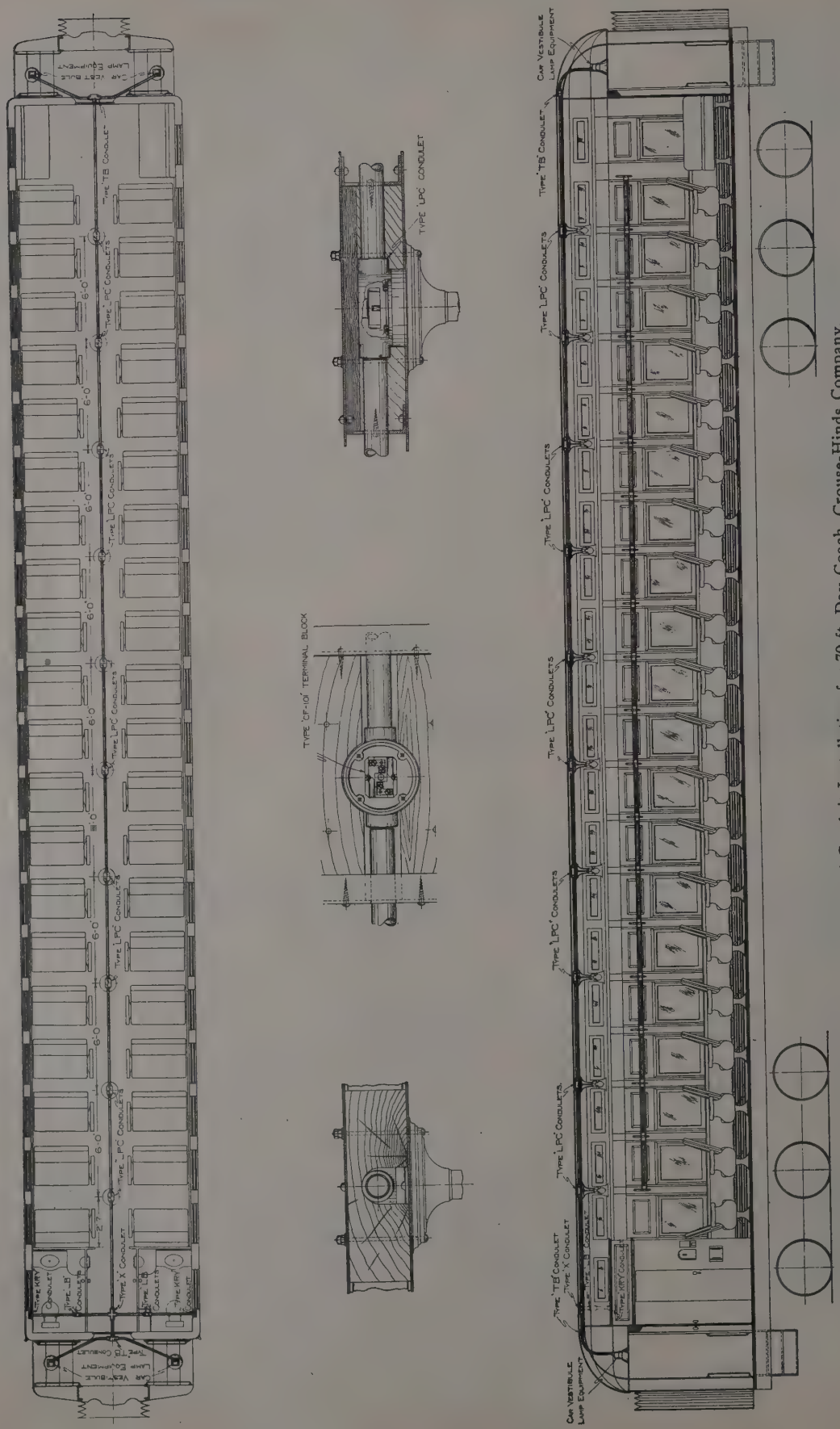


Fig. 2485—Condulets and Conduit Installation for 70-ft. Day Coach. Crouse-Hinds Company.

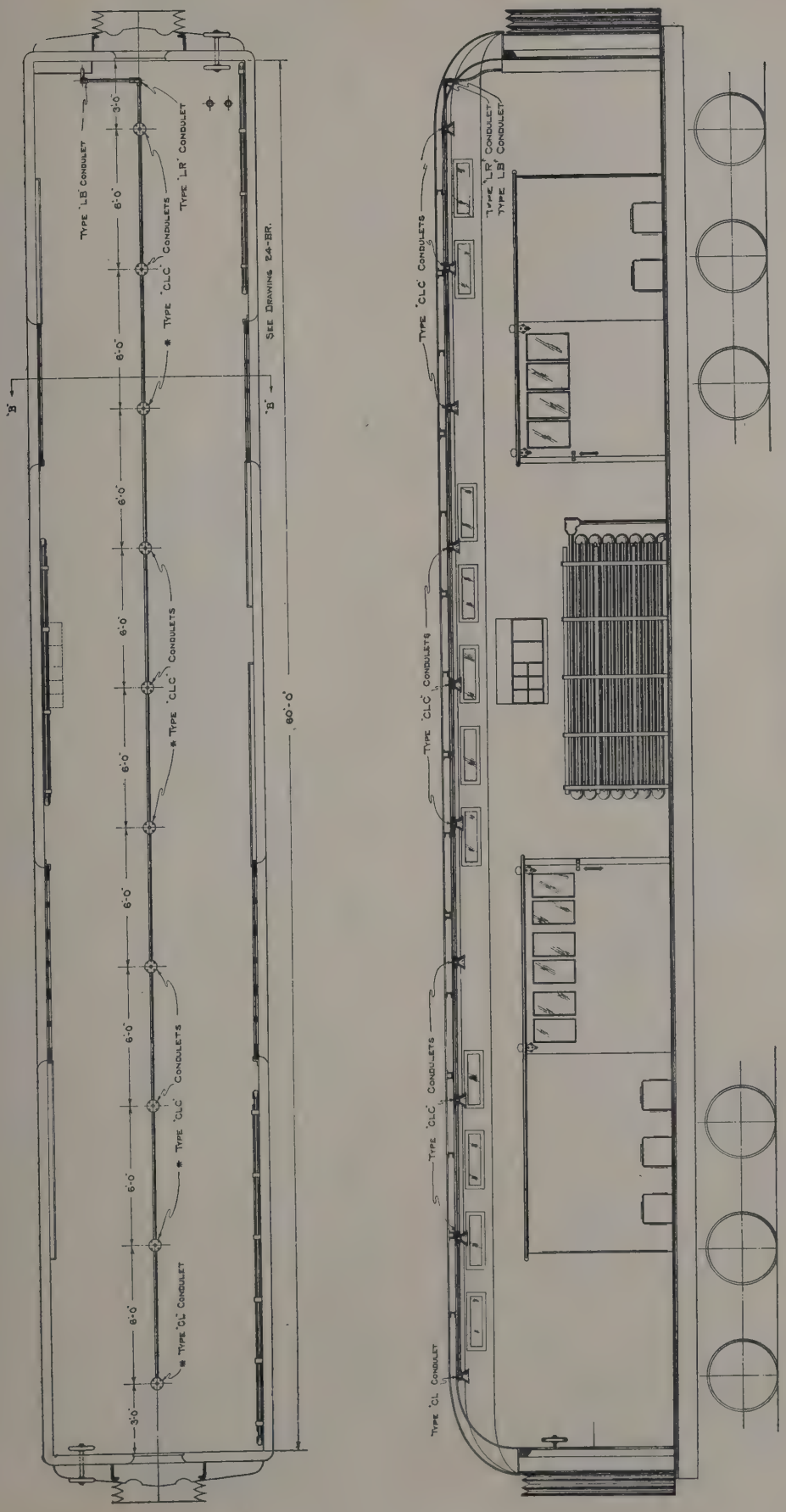


Fig. 2486—Condulet and Conduit Installation for 60-ft. Baggage Car. Crouse-Hinds Company.

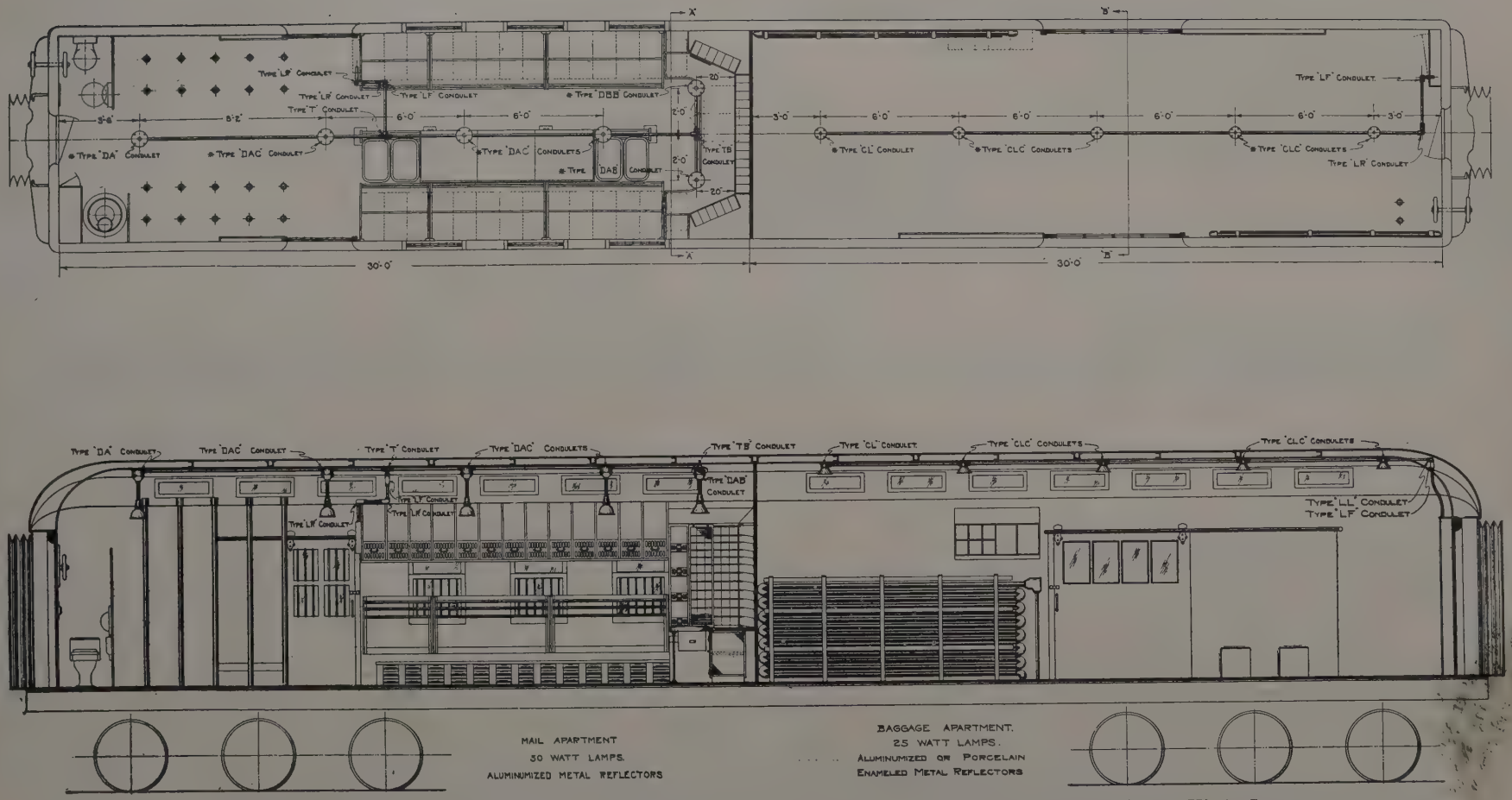


Fig. 2487—Condulet and Conduit Installation for Standard 30-ft. Mail and 30-ft. Baggage Compartments. Crouse-Hinds Company.

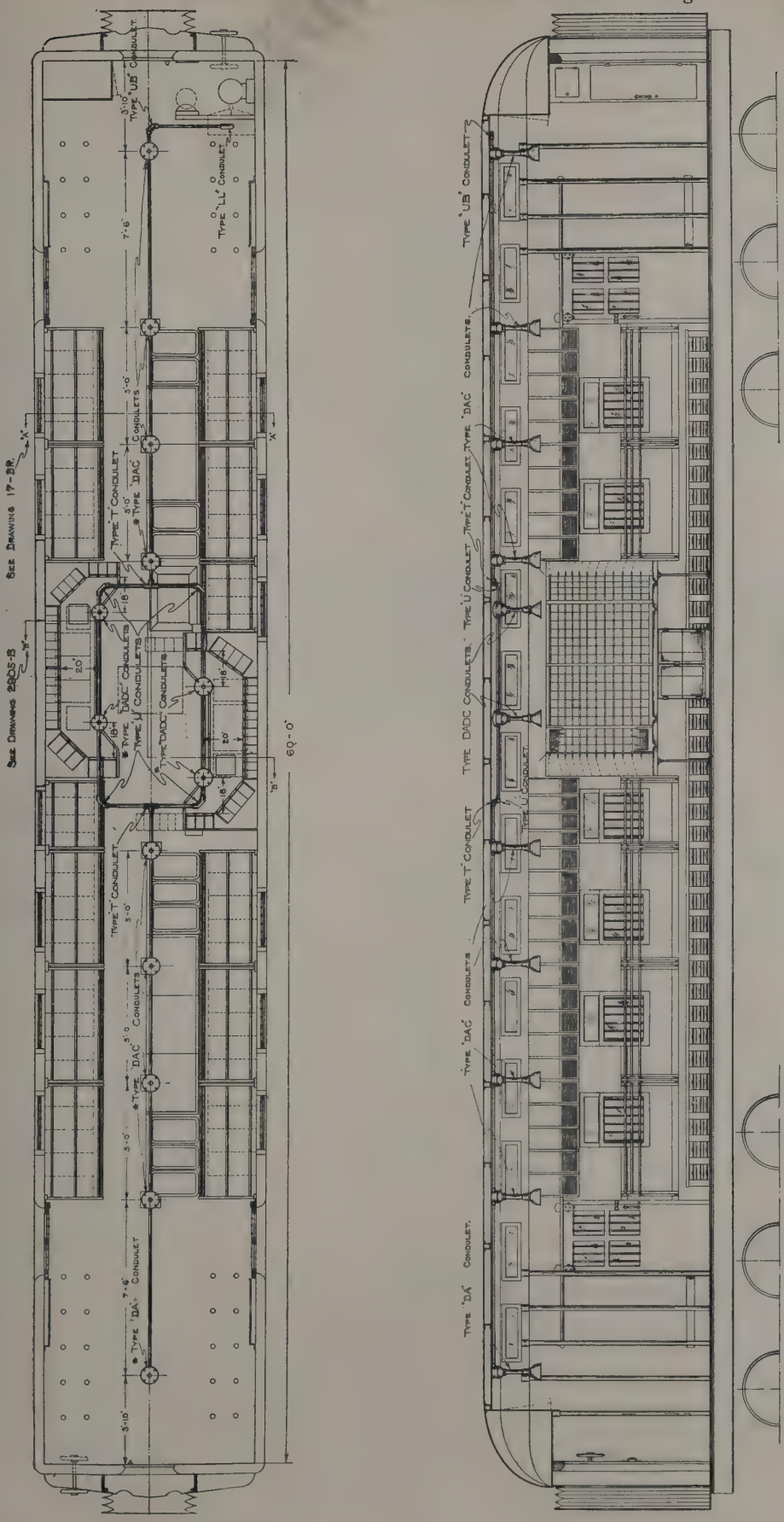


Fig. 2488—Lighting Installation Meeting United States Railway and Mail Service Specifications for Postal Cars. Crouse-Hinds Company.

(*See Fig. 2489 for Transverse Sections.*)

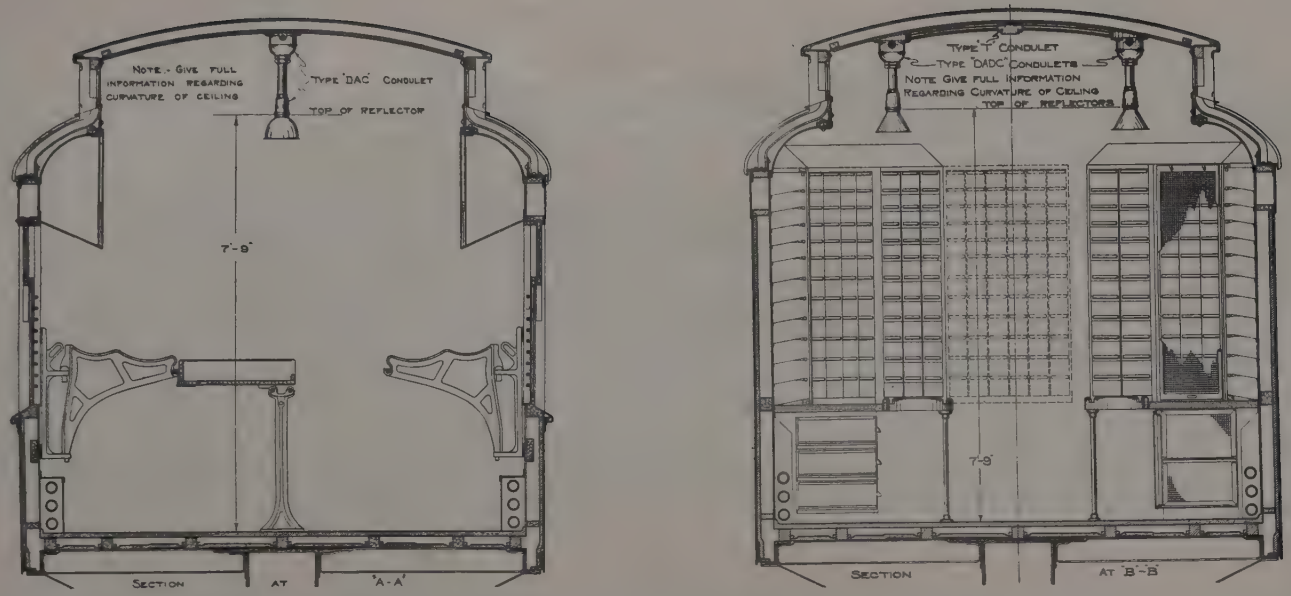


Fig. 2489—Transverse Sections of Mail Car Shown in Fig. 2488. Crouse-Hinds Company.

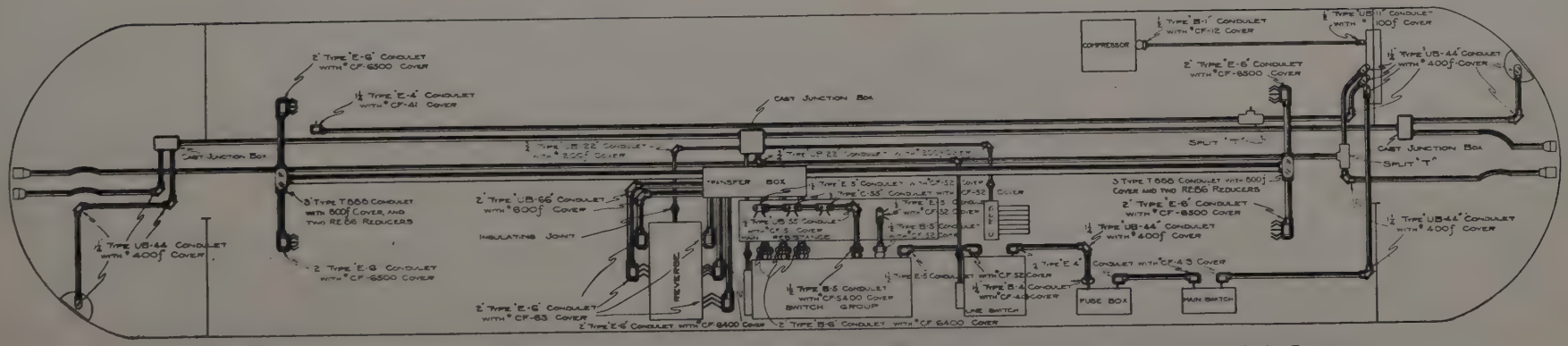


Fig. 2490—Condulet Installation for Underneath an Electric Car Equipped with Multiple Unit Control. Crouse-Hinds Company.

Kerite Insulated Wires and Cables

The Kerite Insulated Wire & Cable Company, Inc., has, for over half a century manufactured high grade insulated wires and cables for aerial, underground, submarine and interior service. With the advent of electricity for use in train lighting and train propulsion, there was created a demand for insulated wires and cables capable of withstanding the most severe kind of service. The long experience of the Kerite Company has proved to be of special value in meeting the demands of railway car builders and electrical engineers.

The distinctive characteristics of Kerite insulation include long life, and resistance to drying out or to the action of heat, oils, and various chemical reagents. This insulation also retains its initial physical, chemical, and dielectric properties for a long period of time.

The uses for which these characteristics adapt Kerite wires and cables in railway car building, include three classes. On steam railway cars, they are suitable for the electric train lighting circuits,—axle generator, portable storage battery, or head-end systems. On electric railway cars they may be used for lighting circuits, power circuits, and control circuits including bus lines, jumpers, and high tension trolley connections. The yard and terminal uses are comprised of power and lighting circuits for shops, battery charging plants, and for storage battery connectors.

For steam railway equipment Kerite flexible braided cables are adapted for axle generator leads; Kerite stranded plain insulated cable may be used for storage battery connectors. Kerite solid or stranded low voltage braided conductors are suitable for car wiring installed in conduits and have N. E. C. S. wall thickness of insulation. Braided fixture wires for car lighting, train bus-line cables, and extra flexible coupler cables for head-end lighting systems are other Kerite products manufactured especially for railway use.

For electric railway equipment, Kerite products include stranded or solid braided conductors for series, multiple, or emergency battery car lighting; train bus-line cables and control cables, also the connectors and jumpers for these circuits; flexible motor leads; high tension cables for trolley or pantograph connections on A. C. equipment.

For storage battery charging installations Kerite wires and cables are widely used for generator, switchboard, and station circuits; Kerite underground cables, braided or leaded are economical for yard and terminal distribution; and special armored or protected portable cables are manufactured for battery charging.

The illustration—Fig. 2491—gives a clear idea of the thoroughness with which Kerite portable cables for battery charging are constructed. Each conductor is a flexible stranded copper wire. These conductors are individually covered with a wall of Kerite insulation applied to give insulating properties while withstanding the twisting, bending and generally rough handling to which such equipment is subject. Over this layer of insulation is a layer of fabric. The round cross-section of the complete cable is obtained by means of jute laterals. The "core" so built up is bound together and held in place by three layers of woven fabric. The exterior fabric is designed for protection against the rubbing and scraping incident to service. From the foregoing it is evident that durability is an inherent quality of this Kerite product and economy results from its installation.

Fig. 2491—Kerite Portable Cable for Battery Charging

The company uses the best materials and processes of manufacture that experience indicates, or that money can procure, which insures accuracy of size, precision of workmanship, and excellence of finish. Great uniformity of product is secured by thorough test and inspection and a pride in the excellence of output, resulting from over fifty years of manufacture, continuity of responsibility and control.

Insulation of great permanency is required in order to withstand the drying out and vibration encountered in car lighting circuits; and the acid, oil, water, and rough handling in battery charging plants. In all electrical equipment of cars, renewals are expensive and interruption of operation, due to inadequate service given by materials, cannot be tolerated.

The service record of Kerite wires and cables, insures that the highest safety, reliability and economy will result from their use.

For other products and branch offices, see classified and alphabetical indexes.

KERITE INSULATED WIRE & CABLE CO., INC., NEW YORK, N. Y.

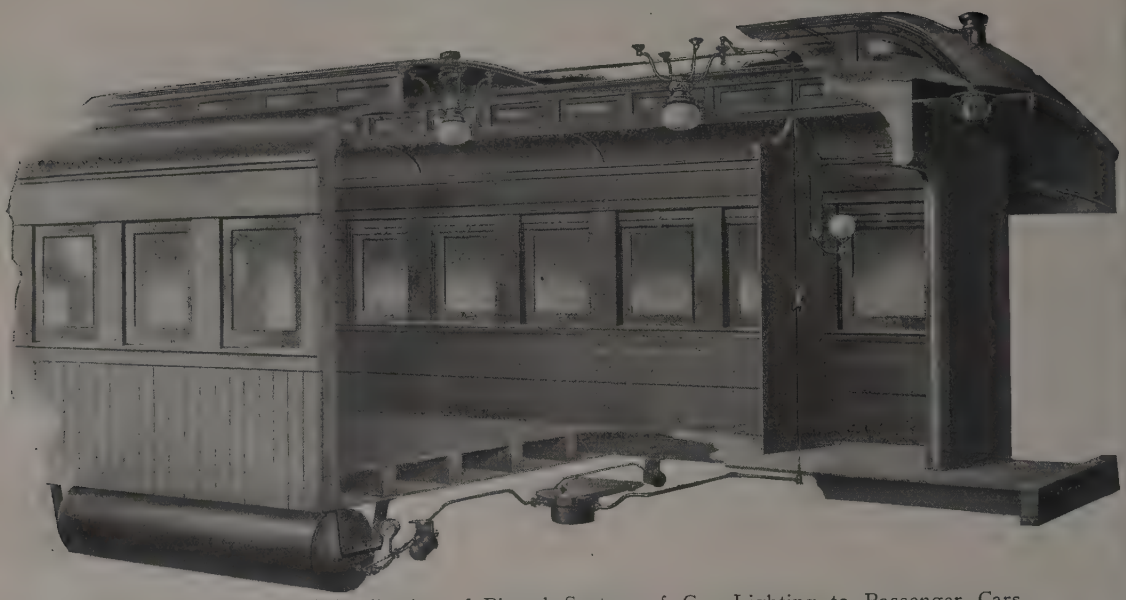


Fig. 2492—Method of Application of Pintsch System of Gas Lighting to Passenger Cars.

Torch and Key. No. 300

Regulator.

No. 244 2 in. Water Pressure.
No. 254 2 lb. Pressure.
No. 1844 6 in. Water Pressure.
No. 1954 1 lb. Pressure.

No. 222a, Burner.

Cover for Main Cocks.

Main Cock; ¼, ⅜ and ½ in.

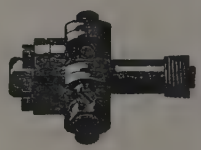
No. 214a, Gage for Car.

Nos. 12-13, Tee Flange Unions; ¼ by ⅛ in. ¼ by ¼ in.

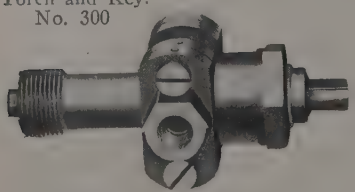
No. 49, Flange Tee for Regulator, ¼ in.

No. 17a, Angle Flange, ⅛ in.

Nos. 16a, b and c, Tee Flanges.

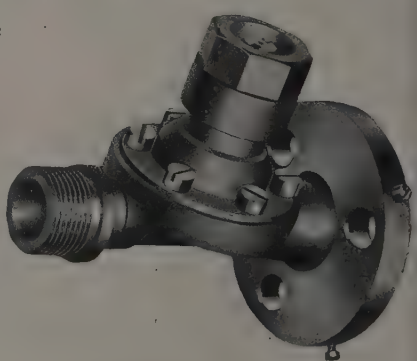


No. 55a, Flange Cross.



Holder Valve No. 53B.

No. 118a, Bracket for Filling Valve.



Filling Valve No. 8665.

Fig. 2493—Filling Valve Cover No. 8689.

Fig. 2494—Gas Holder No. 250.

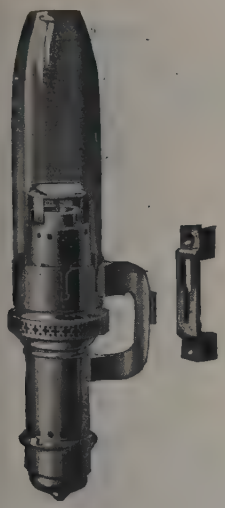


Fig. 2495—Removable Candle Bracket Emergency Lamp No. 282.

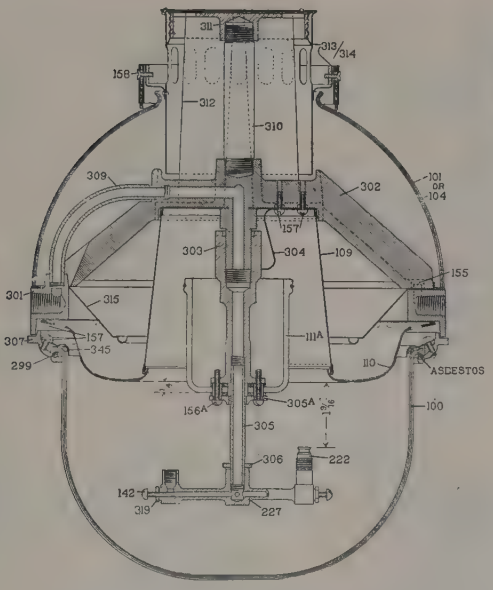


Fig. 2496—Section Through Standard Lamp Body.

Fig. 2497—Two and Four-Flame Vestibule Lamp No. 194.

Parts of Mantle Lamps—Fig. 2500

2603a *Opal Bowl*
2611 *Mantle and Globe Holder*
2620 *Globe Ring*
2621 *Mantle and Globe Holder*
2640 *Mantle*
2712 *Clear Glass Bowl*
2751 *Inner Globe Ring*
2752 *Outer Globe Ring*
2753 *Inner Globe Ring*

List of Parts—Fig 2496

100 *Glass Bowl*
101 *Opalescent Dome*
104 *Opal Dome*
109 *Mica Chimney*
110 *Ring Reflector*
111a *Cup Reflector (Porcelain)*
142 *Check Screws for Cluster*
155 *Screw for Hinge and Spider*
156 *Screw for Hinge Cover and Spring Catch*
156a *Screw for Cluster Stem*
157 *Screw for Reflector*
158 *Screw for Inner Ring or Crown*
222 *Burner Tips, Hexagon Base*
227 *Four-flame Cluster*
299 *Asbestos Wick*
301 *Cast Iron Ring*
302 *Spider*
303 *Extension Pillar*
304 *Lock*
305 *Cluster Stem*
305a *Cluster Stem Flange*
306 *Locknut for Cluster Stem*
307 *Bezel or Ring for Bowl*
309 *Gas-way Tube*
310 *Post*
311 *Top Piece for Flues*
312 *Flues*
313 *Chimney*
314 *Ring for Fastening Crown*
315 *Diaphragm*
319 *Locknuts for Check Screws*
345 *Spun Globe Holder Ring*

Fig. 2498 — Pintsch Mantle.
—90 c.p. No. 3044
—25 c.p. No. 9644

Fig. 2499—Pintsch Mantle No. 2640 and Protector.

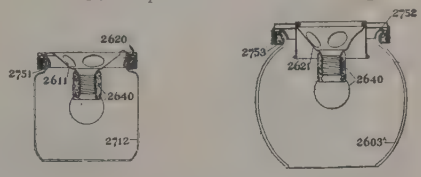


Fig. 2500—Sections Through Mantle Lamp Bulbs.

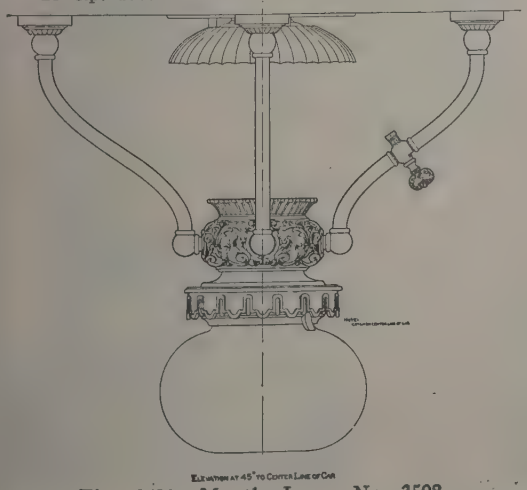


Fig. 2501—Mantle Lamp No. 3508.

Fig. 2502—Mantle Lamp No. 8531, for Letter Cases in Postal Cars.

Fig. 2503—Drop Bracket Lamp No. 86.

Fig. 2504—Bracket Mantle Lamp No. 2536.

Fig. 2505—Deck Mantle Lamp No. 8511 for Baggage Cars.

Fig. 2506—Bracket Mantle Lamp No. 2587.

Fig. 2507 — Combination Gas and Electric Bracket Lamp No. 1910A.

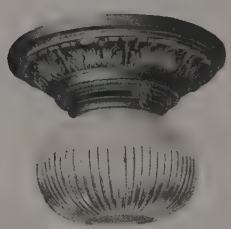


Fig. 2508—Gas Mantle Lamp No. 3599.

Fig. 2509—Mantle Lamp No. 3534.

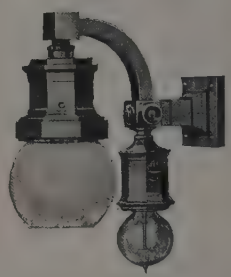


Fig. 2510—Combination Gas and Electric Bracket Mantle Lamp No.

Safety Car Heating & Lighting Company

Fig. 2511—Combination Bracket Lamp, Gas Mantle and Electric.

Fig. 2512 — Deck Gas Mantle Lamp.

Fig. 2513—Gas Mantle Lamp.

Fig. 2514 — Bracket Gas Mantle Lamp.

Fig. 2515 — Combination Mantle Lamp, Gas Mantle and Electric.

Fig. 2516—Gas Mantle Lamp.

Fig. 2517—Combination Gas Mantle and Electric Deck Lamp.

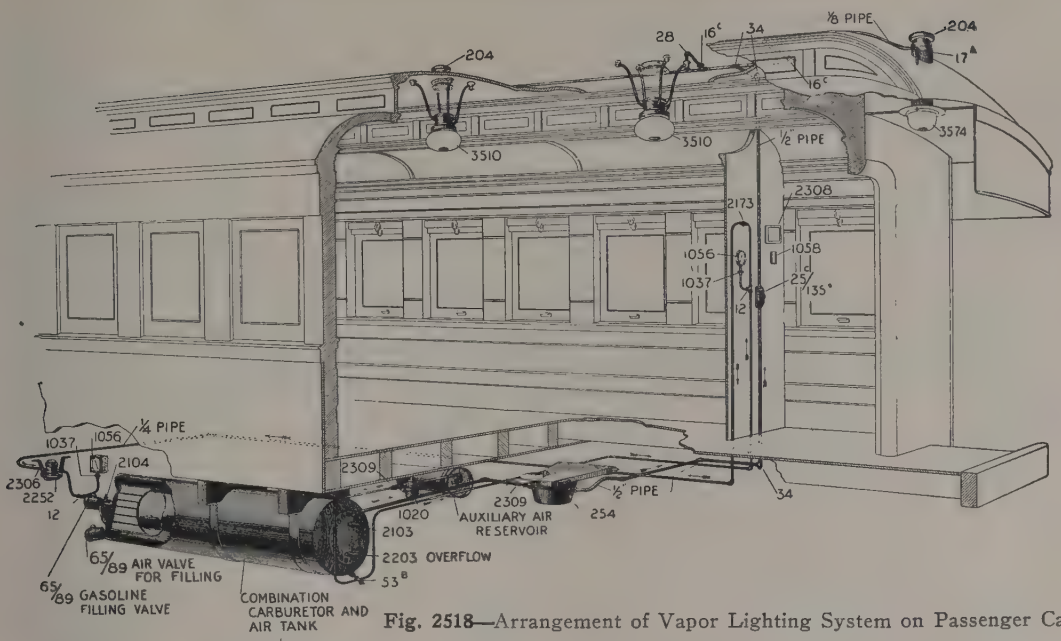


Fig. 2518—Arrangement of Vapor Lighting System on Passenger Car.

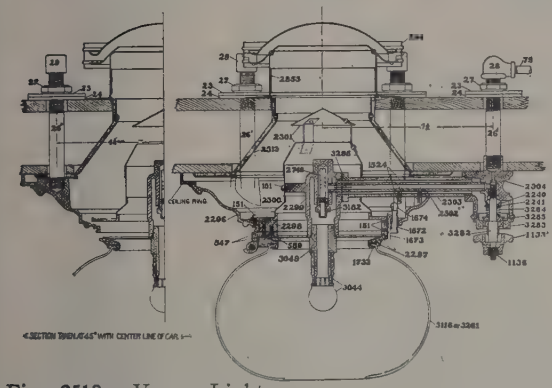


Fig. 2519—Vapor Lighting Deck Lamp No. 3530.

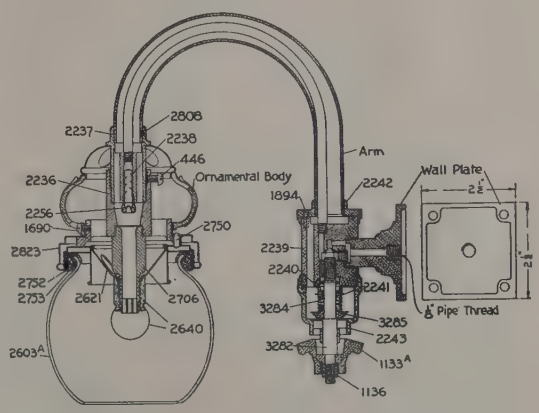


Fig. 2520—Vapor Lighting Bracket Lamp.

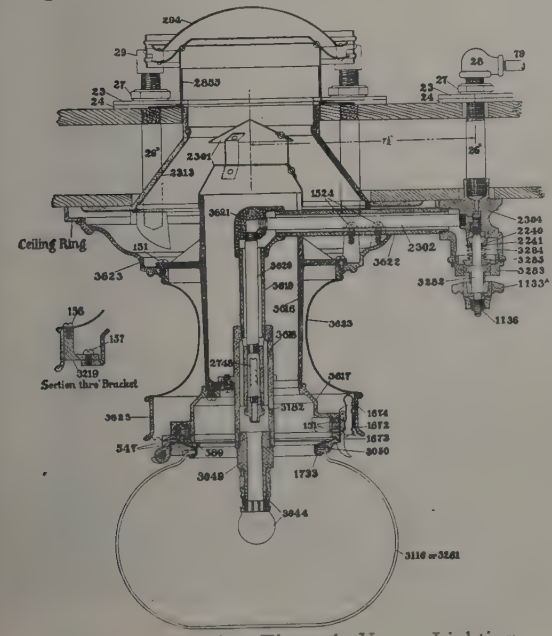


Fig. 2521—Section Through Vapor Lighting Lamp No. 3546.

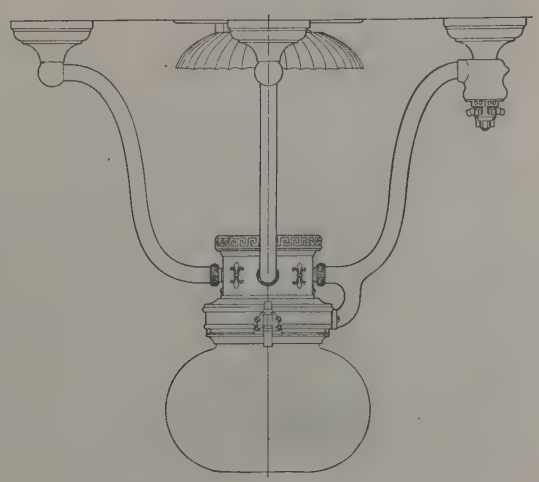


Fig. 2522—Vapor Lighting Lamp No. 3510.

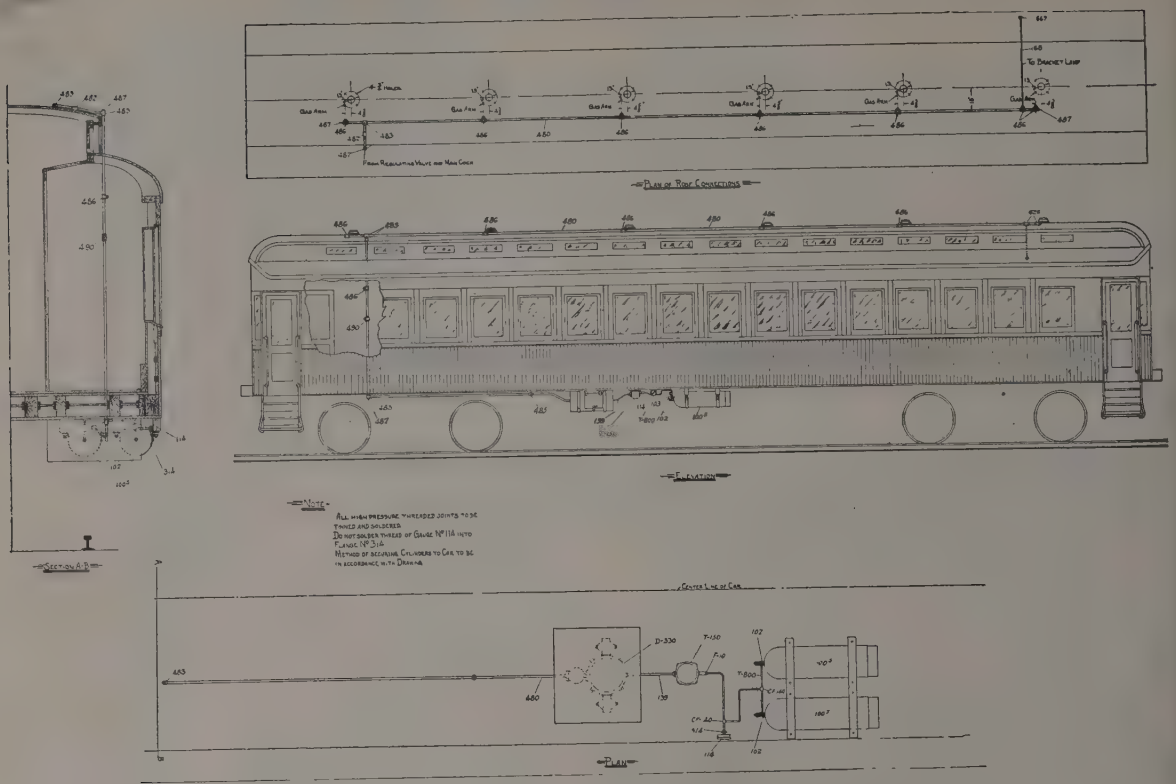

Plan of Roof Connections
Elevation
Section A-B
Plan
Note
All high pressure threaded joints to be tinned and soldered.
Do not solder threads of Gauge No. 114 into Flange No. 314.
Method of securing Cylinders to Car to be in accordance with Drawing.

Fig. 2523—Complete Plan of Installation of A. G. A. Lighting System to Railway Coach.

List of Parts, Figs. 2523-2524.

High Pressure Equipment		Low Pressure Equipment	
2 12 in. x 44 in. Cylinders	100-S	100 ft. ¾ in. Galv. Iron Pipe	480
2 Hexagon Brass Nuts for Cylinder Connection	100	1 ¾ in. Galv. Iron Couplings	481
2 Case-hardened Steel Nipples for Cylinder Connection	103	1 ¾ in. Galv. Iron Couplings—R. & L.	482
1 Key for Cylinder	106	3 ¾ in. Galv. Iron Tees	483
2 Block Tees for 8 m/m Tubing	CF-140	1 ¾ in. Ground Joint Union, Galv.	485
1 Mixer Connection	F-10	8 ¾ in. x ¾ in. x ⅛ in. Brass Union Tees	486
1 Pressure Gauge	114	4 ¾ in. Plugs	487
20 ft.—8 m/m Copper Covered Tubing	T-800	24 ¾ in. Pipe Straps	488
6-8m/m Pipe Straps	F-120	1 ¾ in. Main Cock	490
1 Mixer	D-330	1 Main Cock Key	491
1 Pressure Regulator with Filter	T-150	25 ft. ⅛ in. Galv. Iron Pipe	168
24 in.—⅜ in. Extra Strong Pipe	139	12 ⅛ in. Galv. Pipe Straps	171-D
1 Gauge Connection	314	1 1⅛ in. Brass Flanged E11	867

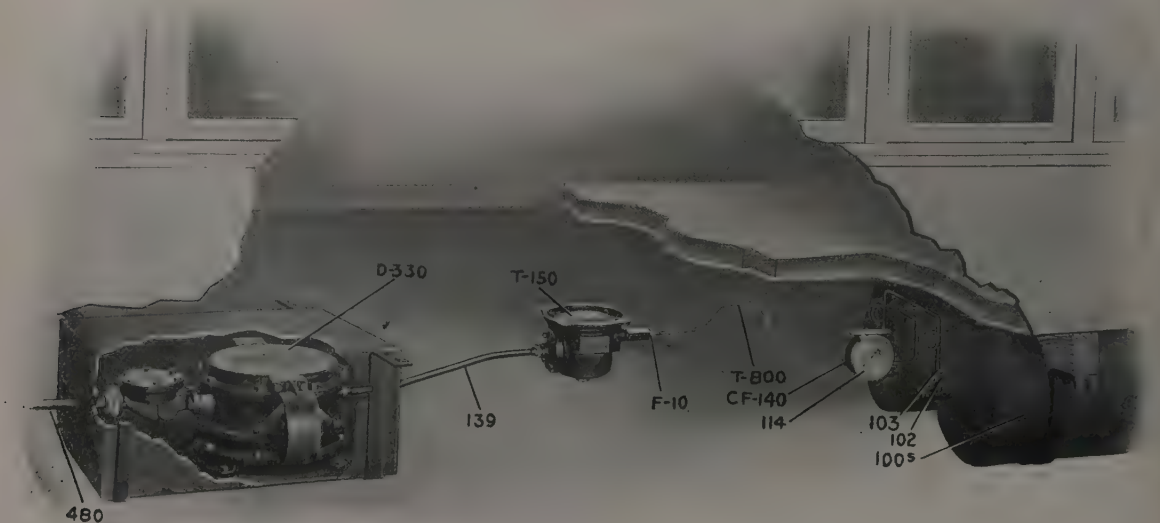


Fig. 2524—A. G. A. Lighting System Applied to Coach.

A. G. A. Railway Light & Signal Company.

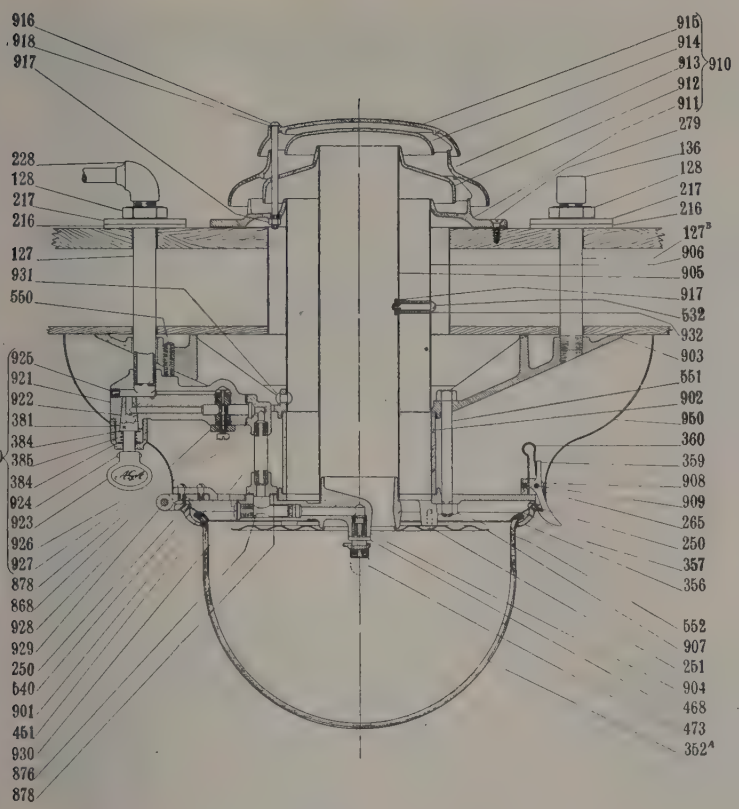


Fig. 2525—Section of 12 in. Drop Deck Lamp. No. 900.

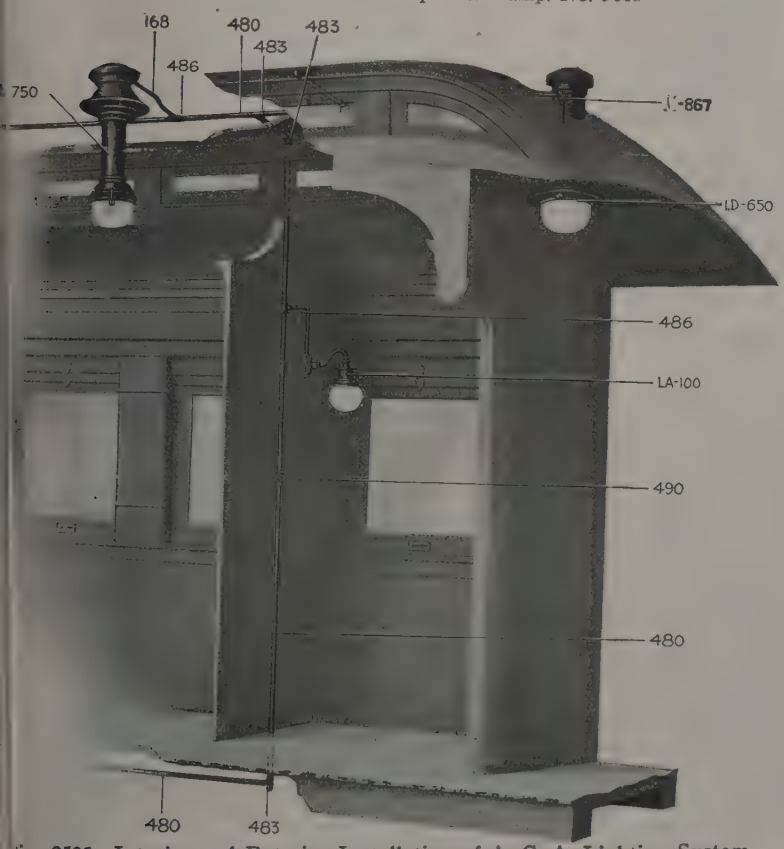


Fig. 2526—Interior and Exterior Installation of A. G. A. Lighting System.

List of Parts, Fig. 2525.

352A	9½ *in. Opal Bowl*
356	*Bezel Ring*
357	*Globe Holder*
901	*Lamp Body Plate*
902	*Lamp Body Ring*
903	*Lamp Body Support*
904	*Gas Way*
905	*Inner Flue*
906	*Outer Flue*
910	Ventilator Complete includes:
911	*Base Plate for Ventilator*
912	*Draft Flue for Ventilator*
913	*Bottom Cover for Ventilator*
914	*Inside Cover for Ventilator*
915	*Outside Cover for Ventilator*
916	*Screw for Ventilator*
917	*Hex. Nut*
918	*Lead Washer for Ventilator Bolt*
907	*8 in. Enameled Reflector*
359	*Catch*
360	*Spring for Catch*
908	*Support for Catch*
909	*Pin for Catch*
920	Cock Complete includes:
921	*Body for Cock*
922	*Plug for Cock*
923	*Thumb-piece for Cock*
924	*Pin for Cock*
381	*Cap for Cock*
384	*Washer for Cock*
385	*Spring for Cock*
928	*Hinge Plate*
929	*Hinge Pin*
925	*Plug for Pilot Bore*
926	*Body for Pilot Valve*
927	*Stem for Pilot Valve*
930	*Choke Plug*
468	*Burner Tip*
473	*½ cubic foot Mantle*
950	*Spun Lamp Body*
127B	*⅜ in. x 5 in. Nipple*
127	*⅜ in. x 6 in. Nipple*
216	*Rubber Washer*
217	*Iron Washer*
228	*⅛ in. x ⅜ in. Malleable Iron Ell*
136	*⅜ in. Malleable Iron Pipe Cap*
128	*⅜ in. Malleable Iron Pipe Locknut*
876	*Gas Flange for Lamp Body Plate*
868	*Elbow Flange for Cock Body*
878	*Lead Gasket for Gas Flanges*
451	*⅛ in. Nipple for Gas Flanges*
250	*Screw for Bezel Ring*
530	*Screw for Catch Support and Gas Way.*
540	*Screw for Hinge Plate*
531	*Screw for Gas Flanges*
265	*Screw for Catch Spring*
550	*Screw for Adjusting Cock Body*
532	*Screw for Flue Spacing Piece*
251	*Screw for Reflector*
279	*Wood Screw for Ventilator*
551	*Hex. Head Machine Bolt*
552	*Hex. Nut*
931	*Rivet for Outer Flue*
932	*Spacing Piece for Flue*

List of Parts, Fig. 2526.

168	*⅛" Galv. iron pipe*
480	*¾" Galv. iron pipe*
483	*¾" Galv. iron tee*
486	*¾" x ¾" x ⅛" brass union tee*
490	*¾" main cock*
867	*⅛" flanged ell*
LA-100	*bracket lamp*
LD-650	*vestibule lamp*
LD-750	*center deck lamp, 24" drop*
L-900	*center deck lamp, 12" drop*

Fig. 2527—Two-Light Chandelier No. 202.

Fig. 2528—Two-Light Chandelier No. 302.

Fig. 2529—Bracket Acetylene Gas Lamps.

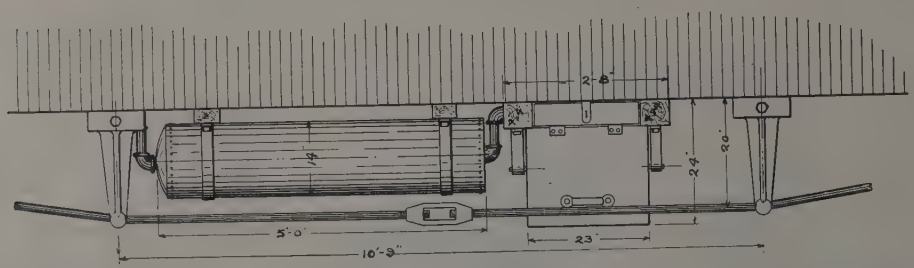


Fig. 2530—Application of Generator and Gas Tank Under Car; Avery System of Acetylene Gas Lighting.

Fig. 2531—Generator Box Lowered for Recharging.

Fig. 2532—Generator Box Closed in Running Position.

Dayton Manufacturing Company.

Fig. 2533—Side Wall Lamp.

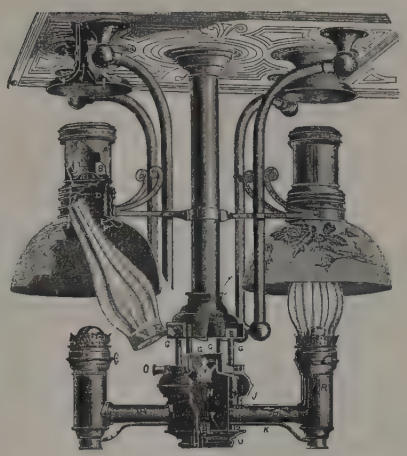


Fig. 2534—Center Lamps.

Fig. 2535—Center Lamps.

Dayton Manufacturing Company.

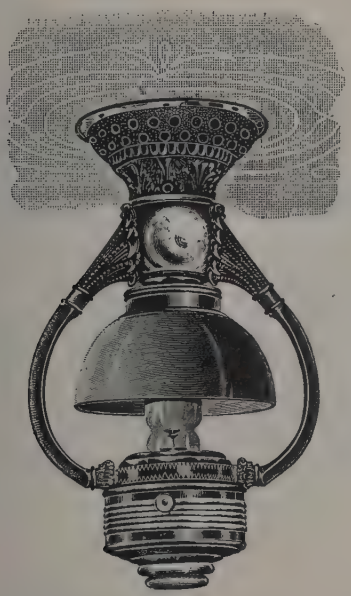


Fig. 2536—Center Lamp. Adams & Westlake Company.

Fig. 2537—Center Lamps for Use with Heavy Oil. Jas. L. Howard & Company.

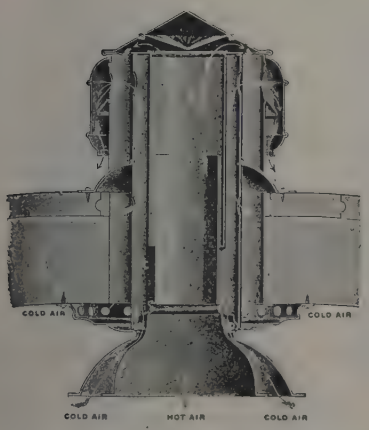


Fig. 2538—Improved Combination Smoke Bell and Ventilator. Adams & Westlake Company.

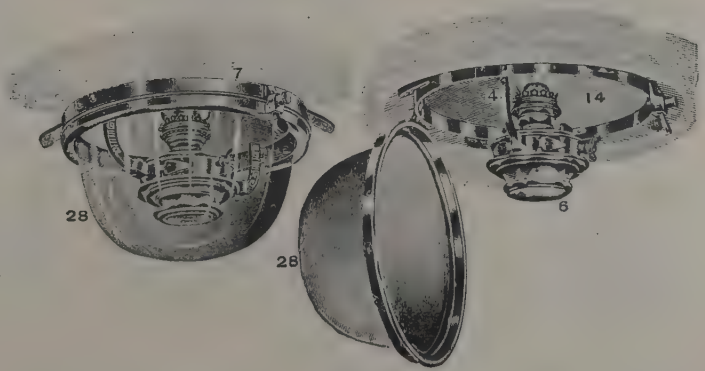


Fig. 2539—Vestibule Dome or Platform Lamp. Adams & Westlake Company.

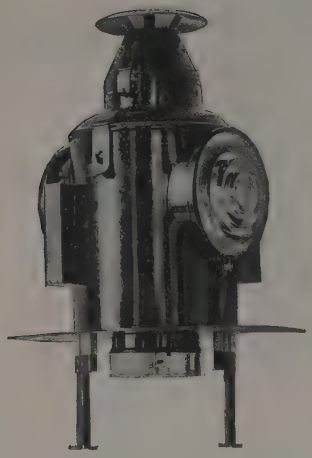


Fig. 2541—Caboose Cupola Lamp.

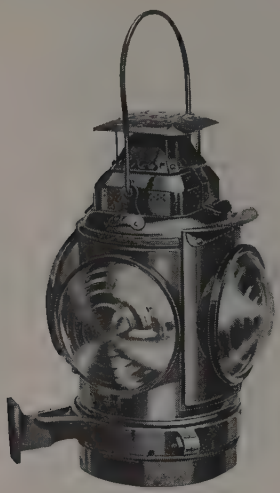


Fig. 2542—Marker or Tail Lamp No. 270.

Fig. 2543—Kero Hand Lantern No. 200.

The Adams & Westlake Company.

Fig. 2544—Spheroidal Car Repair Track Lamp No. 458.

Fig. 2545—Straight Body Steel Marker Lamp.

Fig. 2546—Armspear Outside Adjustment Lantern.

Fig. 2547—Armspear Hand Lantern

Armspear Manufacturing Company.

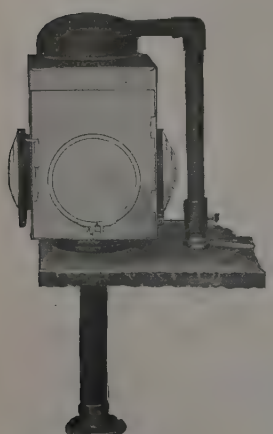


Fig. 2548—Electric Corner Deck Signal Marker Lantern.

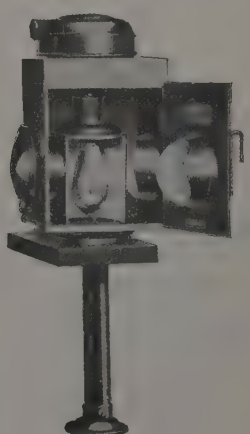


Fig. 2549—Interior of Lantern Shown in Fig. 2219.

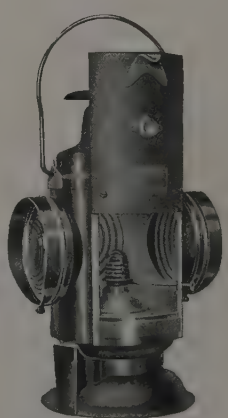


Fig. 2550 — Standard Three Lens Tail or Marker Lantern.

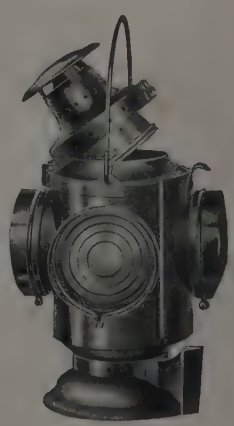
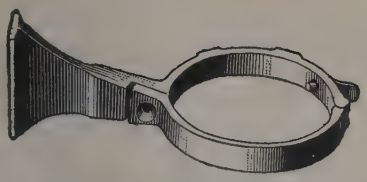


Fig. 2551 — Standard Four Lens Tail or Marker Lantern.

Peter Gray & Sons, Inc.



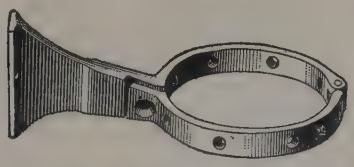


Fig. 2552—Marker or Tail Lamp Brackets. Armspear Manufacturing Company.

Fig. 2553 — Adjustable Marker Arm. Peter Gray & Sons.

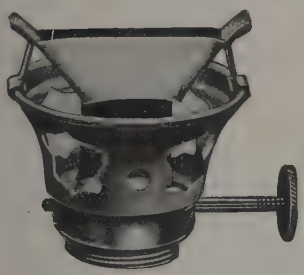


Fig. 2554—Dressel Low Burner with Flame Spreader. Dressel Manufacturing Company.

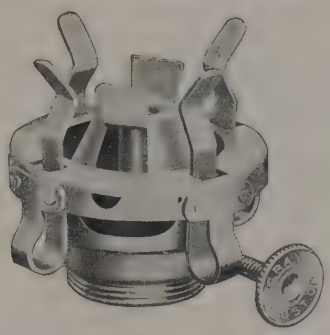


Fig. 2555—Lamp Burner. Peter Gray & Sons.

Fig. 2556 — Combination Lamp and Flag Socket. Armspear Manufacturing Company.

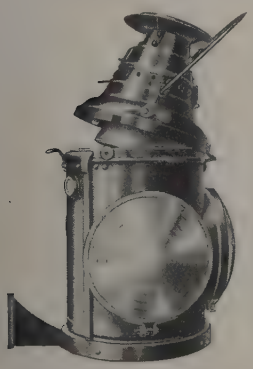


Fig. 2557—Engine Lamp. Dressel Manufacturing Company.

Fig. 2558—Tail Lamp with Detachable Base. Dressel Manufacturing Company.

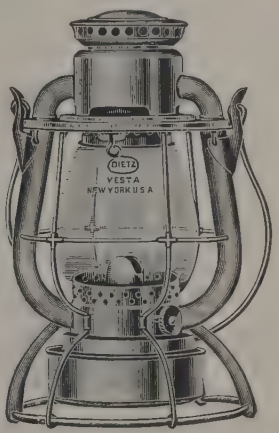


Fig. 2559—Vesta Cold Blast Railroad Lantern. R. E. Dietz Company.

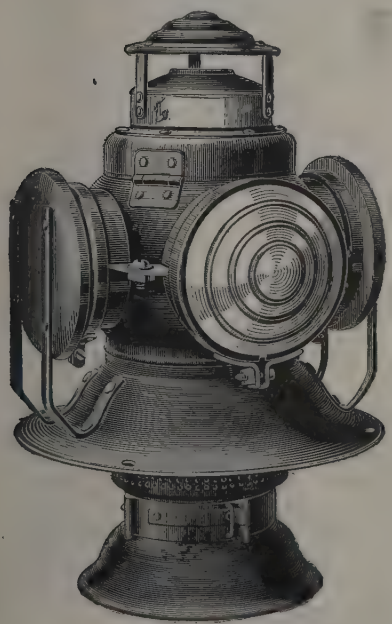


Fig. 2560—Caboose Deck Lamp. Armspear Manufacturing Company.

Fig. 2561 — No. 519. Bunk Car Lamp. Adams & Westlake Company.

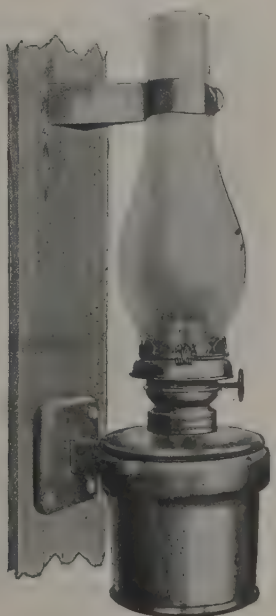


Fig. 2562 — No. 530. Side Bracket Lamp. Dressel Manufacturing Company.

Adlake Passenger Car Fittings

The Adams & Westlake Company have developed a large number of fittings and trimmings for passenger cars, including many types of brake handles, lighting fixtures, washstands and closets, basket racks; general car interior hardware, and other materials or appliances of this kind.

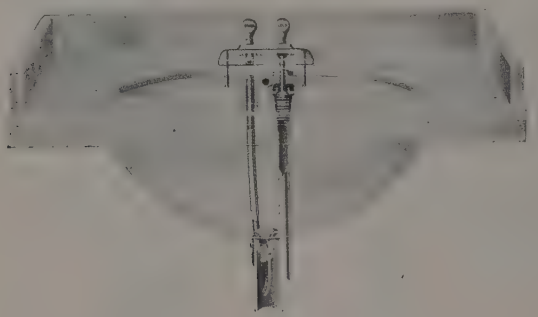


Fig. 2563—Adlake White Ajax Metal Washstand

Adlake White Ajax Metal, of which their washstands, water coolers and lever fittings are made, is a solid white metal, having the appearance of nickel or silver plate, and as this appearance is retained throughout its entire life, the expense of re-plating or refinishing is avoided.

The Adams & Westlake Company's washstands, as shown in Fig. 2563, are equipped with Adlake lever fittings. These fittings are simple in construction, easy to operate and may be maintained at very small expense.

All working parts of the Adlake lever faucet and lever drain are removable from the top of the washstand. The loosening of two screws, which hold the housing in position, gives access to these parts which may be readily withdrawn for repairs or replacement.

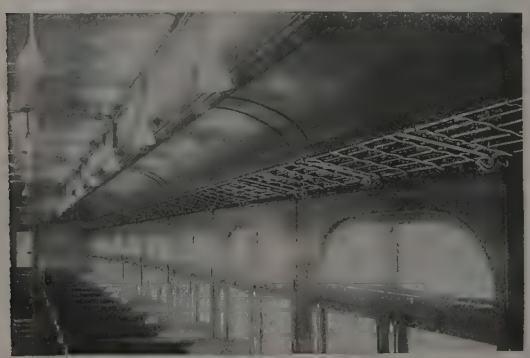


Fig. 2564—Adlake Rod Bottom Basket Rack

The faucet is self draining, since the valve is set higher than the pipe leading into the bowl and as the water feeds directly into the bowl, freezing of the faucet is impossible.

The drain plug is operated by a flexible shaft. Removing a screw at the side of the valve casing permits removal of the valve for cleaning the outlet pipe.

The Adlake rod-bottom basket rack—Fig. 2564—is neater in appearance and is cleaner and roomier than the cast type; it can be enameled to match the interior of the car and may be made as a single or a continuous rack.

Fig. 2565—"Flex" Lamp Shade Holder

The Adlake Flex Shade Holder—Fig. 2565—for lighting fixtures consists essentially of a continuous spring coil, placed between a recess in the body of the shade holder, and a serrated sheet brass guide ring with spring fingers. This construction not only insures a positive flexible grip on the neck of the shade, but also protects the flexible spring collar. Sufficient elasticity is afforded to allow for the expansion of the shade and to prevent chipping or otherwise damaging the shade as it enters the holder.

Coach window locks and fastenings of proper design have an important bearing upon the comfort and convenience of railway passengers.

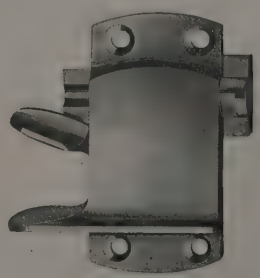


Fig. 2566—No. 1032 Adlake Safety Sash Lock

The Adlake Safety Sash Lock No. 1032 will not allow the window to drop accidentally as this device will still function even if all the holding screws may work loose and come out. The bolt is of such size and so well reinforced within the lock case, that it cannot bend or break. Operating defects and weaknesses so often found in coach window locks, have been eliminated and in the Adlake Safety Lock a window fastening has been produced that will positively prevent accidents.

The Adlake No. 26 Sash Ratchet is simple in operation, positive in action and easy to remove when necessary.

For other products and branch offices, see classified and alphabetical indexes.

Freight and Passenger Car Specialties

The Gould Friction Draft Gear—Fig. 2567—is a self-contained, shock-absorbing device. It is composed entirely of steel and has been designed for convenient application in the standard A. R. A. pocket space, without altering draft sills or other members.

As the Gould Friction Draft Gear is of the spring-loaded type, a uniform frictional resistance is developed which results in a smooth draft gear action, entirely free from undesirable internal

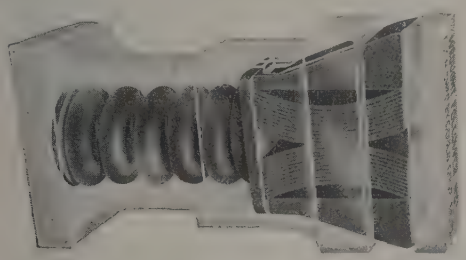


Fig. 2567—Friction Draft Gear FDG-175

shocks. The Gould Draft Gear gives efficient service at all speeds and its shock-absorbing qualities are, to a considerable extent, unaffected by the condition of its friction surfaces.

Solid steel construction with ample friction contact enables this gear to give long service without requiring repairs or replacement of parts. Any wear which may eventually develop can be readily taken up, thus restoring the gear to its full original capacity.

A unique feature of this device is the facility with which its capacity may be reduced to any amount under the maximum by removing two or more leaf springs and substituting a shim, so that it is perfectly feasible to use a high-capacity Gould freight type gear in passenger service, by making a suitable reduction in its capacity.

Draft Gears manufactured by this company are designated FDG-175, with a travel of 2½ in. and a maximum capacity of 240,000 lb.; FDG-350, has a travel of 2¾ in. and 280,000 lb. capacity; FDG-180 has a travel of 2½ in. and a maximum capacity of 150,000 lb.

The Gould Friction Buffer, designated FB-180, is similar in design to the friction draft gear. It occupies a pocket space of 7 in. by 12½ in. by 27¼ in. Its capacity is 125,000 lb. maximum and a total movement of 5 in. has been provided.

The Gould Z-Type Truck Bolster has been designed with greatly increased transverse strength combined with maximum vertical strength. This has been accomplished without increasing the weight beyond that of the usual designs. A transverse strength of at least 75 per cent of the vertical is guaranteed.

The Gould Z-Type Body Bolster is similar in design to the Z-Type truck bolster and may be obtained to suit any variety of car construction. The increased transverse rigidity of this design has resulted in a complete elimination of breakage caused by transverse stresses.

Gould Cast Steel Truck Side Frames are manufactured for all classes of service either in the channel or T section, with or without integral journal boxes.

Journal boxes produced by the Gould Company are adapted to all sizes and styles of trucks. They are made of high grade malleable iron and are fitted with an improved dust proof cover retained in position by a coiled lid spring.

The Gould Z-Type Coupler is of all steel construction and is intended for locomotives and freight car service. It contains few parts and has been designed for either top or bottom operation. This coupler can be furnished with any style of shank; it is equipped with a positive lock set, a knuckle opener and has lugs on the knuckle interlock to prevent knuckle pin failures.

The Gould Coupler Company also manufactures the Standard "D" type coupler together with a complete assortment of lighter and smaller couplers for industrial purposes.

The Gould PC Type Coupler is designed for modern heavy passenger equipment. It is provided with a positive bolt type lock and bell crank knuckle opener and can be furnished to operate from the right and left at the bottom, from right and left at the top, or from the left side of coupler head, as may be preferred. These couplers are made with shanks to suit any car design.

The Gould Carrier and Centering Device is of recent design and combines a cast steel coupler carrier with an efficient coupler centering mechanism which is suitable for use with the heaviest type of coupler.

This company also manufactures a complete line of cast steel yokes for both freight and passenger service.

The Gould Universal Automatic Brake Slack Adjuster will automatically maintain a predetermined piston travel and a uniform hand brake movement. This equipment is adaptable to the brake rigging of any car; it is a simple, safe and positive method for maintaining a high percentage of air and hand brake efficiency and is gradually being adopted as a standard upon many leading electric railways of the country.

The Gould Simplex Electric Lighting System for railway cars is the result of years of experimenting under actual service conditions. During this period many serious difficulties were overcome by improvements and modifications in electrical apparatus until the Gould Simplex System has finally been developed to a standard of efficiency that gives most satisfactory service under all operating conditions. Car lighting equipments are furnished in capacities of 1, 2, 3 and 4 KW.

The Gould Simplex Electric Lighting System has reduced the cost of car illumination to an exceedingly low point and as its operation is absolutely automatic the attention required to maintain a high standard of efficiency, is very small. The electrical and mechanical appliances comprising this system are extremely simple in design and construction. Complete automatic control of generator output and lamp voltage is provided and the entire installation can be adapted to either truck or body hung suspensions.

For other products and branch offices, see classified and alphabetical indexes.

GOULD COUPLER COMPANY, NEW YORK, N. Y.

Dayton Passenger Car Trimmings

The Dayton Manufacturing Company has made railway car interior hardware for over thirty-five years. Dayton Bronze car trimmings are standard on many of the steam and electric railroads of America, and are in extensive use on railways all over the world. Over twenty thousand different patterns are available, making it possible to supply any character of interior fittings. All of these patterns may be had in any one of forty-six different finishes, and as there are numbers of different designs running through the various classes of fittings, it is possible to select from this line patterns to harmonize perfectly with any finish and character of car interior.

Fig. 2568—Steel Enameled Folding Lavatory No. 13

The Steel Enameled Folding Lavatory No. 13—shown in Fig. 2568—has a basin enameled with white porcelain inside and dark blue outside. The soap dish and swinging faucet are nickel-plated and the supply pipe is fitted with a steam jacket to permit heating the water. This lavatory requires a wall space of

Fig. 2569—No. 655 Solid Nickeline Washstand

25¾ in. by 15½ in. When closed it projects 6½ in. from the wall, and when open, this projection is 17⅞ in.

Solid Nickeline Washstands—Fig. 2569—of any size desired are furnished by the Dayton Manufacturing Company. These washstands have many desirable features and may be kept in a clean, sanitary condition indefinitely, without the necessity of being refinished. They are manufactured with any required combination of bowls and fixtures.

Fig. 2570—No. 32 Eckert Water-Closet

The No. 32 Eckert Water Closet—Fig. 2570—has an upper bowl of heavy, vitreous earthenware and a lower hopper of white enameled iron. The operating mechanism is simple and reliable and has been carefully designed with the object of reducing maintenance expense to a minimum. All moving parts and metal fittings are made of heavily nickel-plated brass.

The No. 15 Eckert Water Closet—shown in Fig. 2571—is provided with a vitreous earthenware bowl and a base of enameled iron. The valve is arranged for attachment to an adjacent side wall, in which position is is very readily accessible for renewal of rubber valve seat or other repairs without the necessity of breaking any of the pipe connections or dismantling the entire fixture. The valve, with all piping and connections may be entirely drained when it is necessary to "set out" the car in freezing weather.

Fig. 2571—No. 15 Eckert Water-Closet

Fig. 2572—No. 184 Link Water Cooler

The No. 184 Link Water Cooler—Fig. 2572—is provided with a No. 113 cast-iron base. This cooler has a removable water chamber of 7 gallons capacity and has all parts readily accessible for sterilizing with live steam. Its dimensions are 10⅛ in. by 13⅝ in. and 40 11/16 in. high; it is furnished in galvanized iron, ready for painting. The cooler is supplied with or without a cast-iron base which may be either galvanized or enameled white. The Link Water Cooler has been approved by the U. S. Railway Mail Service authorities for postal car service.

The Flex patented Shade Holder—Fig. 2573—is used where possible on all Dayton electric and gas lighting fixtures. It holds glassware securely under all conditions yet gives perfect freedom for expansion and contraction. Glassware may be readily removed or inserted.

Fig. 2573—Flex-Patented Shade Holder

No. 185 Rock Shaft Sash Lock—Fig. 2574—is furnished with either cast bronze or crimped steel continuous stops, and gives perfect control of the car window. The bolt is drop forged and ample bearing surface has been provided to insure a positive grip on the stop.

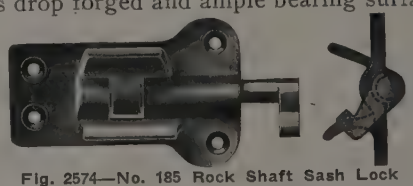


Fig. 2574—No. 185 Rock Shaft Sash Lock

For other products and branch offices, see classified and alphabetical indexes.

Dayton Passenger Car Trimmings *Cont'd.*

No. 192 "Rex" Basket Rack—Fig. 2575—has the bottom section assembled to the brackets with 4 swivel hexagon nuts. The longest continuous rack is easily installed and individual sections may be removed for refinishing without disturbing the brackets or

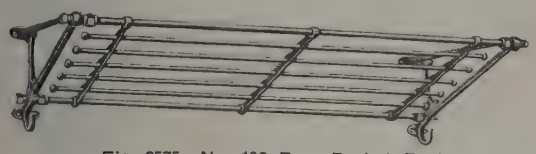


Fig. 2575—No. 192 Rex—Basket Rack

removing other sections. Like all other Dayton fixtures, ample strength for service is provided in the design.

The No. 13 Lindstrom Brake Handle—Fig. 2576—is furnished by the Dayton Manufacturing Company in either malleable iron or bronze as desired. This handle has been made standard on many of the leading railroads all over the United States. It has an over-all swing of 24¾ in.; the various parts are well proportioned and they have received the greatest possible care in design, with the object of producing a brake operating mechanism of the utmost reliability and efficiency. Particular attention is directed to the width of the ratchet wheels, the enclosed construction and the general rugged character of the entire appliance.

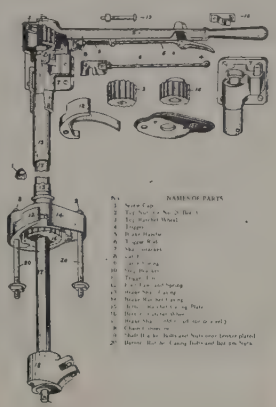


Fig. 2576—No. 13 Lindstrom Brake Handles

No. 678 End Door Lock—Fig. 2577—is fitted with the Dayton anti-friction swing latch. The interior parts are designed to stand up under heavy service. Exclusive of the keeper it measures 3¾ in. by 4⅞ in. and may be fitted to any railroad door key. When made with a thumbpiece instead of a keyhole on the face side, this pattern is known as No. 876 Saloon Door Lock. Each

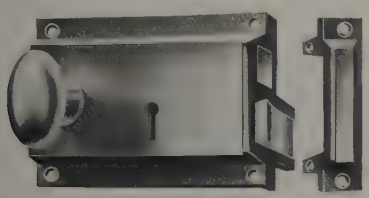


Fig. 2577—No. 678 End Door Lock

style will be furnished with either knobs or flush handles on the reverse side depending on the conditions the designer has to fill.

The Link Trap Door—Fig. 2578—can be applied to any design of passenger or combination car, on both steam and electric railroads. The door cannot get out of alignment and the lifting springs may be adjusted to stop the trap door at any angle or to open it wide and with sufficient force to make it engage a catch on the post.

The illustration shows a type B trap door. This type is arranged in such a manner that it is necessary to open the vestibule side door before the trap can be raised. In the type A design a single plunger is used and the trap may be lifted before opening the door.

Whether for new or repaired equipment, trap doors, having the many desirable features incorporated in the Dayton Manufacturing Company's product offer many advantages for use on passenger cars.

Fig. 2578—The Link Trap Door Type B

The Mallard Safety Door Fastener — Fig. 2579 — was designed for use on sliding doors on baggage and express cars as a positive and effective safety device to prevent a sliding door from closing suddenly when a train is quickly stopped or started and thereby avoid the possibility of serious injury to the body or limbs of any person who might be standing in the doorway. The pull-handle must be held continuously raised, before the door can be closed more than a few inches. The Mallard Door Fastener may be applied equally well to old doors or

Fig. 2579—No. 908 Mallard Safety Door Fastener With No. 1 Door Sleeve

new equipment and may be used with any style of door track.

Dayton service is always available when hardware of any kind is required for new passenger cars or when fittings for repairing old equipment are desired.

For other products and branch offices, see classified and alphabetical indexes.

THE DAYTON MANUFACTURING COMPANY, DAYTON, OHIO

Locks, Combined Lock and Brake and Baggage Racks

Howard Locks are designed for hollow steel doors, both sliding and swinging types. The locks for sliding doors—Fig 2581—are in extensive use on the Interborough Rapid Transit, also on the Brooklyn Rapid Transit, the Hudson & Manhattan Ry., the New York Municipal Ry., the Philadelphia Rapid Transit Ry., the Frankford Elevated Ry., and the Boston Elevated Ry. The swinging-door type of lock is used in large numbers on the New York Central.

The corners of the door-stile are not cut away and only a minimum of the shell of the door is removed when these locks are applied. No screw holes need to be tapped into the door stile, so that the necessity for internal reinforcements is obviated The parts which must be separated when fitting the lock, are made to register together and support each other so that when assembled on the door by the car builder all parts come together in the same adjustment as when fitted in the factory.

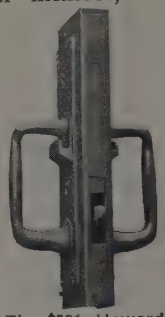


Fig. 2581—Howard Sliding Lock

Howard Non-Wear Ball Hinges—patent pending — of improved design are proving successful. Both the vertical and horizontal pressures in these hinges are taken on the balls.

The Howard Baggage Rack—Fig. 2582—is one section of a new continuous rack—patent applied for. This is so constructed as to provide for bags and parcels, an uninterrupted space running the entire length of a car. The supporting brackets are so designed as to cause no interference with head room. Each section is a unit consisting of the bracket and the bottom member with no parts to assemble, and sections can be added to make up any required length. When assembled in a car any one bottom member can be removed without removing a bracket or disturbing the adjacent bottom member. It is easily installed and provides increased capacity.

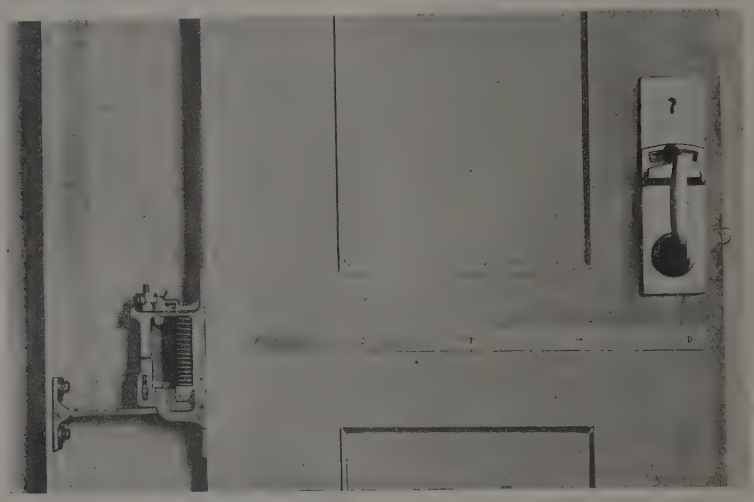


Fig. 2580—Combined Lock and Brake

The Howard Combination Lock and Brake is an appliance particularly suitable for use with sliding doors, which sometimes close unexpectedly with possible injury to passengers. The Combined Lock and Brake aims to obviate this danger. When the lock handle is at rest vertically, the brake is applied, and considerable force is required to move the door. A lurch of the car will only cause the door to close slowly. To move the door, the handle is tipped in the direction of the movement of the door. The connecting mechanism automatically releases the brake and allows the door to move freely.

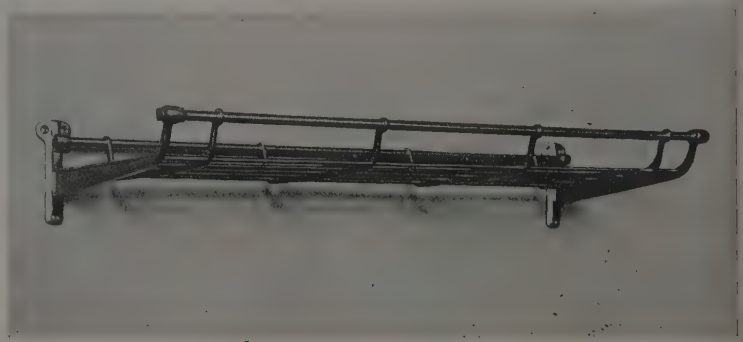


Fig. 2582—Howard Sectional Rack for Baggage and Parcels

Howard Hangers and Tracks for sliding doors are designed especially for simplicity and durability. They have ball-bearing sheaves which are so arranged that the balls carry both the vertical and horizontal pressures. The track is constructed of stiff angle iron having a groove machined in its horizontal member, in which the sheaves run smoothly. The whole fixture is of steel and easily applied to the car.

For other products and branch offices, see classified and alphabetical indexes.

JAMES L. HOWARD & COMPANY, HARTFORD, CONN.

Pressed Steel Shapes for Car Finish

Interior steel finish for all types of passenger cars has developed rapidly with the increasing use of the all-steel car. It has reached such a degree of perfection that steel can be used in place of wood without any material sacrifice in weight and, at the same time, give a finish as pleasing to the eye as natural wood. Together with these characteristics interior steel finish provides a strong, durable and easily handled material for inside trim.

The Morton Manufacturing Company has made a special study of this work and has developed many pressed steel products for passenger cars. The

Fig. 2583—Steel Sliding Side Door. Two Lights of Glass, with Round Corners and Beading

Fig. 2584 — End Steel Door, Drop Sash and Half Panel Construction

company manufactures pressed steel car doors, steel flooring and other pressed steel shapes and drawn mouldings for steel passenger car finish. The pressed shapes and mouldings are of every standard description, made up in various sections both for inside and outside car finish.

Acme Steel Doors are well constructed mechanically in any type desired for passenger train equipment. Particular attention has been given to the development of standard types of steel doors. The result has been the manufacture of a complete line of vestibule side doors, with or without panels—see Figs. 716 and 717—end panel doors with round corners and glass beading—see Fig. 718—sliding side doors, with one and two lights of glass with round corners and glass beading—see Fig. 2583—end doors with drop sash—see Fig. 2584—and a new style steel baggage car door as shown in Fig. 2586.

The above designs and other "Acme" types show neatness of finish and durability. The result of many years of experience in their design has given a combination of great strength together with minimum weight.

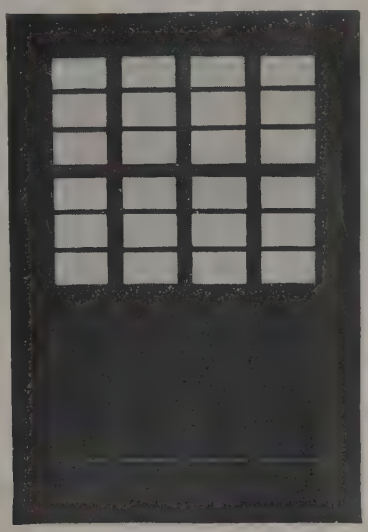


Fig. 2586—Steel Baggage Car Door, With or Without Glass Openings

The Acme Anti-Pinch Door Shield positively prevents injuries to passengers' hands from being caught between door jamb and door. The many accidents of this kind, with resulting damage claims, can be avoided where end doors on passenger train cars are equipped with these shields.

Chanarch Steel Flooring is of special design, the sheets being formed into multiples of arches and dove tail channels for the purpose of securely anchoring the composition floor. Chanarch flooring is fabricated of rust resisting metal or galvanized steel sheets of 16, 18, 20, 22 and 24 gage in thickness.

The arched construction has sufficient strength to support the floor load between spans of sills, while the keyed construction gives the desired anchorage for the composition floor, all of this being accomplished with minimum weight. This flooring with a composition surface is sanitary; fireproof; light in weight; easily cleaned by flushing and forms an ideal floor for passenger equipment.

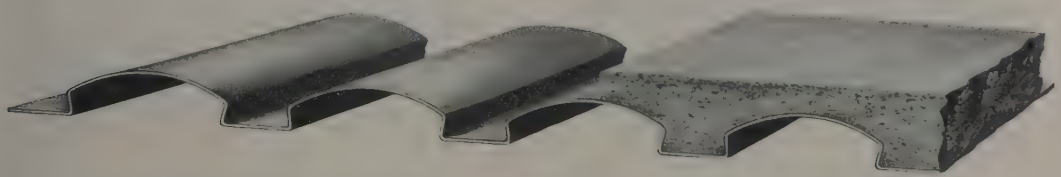


Fig. 2585—Chanarch Steel Flooring for Anchoring and Supporting Composition Floor

For other products and branch offices, see classified and alphabetical indexes.

All Types of Freight and Passenger Cars

The Magor Car Corporation has works at Passaic, New Jersey and the National Steel Car Corporation, Limited, at Hamilton, Canada, both plants being fully equipped with the latest improved car building machinery.

An all steel sleeping coach, built by the National Steel Car Corporation, Limited, for the Canadian Government Railways is illustrated in Fig. 2587. These cars have 10 sections and 2 drawing rooms. They are all-metal construction, the interior steel work being grained to give the appearance and finish of wood. The underframe is built-up with rolled steel channels, and the floor consists of 1½-in. insulated fireproof flooring and ¾-in. rubber tile.

Fig. 2587—All-Steel Sleeping Car Built for the Canadian Government Railways

The Canadian Government Railway box car illustrated by Fig. 2588 represents a general type of box car which is in use on many railways. This car has double four-wheel standard diamond arch bar type of trucks with 33-in. wheels and 5-in. x 9-in. journals; a steel underframe built up of rolled steel sections; a composite superstructure consisting of steel framing and single wooden sheathing; inside metal roof; flooring of 1¾-in. yellow pine.

Many other types of freight and passenger train cars including refrigerator cars, express cars, cabooses, stock cars, steel and wooden gondolas, and baggage cars are manufactured by these companies. It is impracticable to go into the details of construction involved in these numerous examples but mention should be made of the fact that both plants are modern and up-to-date in all respects and fully equipped with the latest, most improved and economical machinery for car building operations. Back of this equipment are skilled engineering and shop organizations prepared to design and build completely; to build from railway drawings and specifications; or to duplicate existing designs meeting the requirements of any railway.

Fig. 2588—Composite Box Car of 80,000 lb. Capacity

For other products and branch offices, see classified and alphabetical indexes.

MAGOR CAR CORPORATION, NEW YORK, N. Y.
NATIONAL STEEL CAR CORPORATION, LTD., HAMILTON, CANADA

Angle Cock Holder and Pipe Anchor

The constant and severe vibration to which train line piping is exposed, renders it of great importance that these parts shall be thoroughly anchored to the car underframe, so that the destructive effect of local rubbing, loosened joints and other detrimental results of excessive vibration may be avoided. In addition to the necessity for securing brake pipes with a positive and durable fastening it is also essential

Fig. 2589—Burnett Brake Pipe Anchor

that the means used shall be so arranged that the piping may be easily removed when car repairs become necessary.

The Burnett Brake Pipe Anchor and the Burnett Angle Cock Holder meet successfully all requirements of efficient yet simple and convenient train line anchorage as outlined above.

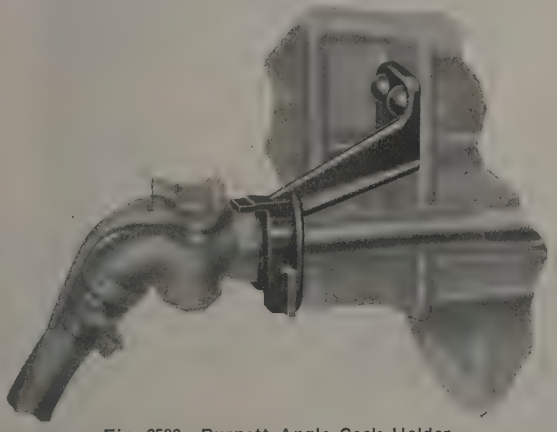


Fig. 2590—Burnett Angle Cock Holder

The Burnett Brake Pipe Anchor, shown in Fig. 2589, is a device which furnishes a positive and durable fastening for the brake pipe and at the same time allows the pipe to be easily removed from the car when necessary on account of repairs. The construction of this Anchor is clearly shown in the illustration. The Burnett Anchor eliminates the use of bolts and nuts; reduces vibration and prevents the longitudinal movement of pipe, loose pipe joints, wearing of holes in pipe, broken pipe nipples and leaks at hose couplings. All of these features add to efficiency and result in reduction of maintenance costs.

The Burnett Angle Cock Holder shown in Fig. 2590 is primarily an Anchor and uses the same special key as the Pipe Anchor with the addition of a suitable projection or lug to engage the "Hex" of the angle cock and an extension of a suitable bracket to attach to end sill or striking plate. While possessing all of the advantages of the Anchor it also holds the angle cock at the required angularity.

The Economy Uncoupling Lever Bracket, shown in Fig. 2591, permits the use of the Uncoupling Lever, shown in Fig. 1335 which provides a maximum leverage for throwing out the knuckle. It eliminates considerable lost motion and makes the uncoupling mechanism much more positive in its

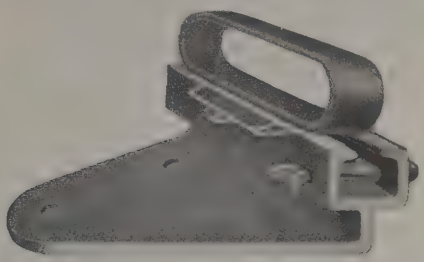


Fig. 2591—Economy Uncoupling Lever Bracket

action thus making it unnecessary to go between the cars when uncoupling cars. Provision is made for every movement of the coupler in service. In comparison with the standard A. R. A. uncoupling device, the Economy center bracket considerably reduces the number of parts per car.

The Rex Emergency Knuckle—shown in Fig. 2592 is a solid steel casting designed to withstand the most severe shocks and stresses. While this

Fig. 2592—Rex Emergency Knuckle

device is intended for emergency application it can, nevertheless, be depended upon to provide a safe connection to move a car to its destination. It may be applied without interfering in any way with the mechanism of a standard coupler; merely remove the broken knuckle and insert a Rex knuckle in its place.

For other products and branch offices, see classified and alphabetical indexes.

Freight and Passenger Car Appliances

The Dunham Hopper Door Mechanism shown in Fig. 2593 is extensively used on self-clearing hopper cars and drop bottom gondolas throughout the United States and Canada. This mechanism is designed to insure tight and positively locked hopper doors—a feature of particular advantage in connection with the movement of coal, ore, and other trains

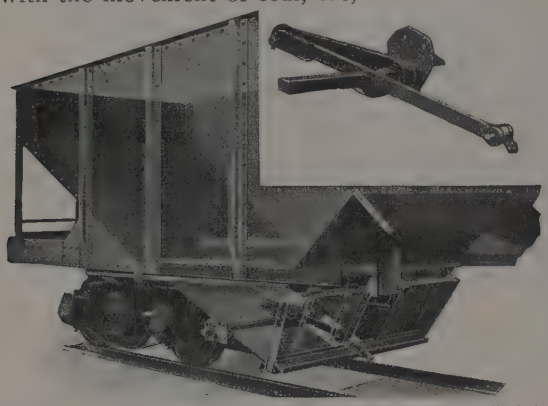


Fig. 2593—Dunham Hopper Door Mechanism as Applied to Self-Clearing Hopper Cars

containing hopper cars. In case hopper doors are not positively locked, serious leakage is frequently caused by the doors coming open due to the shocks experienced when shunting cars. In the Dunham door this fault is entirely eliminated, because it is impossible for these doors to open unless the operating mechanism is properly manipulated. The construction is very simple. Reliability and low maintenance are assured by having the fewest parts requisite to allow the device to function as a door operating mechanism.

The Garland Ventilator—Fig. 2594—is furnished for both the arch and monitor roof cars. The ventilating effect of this device is produced by the movement of air through the cowl openings in the side of the ventilator. This current of air produced by the cowl passes over the opening in the center of the ventilator which opens into the body of the car. This current of air, by the same principle as an injector, draws air from the center openings. This gives the exhaust principle of this ventilator which assures that foul air is removed from the car and that fresh air enters through the intakes. The action of the Garland Ventilator is positive at all speeds, insuring efficient ventilation. The Garland Ventilator Company was the originator of the first successful railway coach ventilator and this device is now widely employed on railway equipment, including Pullman cars.

The Empire Truck Bolster—Fig. 2595—is of built-up pressed steel construction, adapted for cars of 30, 40 or 50 tons capacity. This type of construction has certain fundamental advantages. The most important, from the standpoint of efficient car design, is light weight combined with great strength and rigidity. An additional feature of value, resulting from its built-up composition, is the facility with which the Empire Truck Bolster can be repaired in case of accident or when excessive wear develops and necessitates replacement.

The National Railway Appliance Company is the exclusive selling agent for the various products of the Anglo-American Varnish Company which manufactures railway materials exclusively as follows: Railway varnishes, surfacers, enamels, roof and floor paints, steel preservatives, etc.

The Genesco Corporation manufactures high-grade paint oils for railway uses. This material is sold exclusively by the National Railway Appliance Company.

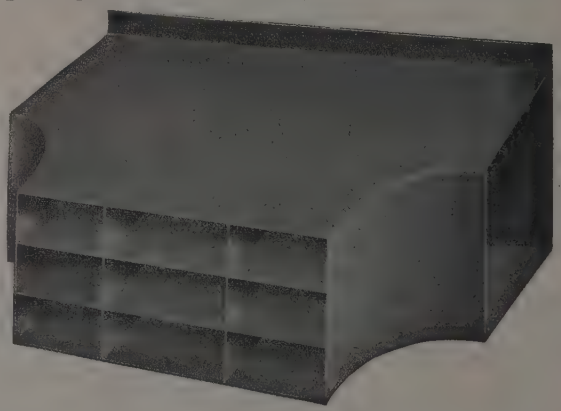


Fig. 2594—The Garland Ventilator Type A-1 for Monitor Roof Cars

The Feasible Drop Brake Staff—Fig. 2064 on page 847—sold by this company, functions with equal facility whether in a lowered or raised position. It is of particular value on flat cars or on any kind of rolling stock requiring a brake staff which may be "dropped" so that it will not interfere with a long lading.

Fig. 2595—Empire Truck Bolster for Freight Cars

For other products and branch offices, see classified and alphabetical indexes.

NATIONAL RAILWAY APPLIANCE COMPANY, NEW YORK, N. Y.

Pullman-Built Passenger and Freight Equipment *(Cont'd)*

experience of the Pullman Company gained in the building of hundreds of sleeping and parlor cars for its own use places it in an exceptional position to meet any and all requirements of the railroads as regards any type of passenger train car.

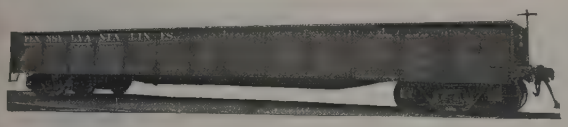


Fig. 2600—All-Steel Gondola Built for the Pennsylvania

Ventilated refrigerator cars built by the Pullman Company for the Pacific Fruit Express represent a class of equipment in which the utmost in

Fig. 2601—Composite Gondola Built by the Pullman Company

freight car construction is required as these cars usually operate in fast freight or express service where failures are costly. The Pullman facilities are ample for making the original designs or constructing from railway or private drawings.

Examples of gondola cars constructed by the

Fig. 2602—A Pullman-Built Tank Car

Pullman Company are found in those built for the Pennsylvania and for the United States Railroad Administration. The Pennsylvania cars illustrate

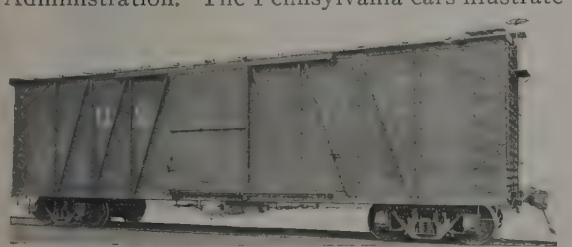


Fig. 2603—Box Car Built for the U. S. R. A. by Haskell & Barker, Now the Pullman Company

all-steel construction; those for the Railroad Administration, composite construction.

Tank cars are also within the range of freight car construction afforded by Pullman facilities and organization. An order of these cars, built for the Paragon Refining Company are in keeping with the best practices of car design as regards this class of equipment.

All types of box cars can be designed and com-

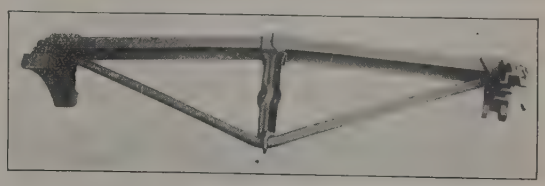


Fig. 2604—Brake Beam

pletely constructed, except for couplers and springs, in the plants of the Pullman Company. These cars are not merely assembled but are

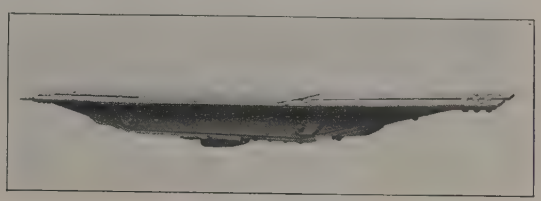


Fig. 2605—Body Bolster

manufactured from the raw materials, and any practical requirement can be met.

Repairing of old freight cars is an important

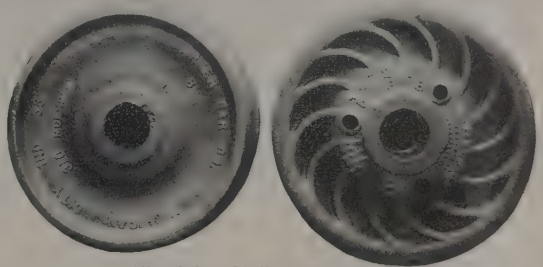


Fig. 2606—Chilled Iron Wheels

function coming within the range of Pullman resources. The labor saving equipment used in the manufacture of new cars can be devoted to repairs and effects high efficiency at low cost.

Individual parts of cars such as wheels, bolsters, brake beams, and miscellaneous castings are also turned out in such quantities at the Pullman Plants that a reliable source of supply for these parts is provided for any railway, whether complete cars are purchased or not.

The extent of the Pullman facilities, together with the engineering skill, knowledge, and experi-

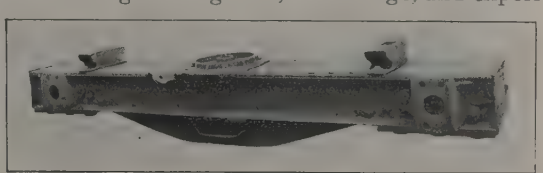


Fig. 2607—Truck Bolster

ence gained by the Pullman organization in building a wide variety of specialized types of railway equipment, place this company in a favorable position for meeting every requirement pertaining to modern railway car building practice.

For other products and branch offices, see classified and alphabetical indexes.

THE PULLMAN COMPANY, CHICAGO, ILL.

Freight and Passenger Cars

The Pressed Steel Car Company is centrally located in the heart of America's greatest steel producing district. Its various departments are well provided with all facilities to handle the fabrication of freight and passenger car equipment, including the manufacture of castings, forgings, bolsters, brake beams and cast iron car wheels.

In view of its location, this company has quick access to a large supply of raw and finished material, which greatly facilitates the rapid handling of car construction and repair contracts. Its organization includes an engineering department thoroughly familiar with all essentials of rolling stock design imposed by modern traffic conditions and which is prepared to render every possible assistance to railroad officials in the preparation of plans and specifications covering either freight or passenger car requirements.

In addition to its extensive manufacturing establishment, the Pressed Steel Car Company is also equipped with complete car repair and repair work and new construction is handled in strict accordance with the owner's specifications.

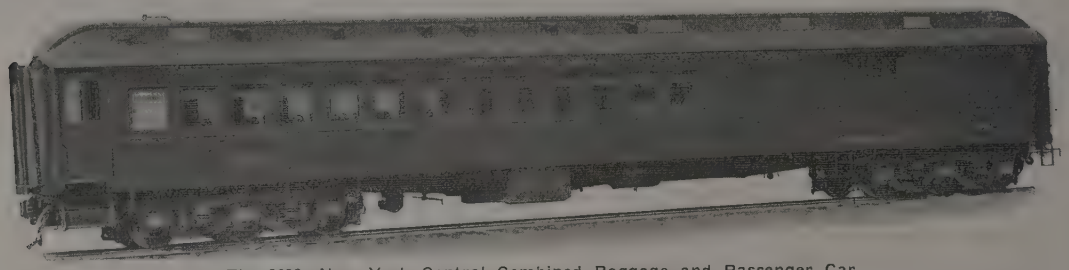


Fig. 2608—New York Central Combined Baggage and Passenger Car

building facilities. The work is expeditiously performed by a repair organization of skilled mechanics under expert supervision, who have at their disposal labor saving and special appliances of the most modern description. All

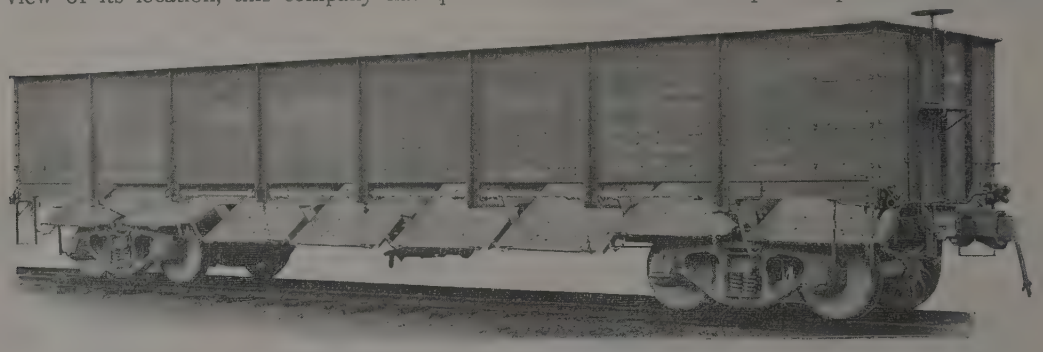


Fig. 2609—Great Northern Side Discharge Gondola Car

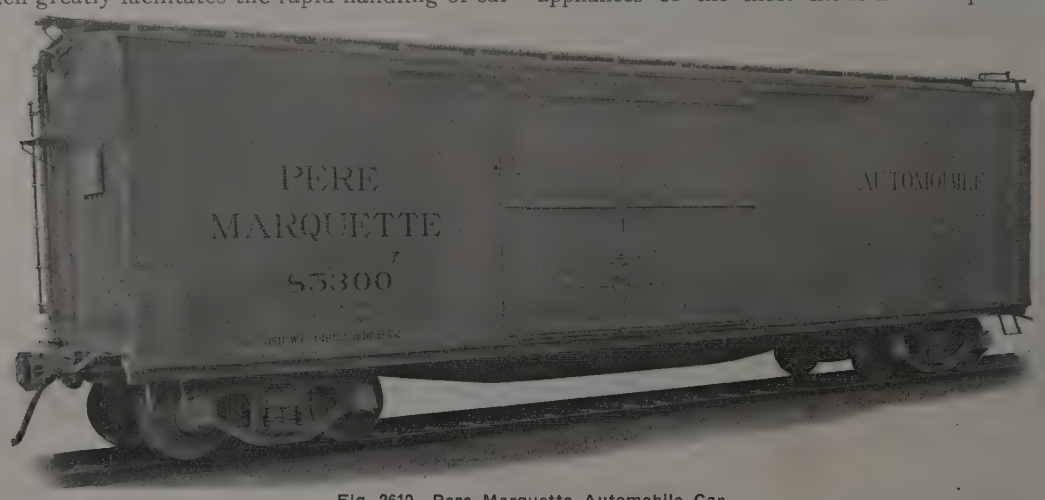


Fig. 2610—Pere Marquette Automobile Car

For other products and branch offices, see classified and alphabetical indexes.

PRESSED STEEL CAR COMPANY, PITTSBURGH, PA.

Steel and Wooden Construction and "Gasmotorail" Cars

An extensive variety of types and designs characterize the product of the St. Louis Car Company as manufactured at its plant in St. Louis. The facilities and organization of this company provide for the design and construction of passenger coaches, express cars, all classes of this order demonstrates that this company's facilities are adapted for carrying on the building of the most up-to-date freight equipment.

"Gasmotorail" cars are a recent development of railway equipment, which has been made available for increasing the operating economy of branch line service where the traffic density is not sufficient to justify the regular operation of steam trains.

Fig. 2611—Electric Sleeping Car Used on the Illinois Traction Lines

of steel, wooden, and composite freight cars, interurban motor cars and gasoline driven cars for steam railway branch line traffic.

The sleeping car Edwardsville, built for the Illinois Traction, is an example of the manner in which many of the problems incident to passenger car building have been solved satisfactorily. This car is of wood and steel construction and is in use in high speed interurban electric service.

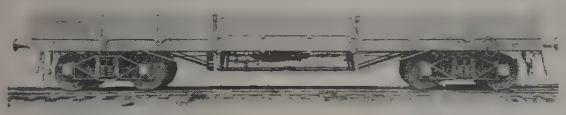


Fig. 2612—Wooden Gondola for Military Use

Freight cars for military purposes were built by this company during the war for the use of the American Expeditionary Forces in France. The types included both gondola and box cars, while the designs were a combination of foreign and American practice.

For the United States Railroad Administration, the St. Louis Car Company constructed an order of standard composite box cars. The completion of this order demonstrates that this company's facilities are adapted for carrying on the building of the most up-to-date freight equipment.

"Gasmotorail" cars are a recent development of railway equipment, which has been made available for increasing the operating economy of branch line service where the traffic density is not sufficient to justify the regular operation of steam trains. This car consists of a special body mounted on a modified chassis of the Four-Wheel Drive automobile truck. The engine of this car is powerful enough to haul a trailer when conditions warrant and the body may be arranged to carry passengers only, or a combination body for the accommodation of both passengers and baggage can be provided.

Fig. 2614—Box Car for Military Use

These examples have been selected at random from records of recent construction but the ability of this company is not limited to building these special types, as specified designs can be originated to meet individual needs. New specifications and designs developed by railway mechanical departments can be carried through to completion efficiently or existing designs can be duplicated accurately.

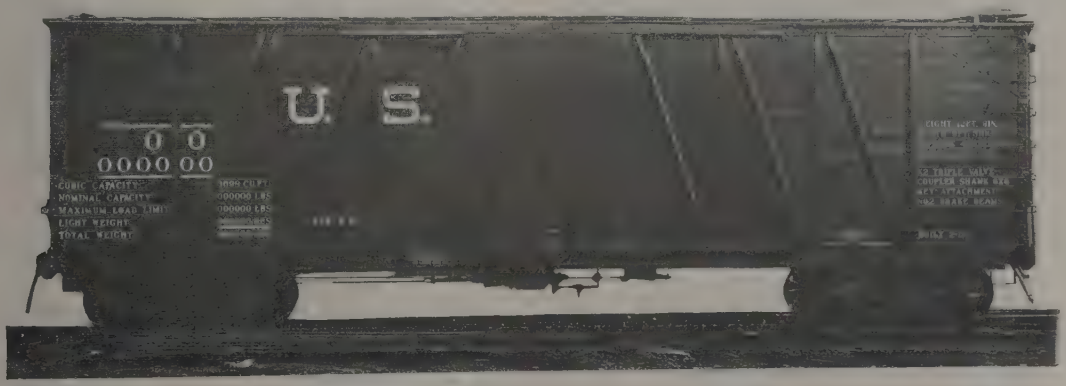


Fig. 2613—Composite Box Car Built for the U. S. R. A.

For other products and branch offices, see classified and alphabetical indexes.

ST. LOUIS CAR COMPANY, ST. LOUIS, MISSOURI

Miscellaneous Steel Forgings for Railway Cars

The Standard Forgings Company is equipped for the manufacture of forgings ranging from 10 lb. to 20 tons in weight. These include a large variety of car forgings, some of which are shown in the accompanying illustrations, car truck axles and also locomotive and tender truck axles, crank pins, piston rods, main and side rods.

The Forged-Key Connected Yoke shown in Figs. 1200 and 2615 is made from solid steel billets. The head members are drop forged and accurately fitted to function as a strong and dependable unit. It is formed in three parts to avoid the necessity of replacing the entire yoke in case of an elongated keyway or for other causes. In this event either the strap or heads can be salvaged. The head members are interchangeable and may be easily replaced.

Drop Forged Steel Center Plates—Figs. 2616 and 2617—are made either in standard designs or to suit special requirements. The use of forged steel for this purpose will effect a reduction in weight with greater strength and at no increase in cost over other methods of manufacture.

Drop Forged Steel Journal Wedges, as shown in Fig. 2618, are produced in all standard A. R. A. sizes. These wedges have important advantages resulting from the drop forging process of manufacture, including the elimination of porosity in their composition and a practically complete absence of other hidden defects.

Drop Forged Draft Gear Stops—Fig. 2619—are also made by the Standard Forgings Company.

Fig. 2615—Individual Parts of Forged-Key Connected Yoke

These are forged either in accordance with standard designs or to conform with the special requirements of any draft gear construction.

Owing to the constantly increasing weight and capacity of freight cars, it is becoming of great importance to use only the most reliable materials in the production of all parts called upon to resist the strains of high speed service. Drop forgings made of solid steel are ideal for this purpose and their use will greatly assist in reducing failures caused by defective or weak train equipment.

Stanforge Draft gear and forged key connected yoke shown on pages 535, and 546.

Fig. 2616—Drop Forged Steel Body Center Plate

Fig. 2617—Drop Forged Truck Center Plate

Fig. 2618—Drop Forged Journal Wedge

Fig. 2619—Drop Forged Draft Gear Stops

For other products and branch offices, see classified and alphabetical indexes.

STANDARD FORGINGS COMPANY, CHICAGO, ILL.

Meritas Leather Cloth

Probably in no other field has there been such rapid strides as in the perfection of coated fabrics designed to take the place of leather.

Several specialties of particular interest to modern car builders are produced by The Standard Textile Products Company, who are specialists in the manufacture of this class of goods. Many styles of Meritas Leather Cloth have been created, differing in weight, grain, color, and finish according to the purpose for which each specific number or style of material is specially adapted.

For Upholstering of seats, Meritas Leather Cloth, Style 1160, in place of plush or rattan, marks a very high development in this class of

Fig. 2620—A Heat Test for Meritas Leather Cloth: Hold a lighted match under corner of Meritas Leather. Notice there is no rim of free oil preceding flame. There is no non-drying oil in Meritas to come to the surface, get sticky or stain clothes.

material. It will retain its flexibility and toughness of surface under all conditions encountered in all classes of service.

Resistance to abrasion requires that upholstering material must be able to withstand the wear and tear of heavy traffic, the scuffing of feet, and the variations in temperature which result from cars standing cold in yards and then, within a few hours being subject to a high temperature. Those seats having steam pipes or electric heaters under them are especially affected by these conditions. After being subjected to all kinds of practical tests at the laboratories of The Standard Textile Products Company, this material has given excellent service for a number of years.

A simple test, to learn whether a leather substitute is proof against abrasion or marring by feet, is to scrape the surface with a coin; do this repeatedly and see whether the surface of the material is affected or not. This resistance to abrasion meets the particular requirement of the upholstered car seat of today.

The sanitary feature of Meritas Leather Cloth has been favorably commented on, not only by railroad men but by many passengers who appreciate the fact that there is no place for vermin to nest and live, and that dust, dirt and finger marks can be removed easily with a rag, no vacuum cleansing being necessary. The labor cost therefore, of maintaining this material is very low.

The leather-like finish of the goods is as near to nature as modern chemistry and modern machinery can come in producing a material that looks like leather and has the resistance to wear that railroad duty requires.

Meritas Car Curtain Material of double texture possesses several distinctive features such as a double face, resembling leather in finish, on both sides. The surface is constructed so that regardless of the length of service and varying temperature changes, it does not become streaky and unsightly. Sun and rain will not affect it. The finish is sufficiently hard to prevent scratches, yet sufficient flexibility is maintained to permit perfect rolling of the curtain. This double-texture Car Curtain material is Meritas style No. 4842, and can be had in the colors desired. Single texture material is also obtainable.

Meritas Car Roofing Material is a double texture material with a waterproof composition between layers, which cements both fabrics together, the finished product forming a practical water-resisting material which is easily applied to the roof and easily painted and kept in good condition.

Meritas Car Lining Material is suitable for ceilings of passenger coaches. It is a strong fabric coated with a durable and non-cracking composition that can be had in various colors.

Meritas Cab Curtain Material is a water-repellent fabric suitable for locomotive cab curtains. Its principal feature is that it will not freeze in winter because it does not absorb and retain water. The crew has easy access to the cab, since this material when tied to hand-holds, will not freeze. It is mildew-proof, will not rot, and coal gas will not

Fig. 2621—The Abrasion Test for Meritas Leather Cloth: Rub the edge of a coin across the surface of Meritas Leather Cloth. Press hard. Do it repeatedly. No surface coating comes off and very little impression is made on the embossing.

affect it. It is furnished in widths ranging from 36 to 92 inches.

All of these materials as well as others manufactured under the name of Meritas Leather Cloth are designed and manufactured especially for railroad use. Samples of any of them are offered for experimental purposes.

For other products and branch offices, see classified and alphabetical indexes.

STANDARD TEXTILE PRODUCTS COMPANY, INC., NEW YORK, N. Y.

Hand Brake Attachment and Side Bearings

The ordinary hand brake wheel and staff used on freight cars is slow in action and often gives insufficient leverage to check the car properly; this is demonstrated by the fact that many brakemen in the railroad yards use sticks as levers in order to control the cars. The A. R. A. specifications require that in some types, particularly tank and heavy capacity cars, the hand brake power shall be a minimum of 60 per cent of the empty weight of the car, but in practice this ratio is difficult to maintain. Friction losses in any hand brake rigging have been shown to run from 25 per cent to 75 per cent in all cases. This loss is not taken into account in the usual hand brake formula and results in much less power at the cylinder connection than actually given by the air.

The Universal Hand Brake Attachment made by the Universal Draft Gear Attachment Company meets this condition in an efficient and inexpensive way. Its installation does not mean discarding all old hand brake equipment and starting anew, but merely the insertion of a properly proportioned cam lever between the ordinary brake staff and the hand brake rod. The from brake staff is fastened, a cast jaw fastened to the brake rod and a forged strap support bolted to the bottom of the car sill. This attachment may be added to the hand brake mechanism of practically any type or design of car without difficulty.

The Cardwell Rocker Side Bearing, manufactured by the Universal Draft Gear Attachment Company is made in three parts, the rocker and the rocker-carrier in two sections. The rocker

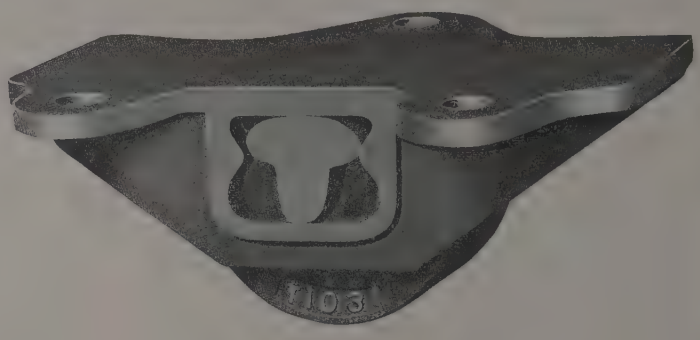


Fig. 2623—Cardwell Rocker Side Bearing

by having a roller-top bearing is rendered practically frictionless. By the use of this rolling principle the travel of a rocker of a given radius is materially increased. The design causes the rocker by its own weight to return to the center

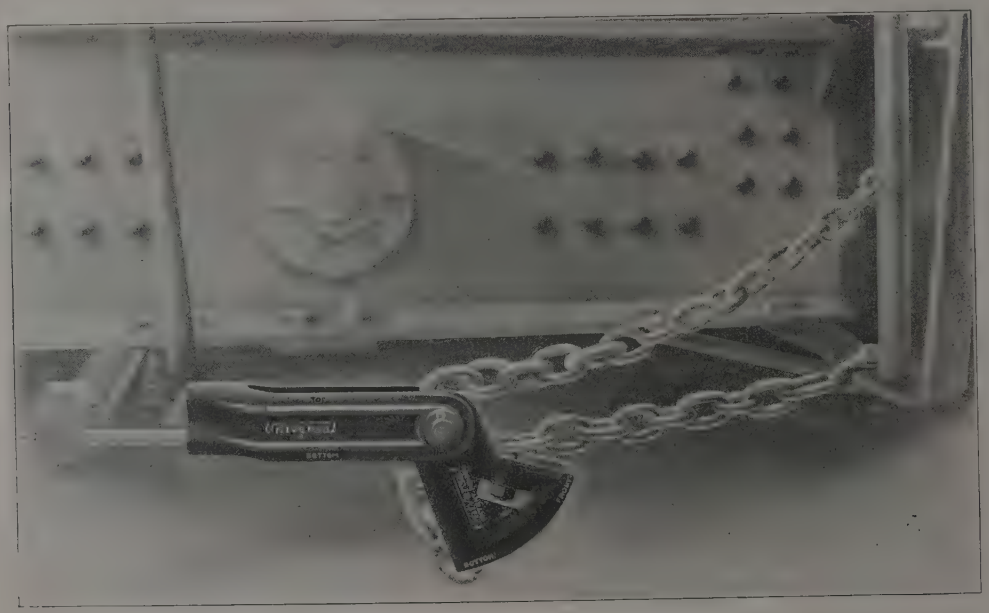


Fig. 2622—Application of Universal Hand Brake Attachment

device is simple and compact, takes up the slack quickly and releases easily. The addition of this attachment improves the ordinary brake wheel and staff making it as powerful as the most expensive lever or ratchet device.

The hand brake attachment as shown in Fig. 2622 consists of a cast cam, to which the chain of the slotted hole, in which it travels, when not in contact with the truck.

Dirt, ice, and snow cannot interfere with the positive action of this bearing.

The Cardwell Rocker Side Bearing is designed for use with any type bolster or car and is in use on many cars now in service.

For other products and branch offices, see classified and alphabetical indexes.

UNIVERSAL DRAFT GEAR ATTACHMENT CO., CHICAGO, ILL.

Railway Service Cars

MAINTENANCE OF THE RAILWAY roadbed, building of new lines, and general construction work in connection with railroad operations requires the use of many special service cars. These include dump cars, motor and hand cars, locomotive cranes, steam shovels, pile-drivers, and various other special cars for transporting the materials used and the men engaged in maintenance service. While not operated under the supervision of the mechanical department, this class of equipment has been officially recognized and classified by the Mechanical Division of the American Railway Association. This classification is as follows:

General Service Maintenance of Way Equipment Cars

"MWB"—Ballast Cars. All descriptions of cars used for the purpose of carrying ballast for the laying of new right of way and repairs. The car used generally for this work is of the gondola type, with side or center dump.

"MWE"—Ballast Spreader and Trimmer. A car with blades or wings for spreading or trimming ballast.

"MWJ"—Ballast Unloader. A car equipped with machinery for pulling a plow through cars loaded with ballast and unloading the ballast to either or both sides.

"MWD"—Dump Cars. On the type of contractors' car used for building up fills; the body of the car dumps being raised by means of counterweight, air or hand power.

"MWF"—Flat Car. Used for transporting rails, ties or ballast and for storage of wrecking trucks, or gathering scraps along right of way. These cars are at times equipped with low sides, about 10 or 12 in. high.

"MWK"—Snow-removing Car. A car equipped with any special device for removing snow from between or alongside of rails.

"MWP"—Pile Driver. A car equipped with machinery for pile driving.

Many modern pile drivers are self-propelled; attachments to locomotive cranes are also used.

"MWS"—Steam Shovel. Car equipped with donkey engine housed in. Having a boom of wood or steel and the end of which is a shovel or scoop. It may be propelled by its own power or by means of a locomotive and run as a car in freight trains, being equipped with safety appliances. The cubic capacity of shovels—in yards—can be indicated by figures placed after the classification letters.

Ditching Car.—A car equipped with machinery for propelling itself, or otherwise, and excavating ditches along the sides of the track as it proceeds. This type of machine is of the same general design as the steam shovel and is commonly termed "railroad ditcher."

"MWW"—Wrecking Derrick. A derrick used for wrecking purposes, having donkey engine to raise and lower booms and hoists; engine housed in and on separate platform with boom, is pivoted in center of car frame in order that it can be worked on either sides or ends; usually fitted with anchor beams to be used for heavy lifting. Fitted with safety appliances and propelled by means of locomotive. Lifting capacity in tons shown by means of figures.

The locomotive crane is constructed along the same General lines as this type of wrecking derrick and is used extensively in railway service.

"MWU"—Wrecking Derrick. This derrick has boom and hoist fitted to frame of flat car and lifting done by means of hand power; propelled by locomotive.

"MWV"—Wrecking Derrick. This derrick has boom and hoist fitted to flat car and having drum at one end to furnish means of hoisting; steam furnished to donkey engine, running drum, by means of flexible steam line from attached locomotive; propelled by locomotive.

"MWM"—Store-supply Car. A car equipped for handling material to be distributed for railway use.

"MWT"—Tool and Block Car. A car used for carrying all descriptions of tool equipment and blocking. This car has side and end housings and roof, also end platforms. There are doors in sides and ends and usually windows. It is fitted inside with proper racks and boxes for storage of tools.

"MWC"—Caboose and Tool Car. Similar to tool car, but having one end fitted up as a caboose, with bunks, stove and water storage, with or without lookout, and is used in either work or wrecking trains.

"MWX"—Boarding Outfit Car. This includes cars used for boarding, sleeping or cooking purposes in construction and similar work.

"MWH"—Hand Car. This car is flat and mounted on four wheels and propelled by means of pushing; known as "Push Car."

"MWL"—Hand Car. This is a small flat car, with or without seats, mounted on four wheels and propelled by means of cranks or hand levers.

"MWG"—Section Gang or Track Inspection Car. Flat car, with or without seats or tool boxes, and equipped with single or double cylinder gasoline engine serving as motive power.

Grass Cutter.—A car equipped with machinery for propelling itself or otherwise, and cutting grass along the track as it proceeds.

Weed Burner.—A car equipped with machinery for propelling itself, or otherwise, and burning weeds along the track as it proceeds.

Weed destroying equipment making use of liquid chemicals as the destructive agent is also extensively employed in such service.

Rail Saw.—A car equipped with machinery for sawing track rails and similar material.

Rail Bender.—A car equipped with machinery for bending track rails and similar material.

Track Layer.—A car equipped with machinery for propelling itself, or otherwise, and laying the track ahead of it as it proceeds.

Of these various classes of equipment probably the most extensively used are locomotive cranes, steam shovels and other excavating machines, pile-drivers, motor and

hand cars; and ballast and dump cars—these latter types being shown in other sections of this book.

Locomotive Cranes

Locomotive cranes have been developed to a high state of efficiency and are extensively used in railroad operations. They may be equipped with a plain fall-block provided with a hook, slings, or tongs; with buckets for handling loose materials; or with electric magnets for handling metals. Many are so designed that power-shovel or pile-driver attachments may be installed. Steam power cranes are most common but electric power and also internal combustion—gasoline—engines are used to some extent. Usually locomotive cranes not only are self-propelled but also have sufficient tractive effort to permit their use for hauling work trains and also for switching purposes in small yards.

The booms are made in lengths ranging upward to 70 or 80 ft. for general service, or more for special service. Various types of boom construction are used; they may consist of a single piece or be made in telescopic or cantilever form and lengthened or shortened as desired.

Approximate capacities of locomotive cranes are given in the following table. These capacities may be increased from 10 per cent to 40 per cent by using rail-clamps or outriggers:

Weight of Crane, Coal, Water, Lb.	Maximum Wheel Load, Lb.	Length of Boom Ft. In.	Capacity at Various Radii Without Outriggers		
			15 ft. Lb.	25 ft. Lb.	35 ft. Lb.
184,000	45,000	40 0	45,600	23,400	14,600
to	to	to	to	to	to
186,000	52,000	60 0	44,800	19,700	11,600
125,000	31,300	31 5	33,500	17,800	11,700
to	to	to	to	to	to
126,000	37,300	48 3½	31,500	16,600	10,500
110,000	28,000	31 5	22,600	11,800	7,500
to	to	to	to	to	to
111,000	33,500	48 3½	21,500	10,600	6,400
96,000	56,000	31 5	25,200	13,300	8,600
to	to	to	to	to	to
97,000	67,000	48 3½	23,900	12,000	7,300
89,000	52,000	31 5	19,800	10,200	6,500
to	to	to	to	to	to
90,000	63,000	48 3½	18,600	9,100	5,400

The wide range of service to which locomotive cranes have been adapted is indicated by the following tabulation showing their application on a large railroad in the eastern section of the United States.

Uses of Locomotive Cranes in Railway Service

ROADWAY SERVICE

Laying rail; laying new track—ties handled in bundles, rails laid and crane moved ahead; handling frogs and switches at frog shops; removing old and laying new frogs and switches; raising tracks, sidings, etc.—either for permanent elevation or in stocking coal, etc.; shifting track or turnouts, etc., to new locations.

Grading for industrial tracks and other sidings; grading approaches on overhead highway crossing bridges.

Loading ties by means of slings; loading, unloading and placing tie-tamper air compressor outfits; loading—using a grab bucket—tie-plates, splices, bolts, kegs of spikes, etc.

Cleaning ballast by means of grab buckets and screens mounted on cars; distributing stone ballast where it would be uneconomical to distribute by opening car hoppers.

Placing pre-cast concrete slabs; loading, distributing, and installing concrete and other types of culverts; distributing material and charging mixers in concrete work; handling gravel and sand at pits.

Ditching along right-of-way or in other places, cleaning or policing the right-of-way and in terminals and yards—handling scrap, refuse, etc., with a grab bucket.

Cleaning off tunnel portals—men shoveling into a bucket; lining tunnel—steel sections carried in on top of boom and placed in position.

Cleaning snow out of cuts; loading, unloading and placing snow fencing panels in position.

Handling rip-rap in the construction of retaining walls; excavating for and placing cribbing and filling same.

Driving piles—being equipped with steam hammers; dredging around pontoons and float bridges.

In construction work—bents and materials framed in advance and placed in position by cranes; tearing down and distributing timbers in the dismantling of obsolete coal trestles, etc.

Setting up steel stacks, etc.; loading, unloading and placing steam boilers, etc., at drawbridges and power houses.

Rocking turntables when necessary to replace or change centers.

Setting up highway crossing alarms.

BRIDGES AND BUILDINGS

Erection of building and sheds—handling material, placing timbers or steel trusses, etc.; picking up and loading or shifting small buildings.

Used in place of jacks for raising small bridges to secure greater clearance; excavating for bridge piers and abutments; hooking up gears and frames at transfer bridges; handling bridge timbers such as decking, ties, etc.; handling steel for bridge renewals and erection.

WATER SERVICE

Excavating trenches in water service and sewer work; setting up stand pipes, water tanks, pipe lines, etc.

Unloading and placing pumps—if unable to move into building and place into position the material is moved as near to its final position as possible; cleaning out suction wells for fire protection pumps.

SIGNAL AND ELECTRICAL

Loading and placing concrete telephone booth, battery wells, etc.

Pulling up and loading or unloading telephone and telegraph poles, etc.; setting up telephone and telegraph poles, signal poles and bridge warning signs.

Erecting or moving signal bridges—new foundations made ready and bridges picked up as a unit—where possible—or in sections and moved to new location.

OTHER USES

Handling coal—stocking coal, coaling engines, unloading coal at stations and other company buildings; handling ashes at engine terminal pits; handling sand at terminals—filling bins, etc.

Handling timber in the lumber storage yard; handling treated timber at treating plant.

Handling pig iron and scrap with magnets at outlying points where electric gantry cranes are not installed; handling heavy material at locomotive shops with or without magnets; handling wheels and axles—mounted or unmounted—at car shops and other locations.

Handling freight at waterfront terminals.

Replacing work train for spotting cars around company shops and yards; re-railing cars in yards.

Wrecking purposes—picking up and throwing aside or loading all refuse, burnt timbers, freight, coal, car parts, etc.; dismantling and removing from trucks old condemned cars.

Most of the uses listed are self-explanatory but others may be briefly described. In ballast cleaning good results have been obtained by forking the ballast out from between the ties, the foul ballast being piled in the center

of the track. A clamshell bucket is then used to pick up this ballast, discharging it into a large screen mounted on a gondola car; the cleaned ballast runs down the screen and to the track; the dirt falls through and is retained in the car.

In handling tie-tamper air compressors, the units are retained in one position as long as possible by the use of long pipe lines; necessary moves are made by a work train hauled with a locomotive crane, the crane picking up the compressor and equipment and loading it on the train. It is then transported to the next location and placed in position.

When necessary to move frogs and switches it can be done very conveniently with a locomotive crane; in many cases one, and sometimes two or three turnouts coupled together have been dragged bodily to a new location. The sidings are disconnected from the turnouts, leaving the latter intact and placing 1 in. boards under the ties to prevent the ballast or sub-grade from piling up when the turnouts are being moved.

In the construction of new tracks, a locomotive crane may be used to distribute the ties and lay the rail. The ties are piled in bundles in a car behind the crane; the rails are likewise carried behind the crane, which first picks up a bundle of ties and drops them on the sub-grade where they are spaced; the rails are next swung into place and spiked down.

Cranes are also used for raising track, particularly in yard siding; ashes or other materials are dumped on the track in the usual manner after which it is raised evenly by the crane, the hoisting cable being fastened either to a chain sling or to some form of clamps on the rail. Elevations of from 1 to 15 ft. are made in this way by simply repeating the operation of dumping materials and lifting the track up through it.

Splice bars, tie plates, bolts and spikes can be handled effectively and quickly in the storage yard. Each pile should be kept within certain limits of size, then when it is necessary to load, a crane can be run in, a clam shell bucket dropped over the pile and the materials handled without damage.

In renewing bridge ties two cranes are used, one on each end of the bridge. These cranes work toward the center, lifting out and setting aside the rails; the old ties are then picked up in bundles and loaded on a car behind the crane. New ties, framed previously, are also carried behind the crane and as space is opened by the removal of the old ties, bundles of new ties are swung into position and installed, after which the cranes pick up and re-lay the rails. Both cranes then move forward and repeat the operation until the track is complete.

When slides occur, the long reach of the crane boom is usually an advantage since the material can often be wasted to one side where otherwise it might be necessary either to rehandle or load it into cars.

In gravel and sand pits where a steady output of material is not required, the use of a locomotive crane has been found advantageous; the crane can be pulled out readily and dispatched to other locations for other work.

In a highway bridge construction job, the elevation of the structure necessitated considerable filling for the approaches; the crane boom was long enough to handle ashes from cars on the tracks to the required distance behind the abutments; without the crane it would have been necessary to dump the filling alongside the track and then wheel it by manual labor or otherwise convey it to the approaches.

In hanging transfer bridges and hooking-up the gears and frames, heavy girders are erected on timber legs, the crane swinging the girders up on the legs where they are fastened together; all gears, frames and motors, etc., are handled in a similar manner.

A locomotive crane equipped with leads suspended from the boom and with a steam hammer, gives a great degree of flexibility which is an advantage where it is impossible to get a water pile-driver in close enough to drive piles.

Wrecking Cranes

Wrecking cranes are a form of locomotive crane, similar in design but, being intended for very heavy severe service, usually are more strongly built than the general service machines. They are designed chiefly for wrecking service but also are used in bridge construction and other heavy service on railroad lines.

The booms—seldom more than 35 to 40 ft. in length—generally are curved near the top, but sometimes are made straight and provided with an extension so that, for special work, they may range in length upward to 90 ft. or more. The shorter booms are generally used in railroad wrecking service; for a vertical lift they have an effective radius ranging from about 15 ft. to 40 ft.; the hoist line may, however, be payed out beyond the end of the boom and used to drag an object within lifting range.

Many of the various lifting devices used with other types of hoisting machines may be used on wrecking cranes but generally these cranes are provided with special types of hooks, slings, and other accessories adapted for very heavy service.

Wrecking cranes generally are steam operated but in some cases, particularly for use in tunnels or subways, they are equipped for electric operation.

Some cranes which are used only in connection with a wrecking train or a work train are not self-propelled and are operated by steam obtained from the train locomotive or from some other outside source.

The approximate capacities typical of a heavy wrecking crane with the boom tackle at various radii, are as follows:

Main Hoist	Auxiliary Hoist (Single part of rope)
Without Outriggers	
24 tons at 17-ft. radius	17 tons at 23-ft. radius
11 tons at 27-ft. radius	8½ tons at 35-ft. radius
Either End or Center Outriggers Set	
85 tons at 17-ft. radius	41 tons at 27-ft. radius
40 tons at 27-ft. radius	28 tons at 35-ft. radius
All Outriggers Set	
150 tons at 17½-ft. radius	45 tons at 35-ft. radius
60 tons at 27½-ft. radius	

Pile-Drivers

Pile-drivers embody many features of locomotive crane construction, in some cases being simply a locomotive crane with a pile-driver attachment. They are designed chiefly for driving piles along a railroad line but may also be used in other locations by providing track on which to travel. These machines are equipped either with a steam operated hammer or a drop-hammer. They have a radius of action up to about 30 ft. from the center of the crane turntable and will drive piles 40 ft. or more in length.

The ordinary locomotive crane is sometimes provided with a pile-driver attachment which may be connected to the crane boom; or the boom may be removed and the

pile-driver attachment installed in its place. When the amount of work to be done would not warrant the expense of maintaining a pile-driver, a crane thus equipped may be used to advantage for general purposes and also for pile-driving.

Excavators

Excavating is an important part of railroad work; the locomotive crane has been adapted to handle practically any class of material in such operations but in many cases, the use of power shovels has been found advantageous.

Power shovels are adapted to digging such materials as sand, gravel, clay shale and earth without blasting; or for handling all classes of loose materials such as coal, ore, rock, or other similar material after blasting. They have been extensively applied to excavation service in railroad work; and for general construction work where excavating and loading of material is necessary. These shovels generally are self-propelled, but they are sometimes mounted on a platform and moved on rollers when it is necessary to change the location of the machine. They are made in several different forms: The standard railroad type for heavy service; the revolving type for general service; and the ditching machine.

The standard railroad type of power shovel—commonly called a steam shovel because of the type of power generally used—is adapted to the most severe service. This type of machine may be equipped with a dipper having a capacity ranging upward to about 6 cu. yds.; a radius of action upward to about 35 ft. swinging through an arc to about 10 deg. beyond a right angle on either side of the car, or a total swing of about 190 to 200 deg.; and a dumping height of about 20 ft. above the surface on which the machine rests.

The proportions of some power shovels of the railroad type are given in the following table:

Capacity of dipper	3½-6 yds.		3½-4½ yds.		2½-3 yds.	
	ft.	in.	ft.	in.	ft.	in.
Length of boom	31	6	30	3	27	3
Length of dipper handle	20	6	19	6	16	9
Dumping radius	32		30	3	26	5
Height of dump	17		18		16	
Depth of cut shovel track to loading track	10		11		9	
Depth of cut below rail	6		6	6	5	9
Digging radius at 8 ft. elevation	33		33	1½	28	4
Radius of level floor	19		19	6½	17	3

A modification of the railroad type of power shovel mounted on traction wheels having a very broad tread has been adapted to such classes of service as making narrow cuts and for other operations where a heavy capacity shovel may be desired, but where it is not practicable to lay tracks for the standard railroad type of machine. Except for the type of truck on which the machine is mounted, this type of shovel is constructed in substantially the same manner as the larger railroad type. The radius of action ranges upward to about 20 ft. through an arc of about 260 deg., and the height of dump—elevation to which material may be handled above the base—is about 12 ft.

The revolving—full circle—type of power shovel performs practically the same class of work as the heavier railroad type, but is designed for lighter service where the larger machines could not be economically operated. It embodies many of the features of construction used in the railroad type, but instead of being arranged so that only the boom and dipper rotate, the entire superstructure is mounted on a turntable similar to that used in the construction of a locomotive crane and it may be rotated in a complete circle. This permits the operation of the shovel in any direction within a comparatively small area and it also will perform a maximum amount of work without changing the location of the machine.

Capacities of the small sizes of revolving power shovels are approximately as follows:

Capacity of dipper	Length of boom		Length of dipper handle		Digging radius at 8 ft. elevation	
Cu. Yd.	Ft.	In.	Ft.	In.	Ft.	In.
⅔	18	0	11	0	23	6
1	20	0	14	0	27	9
1½	25	0	16	3	32	6

A larger, heavier type of revolving power shovel has also been developed for special service where the amount of work to be done warrants the installation and use of a heavy machine.

The ditching machine—commonly called a railroad ditcher—is used chiefly in railroad maintenance work for drainage ditching alongside of the tracks—hence the name "ditcher." It may also be utilized for other similar work within range of the dipper. Generally this type of machine is self-propelled and is mounted on a turntable carried on a truck which usually travels on tracks laid on the platform of a railroad flat car. It differs from the railroad type of power shovel in that its movement is circular—full circle—instead of radial; except for the manner of mounting, it is of substantially the same construction as the revolving type of power shovel and operates in a similar manner.

Two different methods are employed in the operation of the railroad ditcher: a flat-car train; or a dump-car train. When using a flat-car train the ditcher travels from car to car over portable sectional tracks which it transfers ahead as it progresses and loads the material on the cars behind it; the train is then hauled to the dumping ground and the material unloaded with an unloader plow or by manual labor with hand shovels. In the dump-car method, two dump-cars are used and the ditcher is mounted on a flat car between them. The scope of railroad ditchers is approximately as follows:

	Ft.	In.	Ft.	In.
Radius of cut at grade	15	6	18	0
Radius of cut at 8 ft. elevation	23	6	28	0
Radius of dump from pivotal center	22	0	26	6
Radius of boom from pivotal center	18	4	22	¾
Depth of cut below top of rail	3	0	3	0
Height of dump above top of rail	10	0	11	0

Section and Inspection Cars

Railway section or inspection cars are designed primarily to convey the section men to and from their work and to conserve the time of other maintenance employees while on duty. These cars may be either hand-propelled or motor-driven.

The motor cars are equipped with internal combustion engines controlled by means of levers conveniently located in front of the operator. The engines may be either two-cycle, or four-cycle; both types may be either air-cooled or water-cooled.

Motor cars are of three general types: section and heavy duty work cars; light inspection cars; and party inspection cars. All of these types ore four-wheeled cars with seating capacity for one or more persons. The engine is placed either at one side or in the center of the

car between the wheels, the two styles being distinguished by the terms side-load and center-load cars.

A common style of center-load section or heavy duty car has a bench seat extending the entire length of the car in the center of the platform space. It is usually equipped either with a direct-connected engine with gears or chain drive, which is started by pushing the car along the track; or with a free-running engine which may first be started and the car then placed in operation by engaging the gears or friction disc. This type of car will seat from 6 to 8 men and usually has ample power to also haul a loaded trailer; it is used principally by trackmen and bridgemen. Cars now in common use weigh from about 850 lb. to 1,250 lb.

One type of light inspection car is equipped with a direct-connected engine centrally located between the wheels and operating directly on the rear axle; or the engine is fastened to the side of the frame and operates on the axle of the front wheel. This style of car, designed to take the place of railway hand velocipedes, weighs from 350 to 500 lb. and may be disconnected really for shipment by train.

The side-load light inspection car usually has a slat-platform and carries a tool tray. The seat is located on the engine side over the wheels of the vehicle. It thus forms a top for the frame which rests on the axle bearings and is held upright by horizontal cross-braced guide-arms which hold the wheels in their correct relative position.

The party inspection car is provided with a platform having one or more cross-seats sufficient to accommodate from 6 to 12 persons and usually has a canopy top equipped with front, rear, and side curtains. Some cars are equipped with compressed air whistles, pilots, and wind shields. The engine is commonly of the free-running type and is centrally located, wholly or partly beneath the platform; it generally has a friction-disc type of transmission operating a sprocket chain to the rear drive-axle. These cars weigh from 1,000 to 1,500 lb.; as they are too heavy to be readily removed from the track to avoid passing trains, they are preferably operated under train orders.

Another development in the railway motor car field is the motor-equipped hand car or push car; internal combustion engines of either the direct-connected, or the free-running types may be employed to furnish power and some railroads having large numbers of hand cars have equipped them with motor engines. Some of these engines are furnished with special tops made to replace the hand or push car platforms, while other engines are designed to be fitted on the original platform of the car.

Various types of hand-operated cars are also used in maintenance service: Four-wheeled hand cars of the "pump" type are used for transporting workmen, tools, etc.; an A-frame mounted on the platform of the car supports a central walking-beam on the ends of which are wooden cross-handles which are alternately depressed —"pumped"—to rotate the axle gear by which the car is driven. A brake placed between the wheels on the right hand side may be pressed against the wheels to retard the speed. The longitudinal floor sills project beyond the platform, forming handles at each end by which the car may be lifted. When hand cars are to be operated over tracks where the rails carry electric current the wheels are insulated.

A four-wheeled push car—pushed by hand—is commonly used to transport track materials such as rails, ties, bridge timbers, switch materials, etc., which are too bulky or heavy to be carried on a hand car. This type of car usually consists of a wooden platform bolted to the bottom cross braces and longitudinal sills, which rest on four axle bearings and terminate in handles for lifting the car. These cars are sometimes equipped with hand brakes and with insulated wheels.

Other Railway Service Cars

Some other types of cars used in non-revenue railway service are: instruction cars, dynamometer, test-weight, and clearance cars.

The dynamometer car is equipped with apparatus for measuring and recording drawbar pull, horse power, train line pressure, and other data connected with locomotive performance and train haul conditions.

A description of a dynamometer for determining the lateral stresses exerted by the coupler on the underframe when cars are passing around a curve will be found in the 1908 M. C. B. Proceedings, page 149.

Car Dumpers

The use of car dumping machines for handling cars laden with coal or ore has become so extensive that, in 1919, the American Railway Association adopted a Recommended Practice as follows:

Standard Blocking for Cradles of Car Dumping Machines

Recommended Practice—ADOPTED, 1919

Provision is made to take care of projecting grabirons, ladders and ends of winding bars by omitting a part of the 3-in. planking at the "B" end and near the center of the cradle wall. The planking is also omitted between the first and second posts at the "A" end of the machine so that short cars may be handled nearer the center of the cradle—this to be accomplished by spotting the car with the side ladder between the two posts. The long cars are to be spotted with the ladder outside of the end post. This post to be faced with 3-in. timber to make face flush with planking. Railroads operating cars having top side angle projecting beyond face of car side may cut horizontal recess 6 in. wide and 3 in. deep in the face of the blocking at the point of contact with angle.

The matter of applying a metal plate to face of posts above planking to prevent wear of facing on posts is left optional with company operating the machine. All fastenings such as bolts, lags, spikes, etc. shall have heads flush or below face of blocking. The distance from center of track to face of planking should be made 5 ft. 9 in. (where possible) when cradle is in normal position. A guide plate should be located as shown on drawing at "B" end of cradle to prevent damage to blocking by cars having sides bulged too wide to clear.

The planking directly under the clamps should not extend more than 6 ft. 7 in. above top of rail in order that clamp may drop low enough to engage top of low side cars. The spacing of the vertical posts will have to be governed to some extent by the construction of the cradle, but should not be spaced further apart than 3-ft. centers where possible, with the exception of the first two at "A" end, which should be spaced not less than 2 ft. 6 in. between posts, as shown on drawing. The bottom ends of posts should be tapered to prevent material lodging against them when the cradle is overturned.

Oak is recommended for planking on face of posts.

Railroads having industries on their lines using car dumping machines should request such industries to equip their machines in accordance with this recommended practice when renewing blocking.

A report of an M. C. B. committee on damage to freight car equipment by unloading machines will be found in the 1912 Proceedings, page 264; also in the 1913 Proceedings, page 563; and 1914 Proceedings, page 355.

Fig. 2624—Arrangement of Cars in New York Central Wreck Train. From Left to Right—Crane Tender, Crane, Truck Cars, Tool Cars, Sleeping and Dining Cars.

Fig. 2625—Interior of New York Central Tool Car.

Fig. 2626—Interior of New York Central Tool Car.

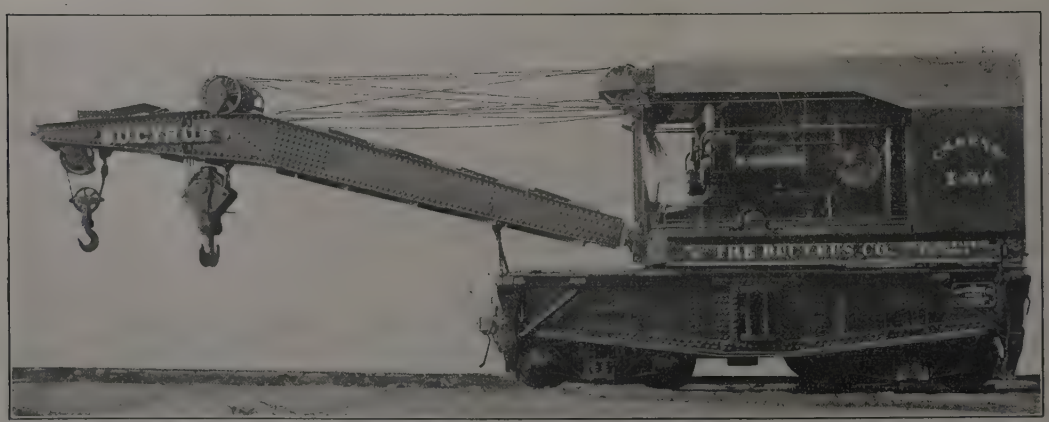


Fig. 2627—Steam Wrecking Crane. Lifting Capacity, 100 Tons. Builder, Bucyrus Company.

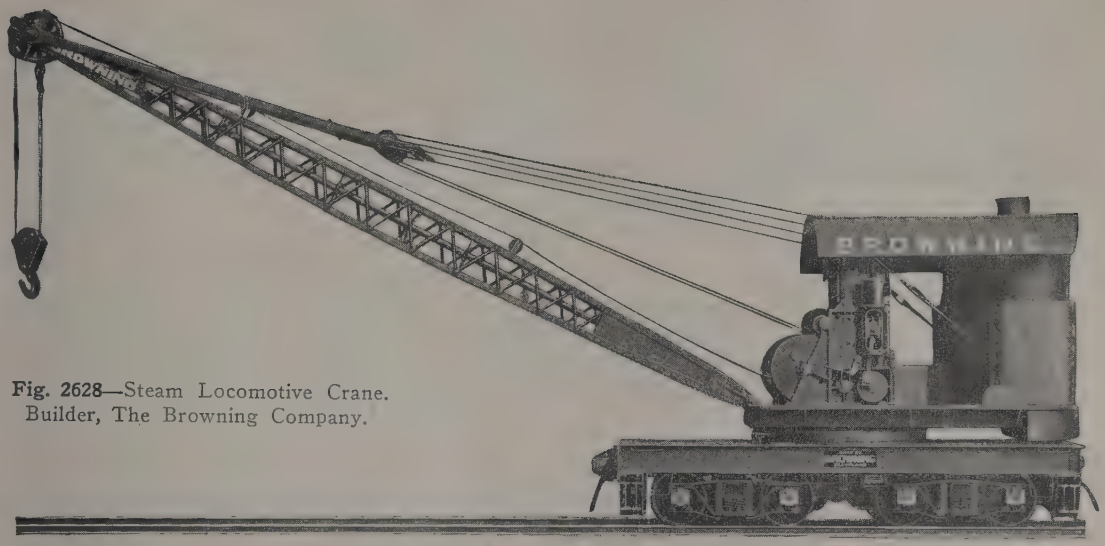


Fig. 2628—Steam Locomotive Crane.
Builder, The Browning Company.

Fig. 2629—Interior of Erie Railroad Tool Car.

Fig. 2630—Interior of Baltimore & Ohio Tool Car.

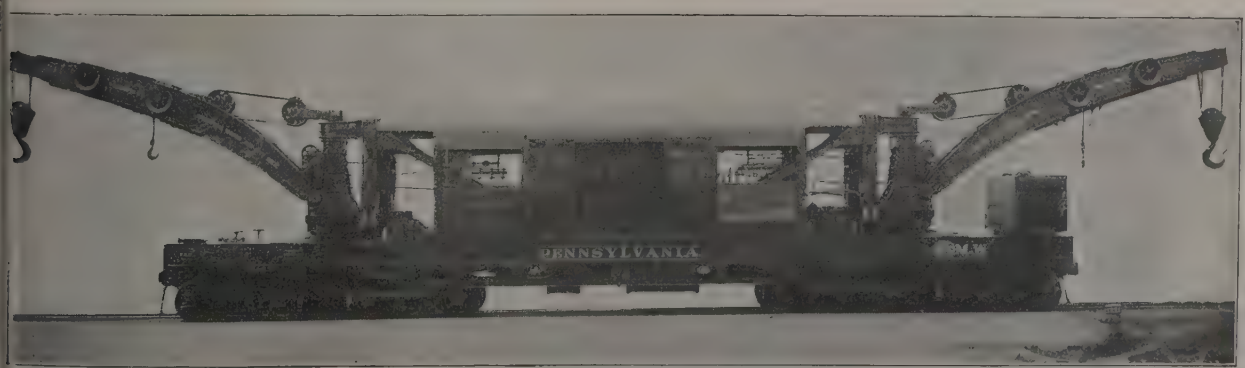


Fig. 2631—Electric Wrecking Crane for Use in Tunnels. Weight, 326,000 lb.; Lifting Capacity at 17 ft. Radius, 50 Tons. Builder, Industrial Works.

(*See also Page* 989)

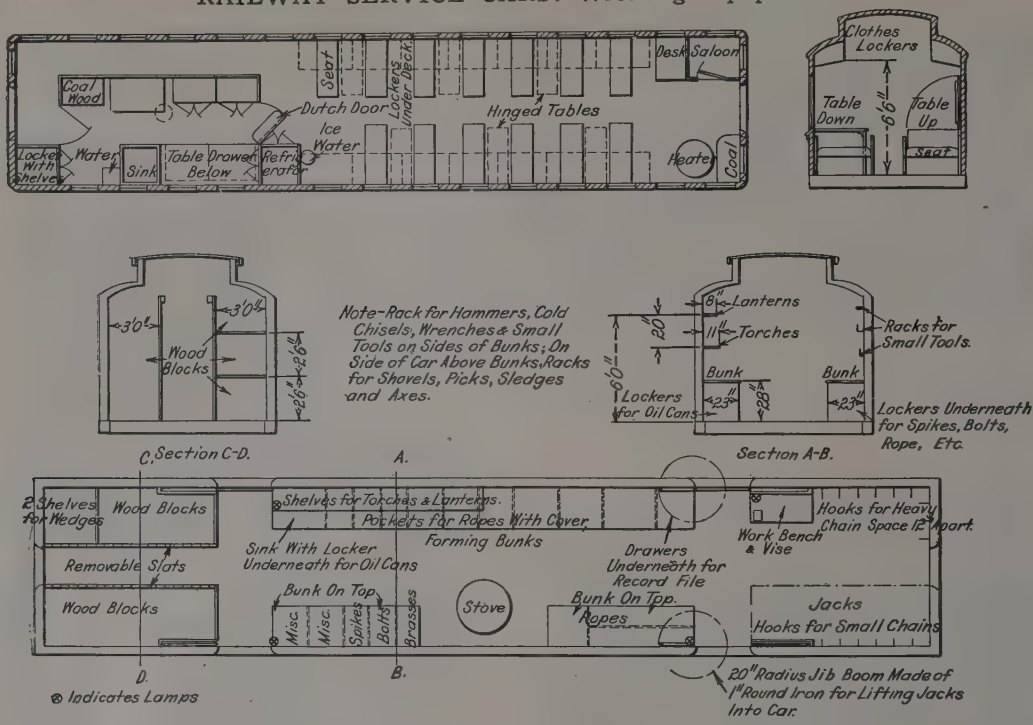
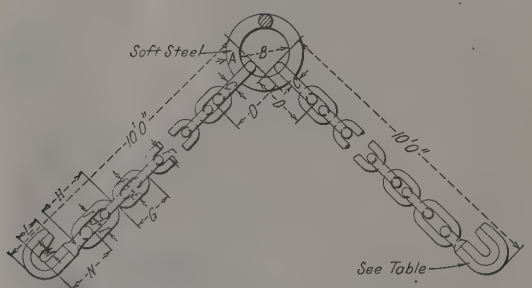
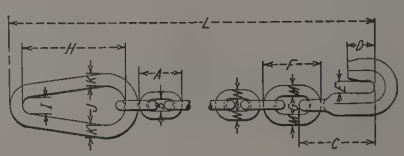


Fig. 2632—New York, New Haven & Hartford Dining, Tool and Sleeping Cars.





Ring	Hook	A	B	C	D	E	F	G	H	I	J	K	L	M	N
OS.O	13	2½	□ 2½	8"	1½"	9¼"	1¼"	1½"	6¼"	9"	1½"	2"	1⅝"	5"	⅞"	11"
"	15½	2⅝	□ 2⅝	2¾	10"	1⅜"	10¼"	1½"	2"	7¾"	10"	1⅜"	2¼"	1⅛"	7"	5"	⅛"	11"
"	16"	2¾	□ 3"	3"	10"	2"	11"	⅝"	2¼"	8½"	10½"	2"	2½"	2¼"	5½"	1¾"	¾"	11½"

No. of Chains	Wrecking Chains												Size	Size	Hook
In Service	Kind of Chains	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Size
10	Common	4½	1¼"	8"	3½	1⅛"	6"	2"	10⅝	2"	4"	1¼"	16'-0"	1"	⅞"	1⅜□Iron
4	Special	5½	1⅜"	10"	4⅜	1¼"	8"	2¼"	11"	2¼"	4"	1⅜"	22'-0"	1⅛"	1"	2⅛□Iron
6	"	5¾	1½"	10"	5"	1¼"	8½	2¼	11"	2¼"	4"	½"	22'-0"	⅛"	1⅛"	2⅜□Iron
8	"	6"	1⅜"	10⅜	5"	1⅜"	8½	2¼	11"	3"	4½	1⅜"	24'-0"	1⅜"	1¼"	2½□Iron
	"	7"	2"	11½	6"	1⅜"	9"	2½	12"	3¼	5½	2"	20'-0"	1⅜"	1½"	2¾□Iron

Fig. 2633—Dimension of Southern Railway Wreck Chains.

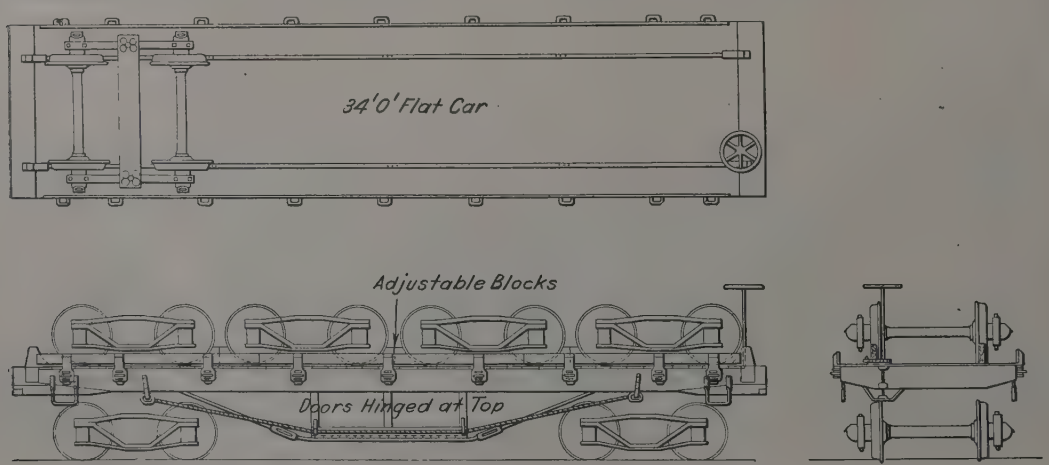


Fig. 2634—New York, New Haven & Hartford Truck Car.

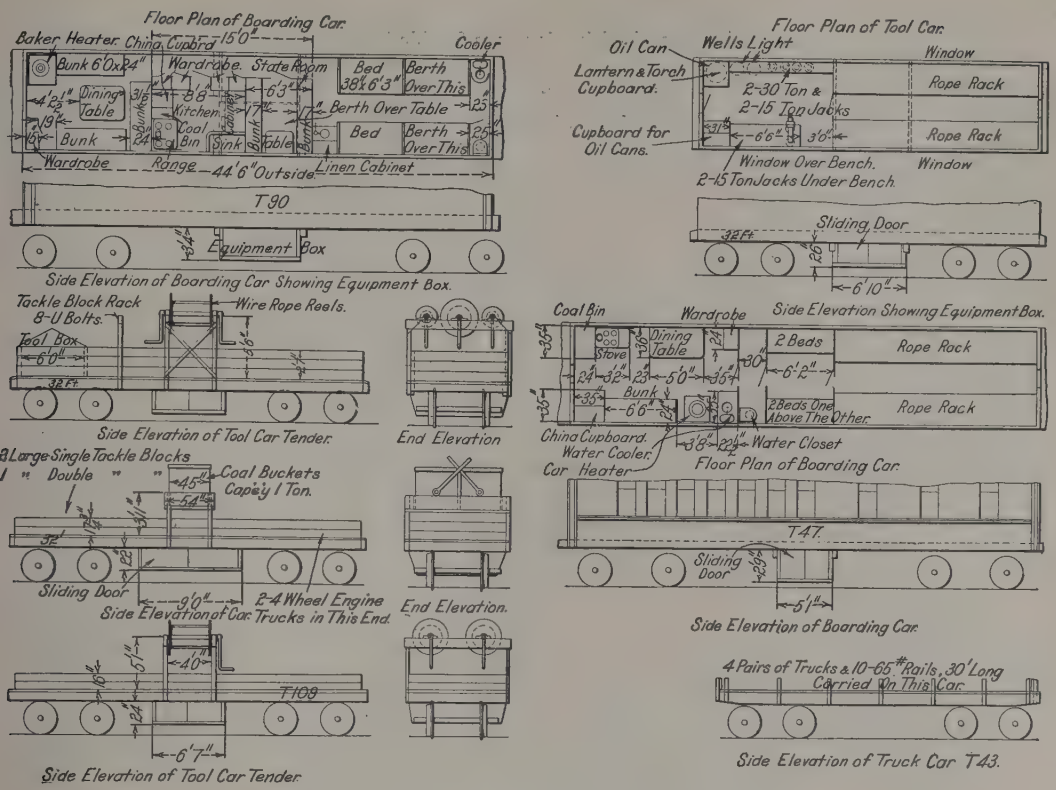


Fig. 2635—Southern Railway Wreck Train Cars.

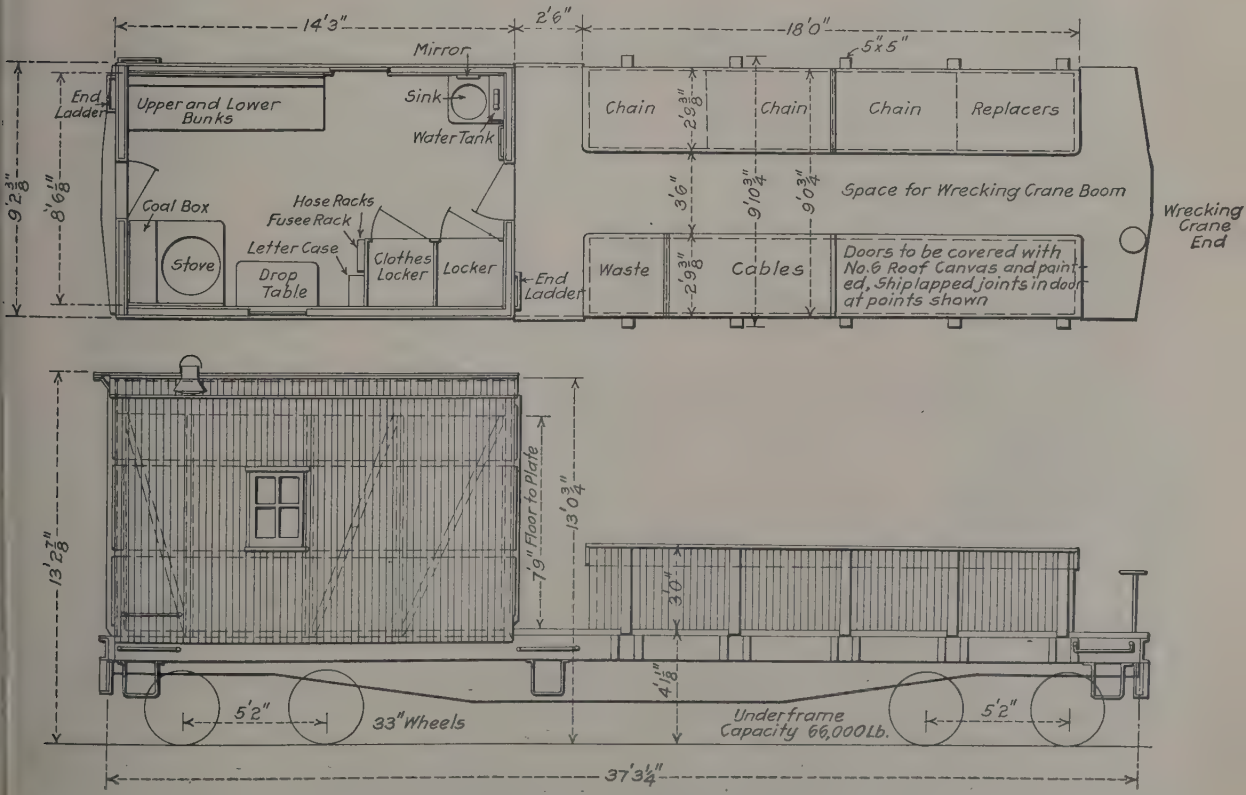


Fig. 2636—Canadian Northern Auxiliary Car for Wrecking Crane.

Cars and Tools Used in Northern Pacific Wreck Trains.

1 100-Tons Capacity Steam Wreck Crane.

Tools in Tool Car.

- 2 40-Ton Hydraulic Jacks with Levers
- 2 30-Ton Norton Jacks with Levers
- 2 Foot Lifts for Hydraulic Jacks
- 4 12 in. Pony Jacks
- 600 ft. in. Rope
- 600 ft. 2 in. Rope
- 300 ft. 1½ in. Rope
- 300 ft. 1¼ in. Rope
- 300 ft. 1 in. Rope.
- 2 Pieces 1¼ in. Rope, 100 ft. Long
- 1 Piece 3 in. Rope, 300 ft. Long, for Rolling Line
- 1 Complete Set of Splicing Tools
- 2 2½ in. Rope Slings, 50 ft. Long
- 2 Wire Cables, 1½ in. diameter, 60 ft. Long, with Heavy Links at Each End
- 1 3-Sheave Tackle Block for 3 in. Rope
- 1 2-Sheave Tackle Block for 3 in. Rope with Becket
- 1 3-Sheave Tackle Block for 2 in. Rope
- 1 2-Sheave Tackle Block for 2 in. Rope with Becket
- 2 2-Sheave Tackle Blocks for 1¼ in. Rope, One with Becket
- 2 2-Sheave Tackle Blocks for 1 in. Rope, One with Becket
- 2 3½ in. Iron Snatch Blocks
- 2 2½ in. Iron Snatch Blocks
- 2 1½ in. Iron Snatch Blocks
- 1 1¼ in. Iron Snatch Block
- 1 1 in. Iron Snatch Block.
- 2 1¼ in. Chains, 25 ft. Long, with Ring in Center and Grabs at Both Ends
- 2 ¾ in. Chains, 30 ft. Long, with Ring in Center and Grabs at Both Ends
- 1 ⅝ in. Chain, with Ring in Center and 4 Ends with Hooks
- 6 ½ in. Chains, 4 to 6 ft. Long, Ring at One End, Hooks at Other End
- 6 1¼ in. Switch Chains, 16 ft. Long
- 20 ⅞ in. Switch Chains, 16 ft. Long
- 2 Coupling bars
- 12 Coupling Links
- 24 Knuckle Pins, Assorted Sizes
- 4 Clevises, 1½ in., with 3½ in. Jaws
- 2 Links, with Thimbles for Rope
- 6 S Hooks, 2 in. to 3 in. in diameter
- 2 Wells-Buckeye Lights No. 5
- 2 Extra Burners for Wells-Buckeye Lights
- 1 Tent for Field Telegraph Service
- 1 Complete Telegrapher's Outfit
- 1 Portable Telephone, Complete with All Attachments
- 3 5 gallon Cans of Headlight Oil.
- 2 3 gallon Cans of Car Oil
- 3 Buckets of Prepared Packing for Journal Boxes
- 3 Packing Irons
- 3 Packing Hooks
- 2 Small Squirt Cans
- 1 Small Funnel
- 1 5 gallon Can of Wood Alcohol for Hydraulic Jacks
- 12 Hand Torches
- 4 White Lanterns
- 4 Red Lanterns
- 6 White Globes, Extra
- 4 Red Globes, Extra
- 2 Blue Globes, Extra
- 6 1¼ in. Air Brake Hose
- 2 Dummy Hose
- 2 Signal Hose
- 6 Pairs Rubber Boots
- 6 Cant Hooks
- 2 Cutting Bars, 4 ft. Long
- 3 Axes
- 4 Axe Handles
- 1 Hand Axe
- 2 Carpenter's Foot Adzes
- 1 5 ft. Cross Cut Saw
- 2 30 in. Hand Saws
- 12 Scoop Shovels
- 6 No. 2 Track Shovels
- 2 Long Handled Shovels
- 4 Picks
- 4 Extra Pick Handles
- 4 Spike Mauls
- 2 Spike Maul Handles
- 4 Lining Bars
- 2 Claw Bars
- 1 Track Level
- 2 12 lb. Sledges
- 1 16 lb. Sledge
- 1 8 lb. Sledge
- 2 3 lb. Hammers
- 2 2 lb. Hammers
- 6 Cold Chisels
- 4 Track Chisels
- 1 18 in. Stilson Wrench
- 2 18 in. Monkey Wrenches
- 2 15 in. Comb Wrenches
- 4 12 in. Monkey Wrenches
- 15 Assorted Open End Wrenches
- 1 5 Wheel Pipe Cutter
- Assortment of Brasses and Wedges for Cars
- 2 Center Pin Drifts
- 2 Cranes at Side Door for Handling Jacks
- 2 Hand Barrows for Carrying Jacks
- 2 Fire Extinguishers
- 2 Fire Axes
- 200 Grain Sacks
- 2 Pairs Aldon Car Replacers for 90 lb. Rails
- 3 Pairs Aldon Car Replacers for Lighter Rails
- 2 Pairs Alexander Car Replacers for Lighter Rails
- 2 Iron Wedges, 8 in. Wide, 2 ft. 9 in. long, 5 in thick
- 1 Track Gauge
- 4 Track Wrenches
- 12 Iron Buckets and 12 Iron Baskets for Handling Grain
- 1 Car Wheel Gauge
- 1 Box with Assortment of Nails
- 5 Pipe Rollers, 3 in. by 2 ft. Long
- 1 Carpenter's Brace
- 1 ¾ in. Car Bit
- 1 ⅞ in. Car Bit
- 1 1 in. Car Bit
- 1 2 in. Auger
- 2 Heavy Iron Dollies
- 1 Tool Chest for Small Tools
- 4 Drifts, for ¾ in., ⅞ in., 1 in. and 1¼ in. Bolts
- 4 Gilman Emergency Knuckles
- 25 lbs. Nuts and Bolts, Assorted Sizes
- 200 lbs. Assorted Bolts
- 2 Tarpaulins, 20 ft. by 40 ft., for Protecting Freight
- 1 First Aid Medicine Case

Material on Truck Car.

- 2 80,000 lbs. Capacity Steel Car Trucks
- 2 60,000 lbs. Capacity Steel Car Trucks
- 150 Pieces Blocking
- 25 Oak Wedges
- 6 30 ft. Cables
- 2 1½ in. Cable Slings, with Heavy Links at Each End
- 4 1½ in. Chains, 20 ft. to 30 ft. Long, Rings Each End
- 4 Kegs Track Spikes in Cellar
- 30 Pairs Angle Bars
- 4 Kegs Track Bolts

Material on Tie and Rail Car.

- 75 Ties
- 8 85 lb. Rails
- 8 72 lb. Rails
- 12 66 lb. Rails

Material in Bunk Car.

- 10 Bunks
- 10 Mattresses
- 1 Steel Kitchen Range
- Complete Set of Cooking Utensils
- 1 Ice Box
- Complete Set of Porcelain Dishes
- 1 Stretcher, Complete with Blankets, Pillows, etc.

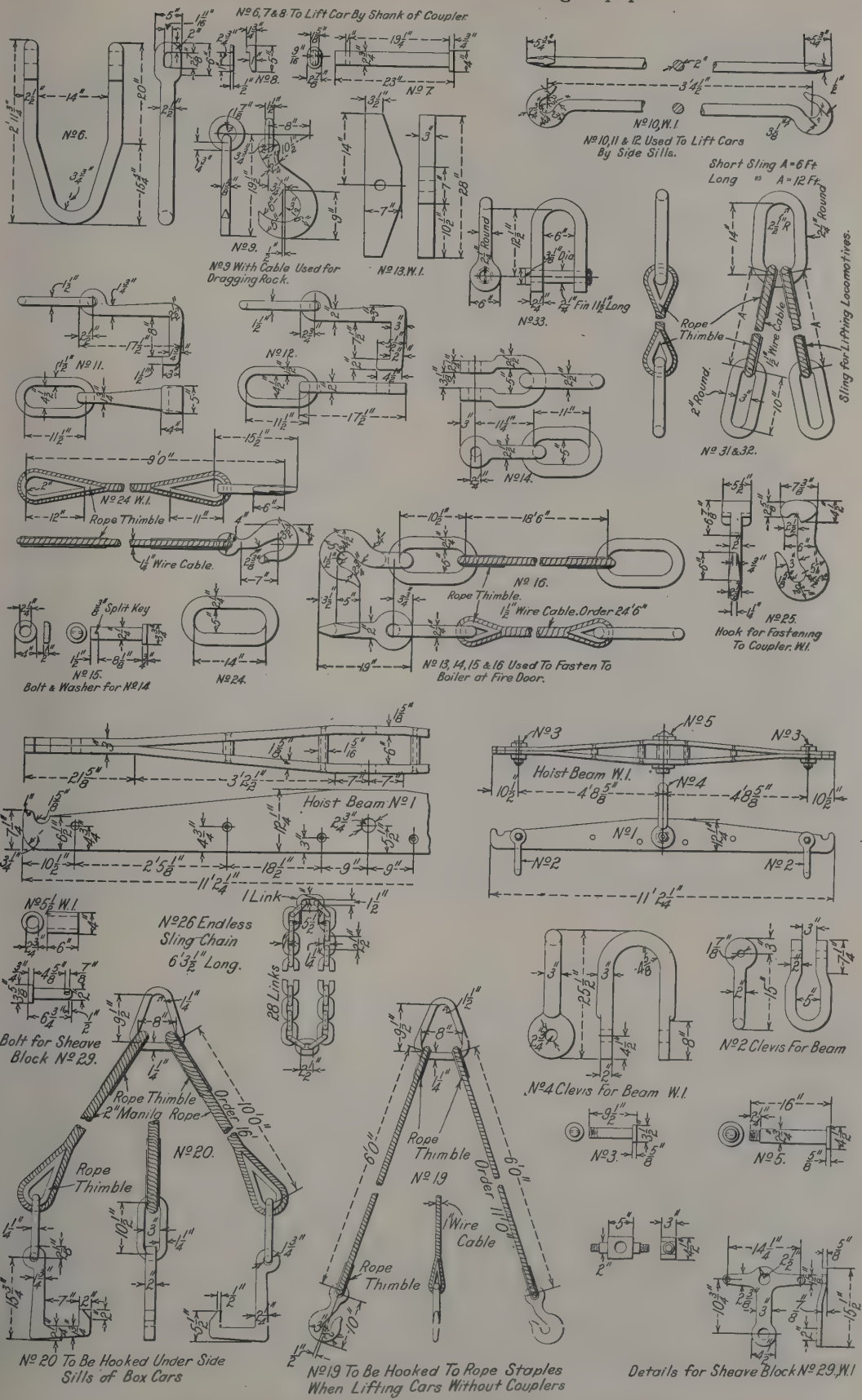

No 6, 7 & 8 To Lift Car By Shank of Coupler.
No 6.
No 7
No 8.
No 9.
No 9 With Cable Used for Dragging Rock.
No 10, W.I.
No 10, 11 & 12 Used To Lift Cars By Side Sills.
No 11.
No 12.
No 13, W.I.
No 14.
No 15.
Bolt & Washer for No 14
No 16.
Rope Thimble.
½" Wire Cable. Order 24'6"
No 24.
No 24 W.I.
Rope Thimble
¼" Wire Cable.
No 13, 14, 15 & 16 Used To Fasten To Boiler at Fire Door.
No 25.
Hook for Fastening To Coupler. W.I.
No 31 & 32.
Short Sling A = 6 Ft Long
" A = 12 Ft
Sling for Lifting Locomotives.
No 33.
Hoist Beam No 1
Hoist Beam W.I.
No 1
No 2
No 3
No 4
No 5
No 5½ W.I.
No 26 Endless Sling Chain 6'3½" Long.
1 Link
28 Links
Bolt for Sheave Block No 29.
No 2 Clevis for Beam
No 4 Clevis for Beam W.I.
No 3.
No 5.
Rope Thimble
2" Manila Rope
Order 100'
No 20.
No 20 To Be Hooked Under Side Sills of Box Cars
Rope Thimble
No 19
Order 11'0"
Wire Cable
No 19 To Be Hooked To Rope Staples When Lifting Cars Without Couplers
Details for Sheave Block No 29, W.I.

Fig. 2637—Chicago, Burlington & Quincy Wreck Train Tools.

Fig. 2638—Goodman Wrecking Hook. The National Malleable Castings Company.

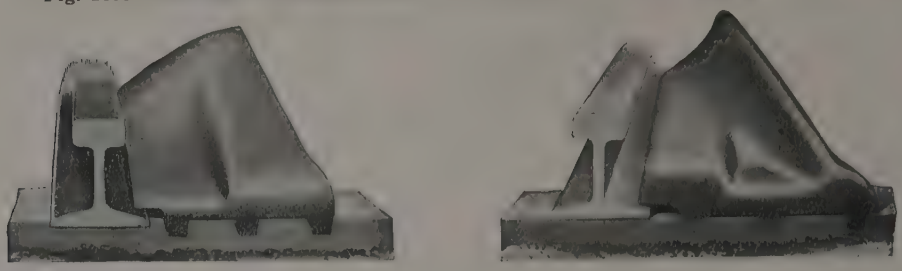


Fig. 2639—Outside and Inside Car Replacers. The Buda Company.

Fig. 2640—Johnson Wrecking Frog. Johnson Wrecking Frog Company.

Fig. 2641—Alexander Car Replacers. Alexander Car Replacer Company.

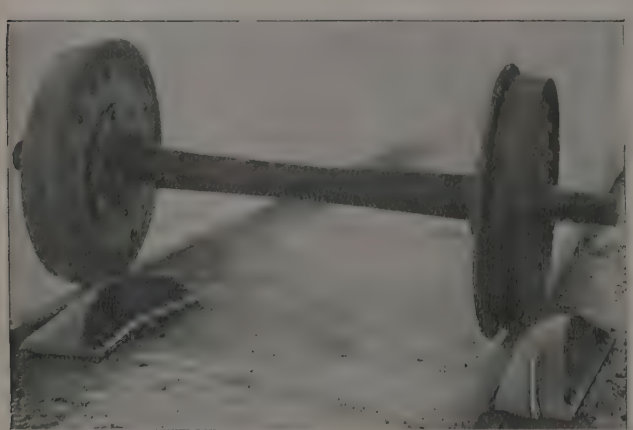


Fig. 2642—Fewings Wrecking Frogs. The Q. & C. Company.

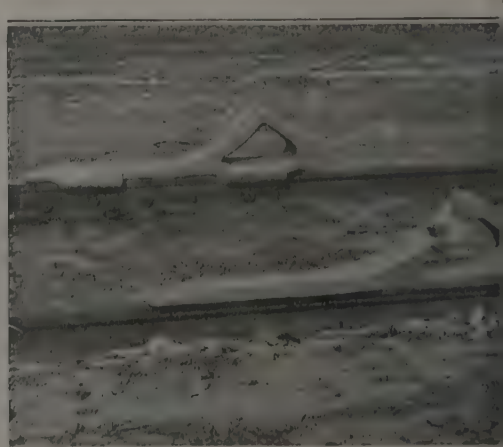


Fig. 2643—Q. & C. Skid Shoe for Sliding Dam Wheels. The Q. & C. Company.

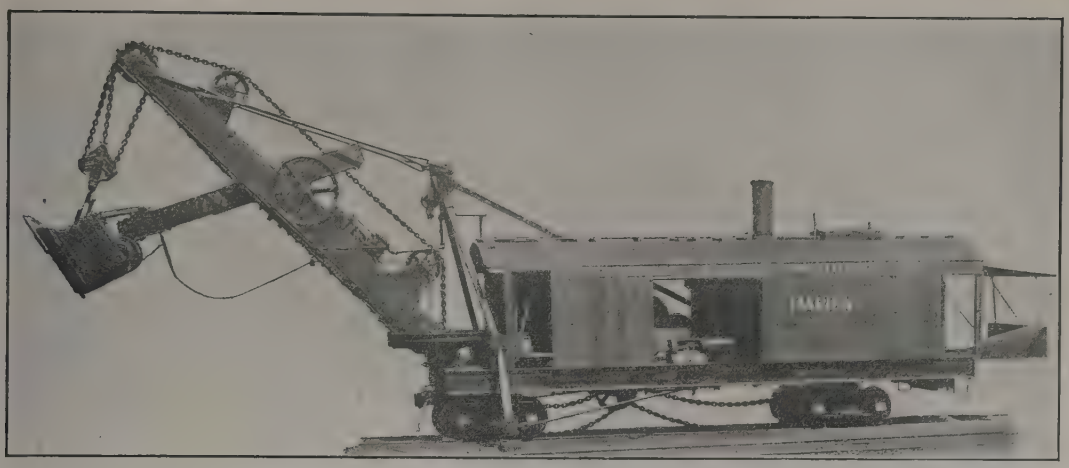


Fig. 2644—Marion Steam Shovel. Builder, The Marion Steam Shovel Co.

Fig. 2645—Bucyrus 88-C Steam Shovel. Capacity of Standard-Dipper 4 cu. yds. Weight in working order, 206,000 lb. Builder, Bucyrus Company.

Fig. 2646—Scoop Car Used on the Norfolk & Western for Removing Earth or Rock Slides.

Fig. 2647—Brownhoist Four-Wheel No. 3 Steam Locomotive Crane with Three-Quarter Cab.

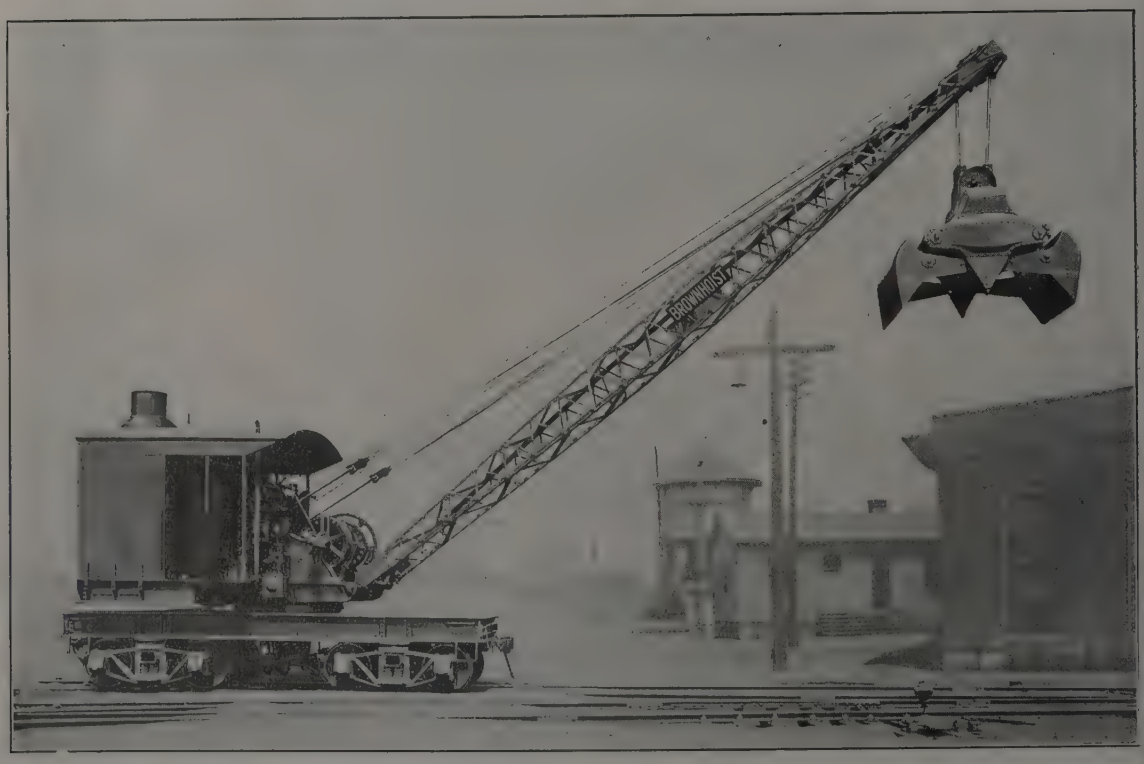


Fig. 2648—Brownhoist Steam Locomotive Crane. Wheel Base, 19 ft. 2 in.; Capacities, 13 ft. Boom, 39,000 lb.; 45 ft. Boom, 8,000 lb.; Bucket Capacity, 1 yd. to 2 yd.; Weight, 136,000 lb.

The Brown Hoisting Machinery Company.

(*See also Pages* 985-987.)

Brownhoist Locomotive Cranes

Railroad work requires hard, steady locomotive crane service and often at times when a locomotive is not available there is considerable switching of cars necessary. Brownhoist Locomotive Cranes have successfully met these severe conditions for over 30 years.

Brownhoist cranes are built in the sizes indicated in the table, each size being made in several types. The large variety of sizes and types makes possible the selection of a crane suitable for any purpose. Each type of crane has a range of capacity depending on the radius at which the load is being carried. These cranes can be overloaded anywhere from 15 per cent to 60 per cent of the figures given in the table before the crane will tip. With the outriggers in use the allowable overload is a still greater percentage of the ratio capacity given.

CLEARANCE TABLE

With same lengths of boom as given in table on following page—booms at 45° angle.

	No. 2	No. 3	No. 4	No. 6
A	20′	24′	31′	33′
B	7′	9′	9′	11′
C	15′	20′	27′	30′
D	12′	13′	13′	14′
G	10′ 1″	12′ 0½″	28′ 1½″	29′ 4″
H	7′	8′	19′ 2″	20′
L	8′ 10″	10′	10′	10′
N	10′ 6″	11′ 6″	11′ 6″	12′ 6″
O	15′ 2″	10′ 1½″	17′ 2″	18′ 7½″

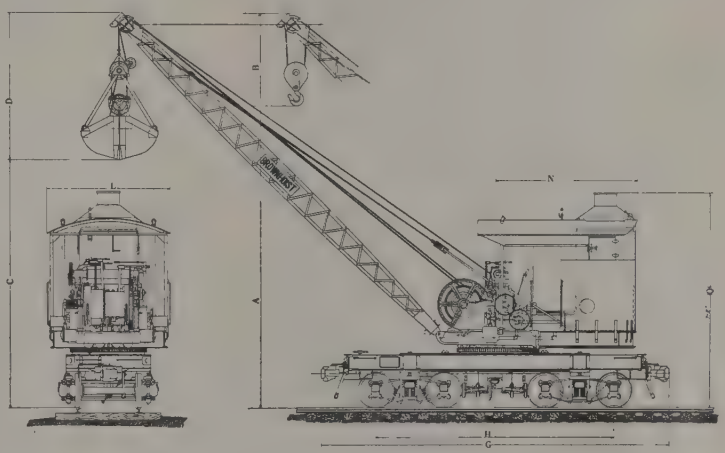


Fig. 2650—Clearance Diagram for Brownhoist Cranes

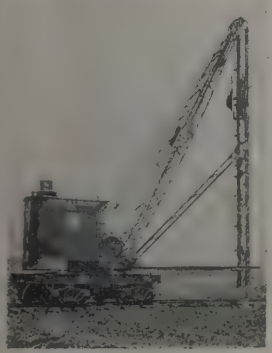


Fig. 2649 — Brownhoist Locomotive Crane with Pile Driver Attachment.

Brownhoist cranes are designed so that they are convenient to handle and to enable the operator to work the crane without undue fatigue. The operator's platform is so located that he can easily reach the operating levers and brakes and full view of the work can be had at all times.

The clutches are very important details on a locomotive crane as every crane operation is controlled through a clutch. The operating speeds and safe performance of the crane depend a great deal upon the grip of the clutches and the speed with which they take hold. Brownhoist cranes are equipped with powerful friction clutches and all the wear occurs on wooden friction blocks which have a one point adjustment, and can be quickly and cheaply renewed. This type of clutch can be thrown in even while the engine is operating at high speed and takes hold with a sure and powerful grip.

A single hoisting drum is provided for use on hoisting work with a single line block, and double drums for grab bucket and other operations which require two lines. The drums are of large size, making a fast operating crane, and will receive the ropes in a single layer—preventing damage from abrasion.

The travel mechanism is also an important part of a locomotive crane. On Brownhoist cranes, this consists of a heavy horizontal shaft, connected by sturdy gears to two driving axles. This horizontal shaft is in turn driven from a vertical travel shaft which is connected to the main engine shaft. On 8-wheel cranes, four universal couplings are used in the horizontal shaft, and they keep the gears in full mesh even when the crane is running on a sharp curve. Each crane is equipped with steam brakes, operative from the cab, and air brakes can be installed if desired.

Fig. 2651—Brownhoist No. 4 Steam Crane with 54 cu. ft. Brownhoist Coal Bucket. Handles 75 to 90 tons of Coal per hour.

The rotating mechanism also deserves mention as a crane rotates with practically every lifting

Fig. 2652—Locomotive Crane on Railroad Car Handling Rails with Hoisting Hook and Clamp. Electric Overhead Trolley Operation.

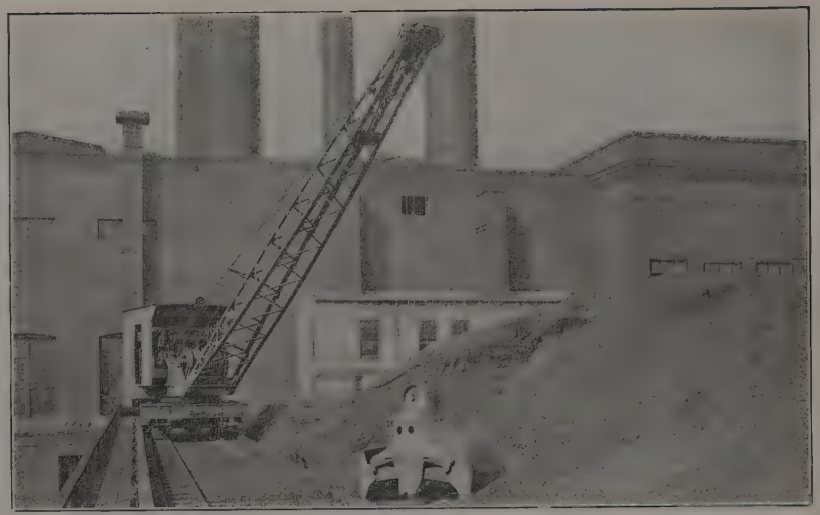


Fig. 2653—Locomotive Crane Handling Fuel at Power House with Two-Rope Grab Bucket. Electric Third Rail Operation.

Fig. 2654—Eight-Wheel Steam Locomotive Crane Handling Scrap Metal with Electric Lifting Magnet.

Fig. 2655—Eight-Wheel Steam Locomotive Crane Handling Dragline Bucket in Excavation Work. Side Outriggers in Place.

The Brown Hoisting Machinery Company.

(*See also Pages* 985 *and* 987)

Brownhoist Locomotive Cranes *Cont'd.*

operation. The Brownhoist revolving superstructure rests upon a slip-ring made in one piece from locomotive tire steel. The under surface of this ring is machined and rests upon a machined seat on the bed casting, but remains free to slip a little in either direction. When the strain from a sudden start or stop becomes great enough to overcome the friction between the ring and seat, the ring will slip enough to prevent breaking any part of the mechanism.

The car body for 8-wheel cranes is built up of heavy I-Beam sections, channels and plates. Standard A. R. A. 50-ton capacity trucks are used; an extra long wheel base increases the stability of the crane and also saves wear on the trackbed. The 8-wheel crane can run on its own wheels in trains, as it complies with the Safety Appliance Act. The bodies for 4-wheel cranes are built up of heavy sections. The No. 2 and No. 3 cranes are equipped with 4-wheel trucks, while the larger sizes have standard A. R. A.

Fig. 2656—Brownhoist No. 2 Crane

trucks. The No. 2 crane may also be equipped with Brownhoist creeper trucks or road wheels.

Power may be supplied by steam engine, electric motor or gas engine. Gasoline engine drive is often furnished on the No. 2 crane and is very desirable for coaling stations, etc., where the crane is not constantly in use. Brownhoist steam boilers are of the vertical tube type with quick steaming qualities, and fully comply with the most rigid State Boiler Laws. They can be supplied to burn coal, coke, wood, or fuel oil. The engines are of the high speed type with large diameter cylinders and short stroke. This type of engine is more suitable than a small diameter engine with longer stroke, because of the almost constant starting and stopping which characterizes locomotive crane service. The hoisting and operating speeds of a crane vary according to the work being handled, and figures are obtainable covering operating speeds under various conditions.

The adjoining Clearance Diagram and Clearance Table give the various clearances of No. 2, 3, 4 and 6 Brownhoist locomotive cranes equipped with Brownhoist buckets. Clearance figures are required if it is necessary to use the crane under restricted space conditions, or if a new layout of buildings, obstructions and yards is contemplated. The engineering department of the Brownhoist Company with its long and varied experience in locomotive crane service are available at any time to assist in the solution of hoisting and handling problems.

Brownhoist cranes are being used on practically all kinds of hoisting work, including the

Fig. 2657—Brownhoist No. 6 Locomotive Crane equipped with lifting magnet. Electric current for magnet can be generated in crane or obtained from outside source.

handling of such materials as coal, ore, coke, cinders, gravel, crushed stone, etc., with a grab bucket. When equipped with a magnet they can handle iron and steel in various forms: with the bottom block and hook, they handle all kinds of miscellaneous loads. Attachments provide for excavating with a drag-line bucket, driving or pulling piling, and many other jobs.

CAPACITIES, WEIGHTS AND WHEEL LOADS.

Number and type of crane	Radius Ft.	Capacities in lbs. without out-riggers	Weight of crane in lbs. in operating condition	Maximum Wheel Load in Lb.		Minimum Radius in feet	Maximum Radius in feet
				With Block Loaded	With Bucket Loaded		
No. 2 Type B 30 ft. boom	15	11,200	43,000	29,000	20,000	15	30
	20	7,600					
	25	5,700					
	30	4,300					
No. 3 Type G 35 ft. boom	15	23,500	94 000	66,000	55,000	12	39
	20	16,300					
	30	9,600					
	35	7,800					
No. 4 Type H 45 ft. boom	15	31,500	126,000	37,500	31,800	14½	48
	25	16,800					
	35	10,700					
	45	7,500					
No. 6 50 ft. boom	15	44,800	185,000	52,000	45,000	15	52
	25	22,700					
	40	11,300					
	50	7,600					

Fig. 2658—Table of Capacities for Brownhoist Cranes

The above table gives the principal characteristics of the No. 2, No. 3, No. 4 and No. 6 Brownhoist cranes.

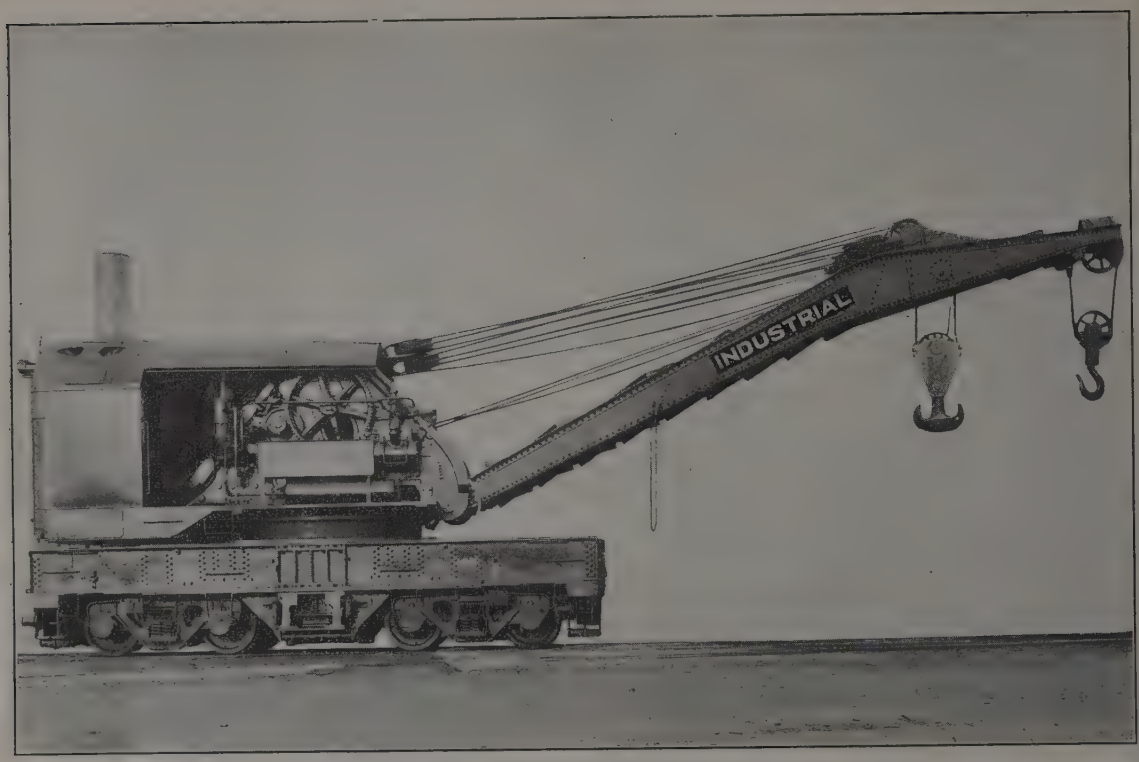


Fig. 2659—150-Ton Capacity, Steam-Operated Wrecking Crane.

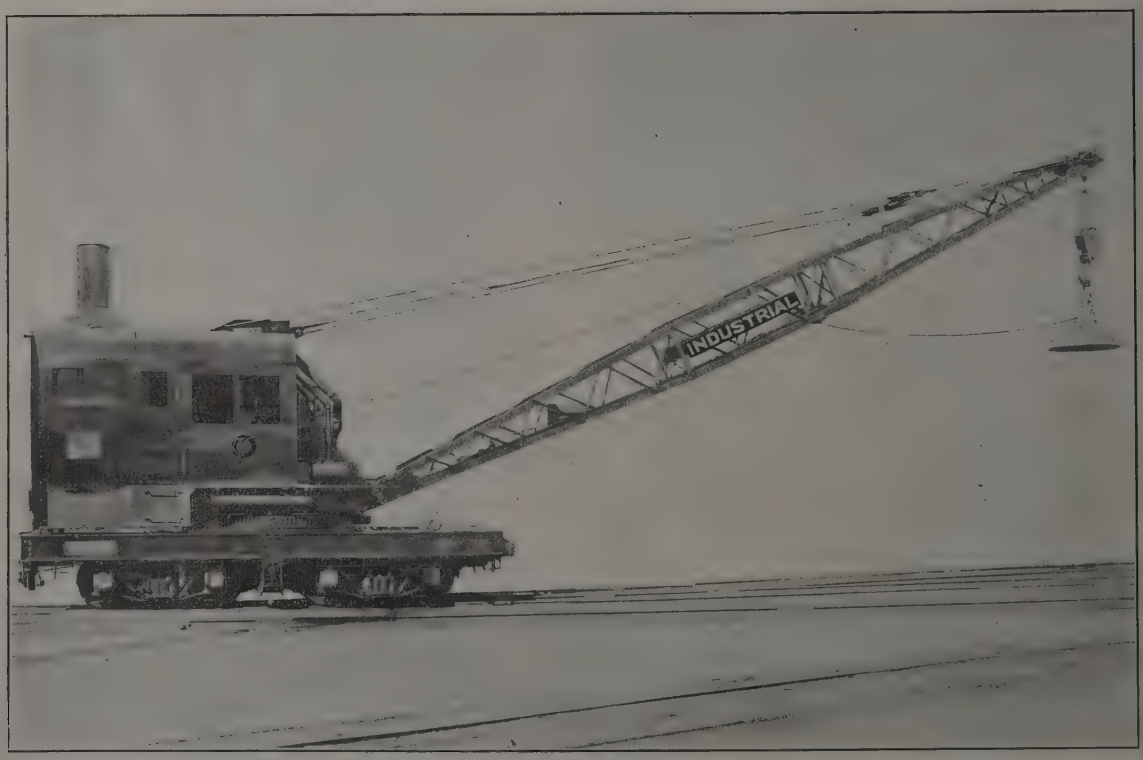


Fig. 2660—Steam Locomotive Crane. Capacity with 50 ft. Boom, 52,700 lb., at 15 ft. Radius. Equipped to Handle Grab Bucket, Electric Lifting Magnet and Shovel Dipper.

Industrial Works.

(*See also Pages* 989-991)

Pile Drivers and Crane-Pile Drivers

In railroad construction work the fundamental requirement of a Pile Driver is the ability to drive piles rapidly either close to the machine on either side of the track or at varying distances ahead of the driver. The Pile Driver also should be self-propelling, and have the power to act as a locomotive in handling loaded cars to and from place of operation. Its propelling mechanism must also permit of easy arrangement for transportation in regular freight trains. "Industrial" Pile Drivers satisfy all these requirements.

The Industrial Works build the No. 4 Pile Driver for the heaviest kind of service, the No. 2 and No. 3 for standard heavy duty and the Convertible Crane-Pile Driver for use when it is desirable to utilize the machine also as a Locomotive Crane. In case a railroad already has a standard Locomotive Crane the Industrial Works can supply detachable leaders and truss, making the Crane available as a Pile Driver.

The "Industrial" No. 4 Pile Driver is of steel construction throughout and has a complete air brake equipment. A large horizontal locomotive type boiler gives the capacity necessary for hauling several loaded cars, and a powerful self-propelling mechanism enables high speed movement on curves. The engines of the double friction drum type with large double cylinders have cut steel gears and bronze bushings. The truss rests upon a turntable having conical rollers and turned roller path. The self supporting leaders which are hinged to the front of the truss may be quickly raised or lowered. Either a drop or steam hammer may be used with these leaders.

All of the motions of operation except battering are power operated from the engine and controlled from the cab. The slewing motion is independent and is powerful enough to enable it to straighten piles which may not drive in the proper direction. The battering arrangement allows an inclination of three inches to the foot.

Fig. 2667—Convertible "Industrial" Locomotive Crane as a Steam Shovel

Fig. 2666—"Industrial" No. 4 Heavy Duty Pile Driver

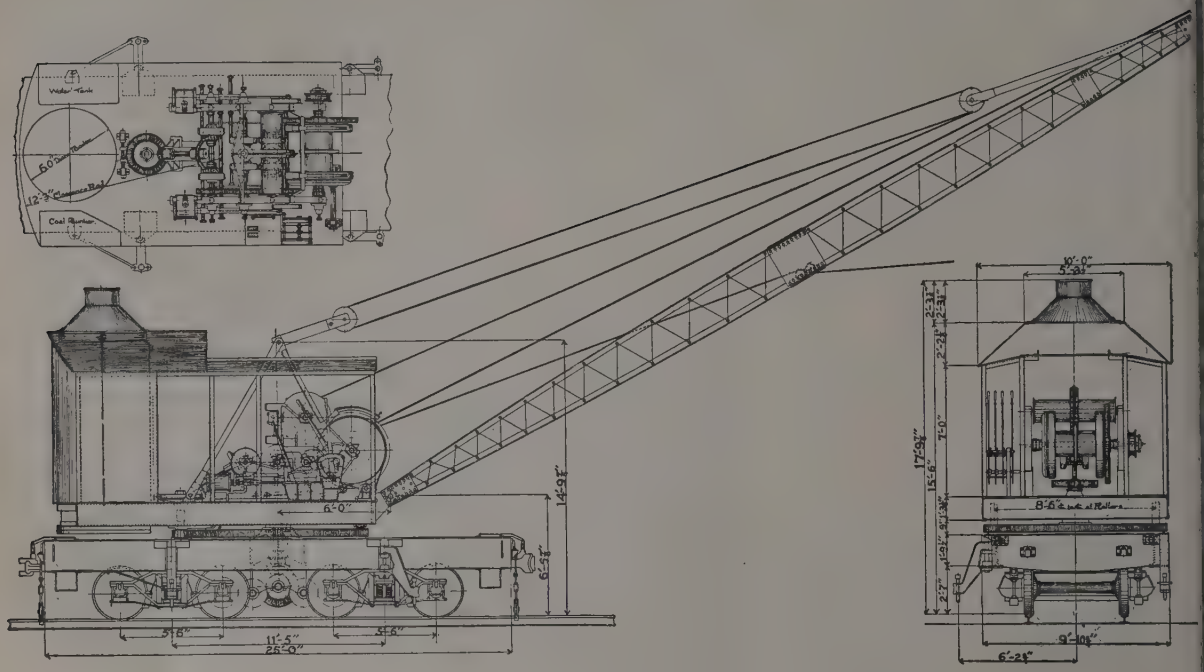
The "Industrial" Steam Pile Hammer—shown in Fig. 2665—is made in two models, one having a short stroke and another having a long stroke. They are double-acting, using steam both to raise the ram and to accelerate its downward stroke and increase the force of the downward blow. This gives a quick action hammer delivering a rapid series of powerful blows to the pile that drive more efficiently than the longer, slower, heavier blows obtained with an ordinary gravity drop hammer or with a single acting steam hammer.

Convertible "Industrial" Locomotive Cranes can be altered readily into Steam Shovels or Pile Drivers. A Locomotive Crane converted into a steam shovel is illustrated in Fig. 2667 and the same Crane can be adapted for pile driving. By equipping the Crane with a special dipper boom which is built with a crowding engine, the machine becomes a highly efficient, powerful steam shovel. By the addition of detachable leaders and truss, all the requirements of the special railroad pile driver are met, with the additional advantage of an exceptionally great operating radius.

Booms for the Locomotive Crane may be built in sections so that the length may be quickly changed to meet various conditions. The propelling mechanism is of a powerful, sturdy type that makes the Crane efficient in switching heavily loaded cars.

For other products and branch offices, see classified and alphabetical indexes.

INDUSTRIAL WORKS, BAY CITY, MICH.



CLEARANCE UNDER HOOK FOR 50 AND 70-FOOT BOOMS.

Radius ..... 12 ft.	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	50 ft.	60 ft.	70 ft.
50-ft. Boom ..... 51′	49′ 6″	47′ 6″	45′	42′	38′	31′ 6″	25′	.....	.....
70-ft. Boom ..... 71′	70′ 6″	70′	69′ 6″	67′	62′ 6″	59′ 6″	56′	51′ 6″	46′

Fig. 2668—Type "J" Standard Gage Locomotive Crane.

Fig. 2669—Steam Locomotive Crane. Weight, 127,000 lb.; Lifting Capacity, 20 Tons.

McMyler Interstate Company.

(*See also Pages* 993-997.)

No. "7" 35-Ton Capacity Locomotive Crane

The McMyler Interstate No. 7 type of crane is distinguished by its flexibility, rapid operation, and high capacity with relation to the operating weight. Embodied in its construction are many valuable features which add greatly to the efficiency of the machine.

Tilting during rotation is prevented by the use of jack screws in the trucks. These jack screws

Fig. 2670—McMyler Interstate No. 7 Locomotive Crane Handling Freight

function by removing the weight from the truck springs.

Swinging outriggers are provided and rotate outward from the side of the car. This type of outrigger may be adjusted easily and quickly and is out of the way when not in operating position.

Complete locomotive air brake equipment, consisting of air pump, air tank, engineer's valve and all attendant mechanism, is furnished. The brakes are applied to all wheels.

Double power drums constitute a noteworthy feature. Both of these drums are operated by friction clutches. In connection with the main hoist drum, an outside band clutch is used. This clutch is powerful and makes the hoist drum adaptable to fall block, clam shell or drag line scraper bucket operation.

A "V" block clutch is used in connection with auxiliary drum. This clutch is nearly as powerful as the outside band type and can be set so as to act as a slip friction when the drum is being used in connection with clam shell bucket operation.

The boom can be adjusted to two different lengths—50 ft. and 70 ft.—which are obtained by the use of sectional construction. There are three sections, the upper and lower sections being 25 ft. in length, while the center section is 20 ft. in length. By removing the center section the upper and lower sections may be bolted together resulting in a boom 50 ft. in length.

The boiler is mounted on the rear of the turntable, the water tank being at the right and the coal bunker at the left of the boiler.

The mechanism constitutes a self-contained unit, and is mounted at the center of the turntable. The horizintal engines with long connecting rods, reduce vibration to a minimum.

The operating levers are located at the front and on the right-hand side of the mechanism, which position affords the operator a clear view of the work in hand at all times.

The engines are non-reversing and double friction clutches are used for controlling the operations of sluing, propelling, and raising or lowering the boom. The claim is made for this arrangement that it has distinct advantages over a reversing-engine arrangement since it eliminates the possibility of an operator becoming confused, and endangering his own, as well as the lives of other people with whom he may be working, not to mention the possible damage to the machine. The double friction clutches, together with the non-reversing engines, give the operator assurance that when he places a hand-lever in a given position the crane can respond only in a certain direction corresponding to the operation controlled by that particular lever. When a reversing engine is used, he must first determine in which direction the engine is running, before he may safely attempt any particular operation.

To increase the simplicity of operation of a locomotive crane is an important step in the direction of ultimate efficiency. By the use of double friction clutches of the right and left hand type, a single hand lever controls each particular operation. Placing the hand lever in one extreme position engages one clutch; bringing the lever to a central position

Fig. 2671—Loading Cinders with a No. 7 Locomotive Crane

disengages both clutches. Placing the lever in the opposite extreme position engages the other clutch. The point is that the operator of a McMyler Interstate Locomotive Crane knows absolutely what this crane will do in accordance with certain actions on his part, which actions, after a little experience, become reflex as they require no forethought, all of

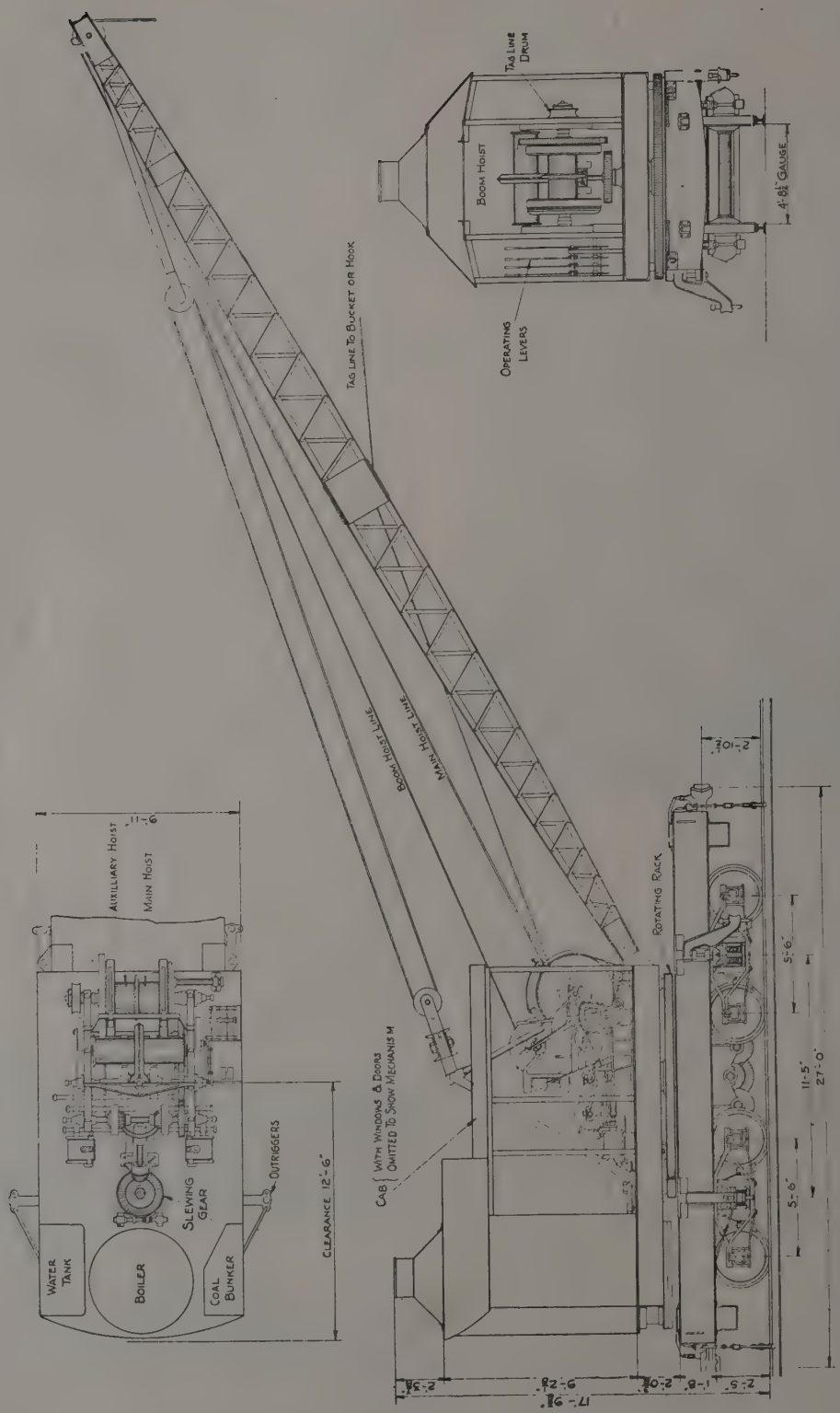


Fig. 2672—General Drawing of Steam Operated Locomotive Crane. The McMyler Interstate Company.

(See also Pages 992-997)

No. "7" 35-Ton Capacity Locomotive Crane *(Cont'd.)*

which makes for safe and speedy operation and consequent satisfactory service in the use of a crane.

On a straight, level and solid track, with the weight relieved from the truck springs, the crane will have a stability rating with and without outriggers and with the various lengths of boom as given below:

	Without Outriggers.	With Outriggers.
12-ft. radius, 50-ft. boom only	69,400 lb.	80,000 lb.
15-ft. " 50-ft. " "	51,800 "	80,000 "
20-ft. " 50-ft. " "	35,900 "	52,200 "
25-ft. " 50-ft. " "	27,000 "	39,000 "
30-ft. " 50 or 70-ft. boom	19,300 "	28,700 "
35-ft. " 50 or 70-ft. boom	15,400 "	23,300 "
40-ft. " 50 or 70-ft. boom	12,500 "	19,400 "
45-ft. " 50 or 70-ft. boom	10,300 "	16,400 "
50-ft. " 50 or 70-ft. boom	8,900 "	14,000 "
60-ft. " 70-ft. boom only	6,000 "	10,400 "
70-ft. " 70-ft. " "	4,300 "	8,000 "

This same type of crane is also built in 30-tons capacity and is then designated as the No. "6."

Flexibility of operation is accomplished by designing this crane so that the addition of a few necessary details converts it into a machine capable of efficiently performing a variety of operations. A 35-ton capacity fall block on the main hoist drum, or a 5-ton ball and hook on the auxiliary drum are handled with equal facility.

Bucket operation, pile driving and switching are also within the scope of this machine. The

Fig. 2673—Operating a Drag-line Scraper Bucket with a McMyler Interstate Locomotive Crane

buckets include drag-line scraper, 2-line clam shell, or 4-line clam shell. When operating 2-line clam shell or orange peel buckets, the double power drum arrangement is employed, the auxiliary drum acting as an automatic drum. For operating a drag-line scraper bucket, the double-power drum arrangement is also used, the drag line being attached to the drum of the main hoist.

Fig. 2674—Driving Piles with a McMyler Interstate Locomotive Crane Equipped with a No. 10 Pile Driver Attachment

For driving piles, three methods may be employed. A No. 10 pile driver attachment can be used and converts the crane into a standard railroad pile driver; pendulum leads may be attached to the end of the boom; or ordinary leads may be suspended from either the main or the auxiliary hoist lines.

Several cars can be switched, with complete locomotive and train air brake control, and in addition to all of the foregoing, the crane is capable of operating a magnet according to either of two methods. A plug-in attachment for an outside line may be used, or space is available for installing in the cab of the crane a generator of any size up to 10 kw. A 7½-kw. generator is usually furnished.

SPECIFICATIONS

Hoisting speed on a single line is	250 ft. per min.
Line pull—main hoist	15,000 lb.
Line pull—auxiliary hoist	10,000 lb.
Sluing speed	4 rpm
Travelling speed on a straight, level track	300 ft. per min.
Drawbar pull	11,000 lb.
Size of air pump	8 in. x 8 in. x 10 in.
Engines	10 in. x 10 in.
Wheel base	16 ft. 11 in.
Diameter of wheels	33 in.
Size of journal	6 in x 11 in.
Gage	4 ft. 8½ in.
Capacity of water tank	475 gal.
Capacity of coal bunker	2,000 lb.
Weight of crane in complete working order	191,000 lb.
Net shipping weight	184,000 lb.

For other products and branch offices, see classified and alphabetical indexes.

Type R Simple and Multi-Power Clam Shell Buckets

The severe service demanded of clam shell buckets in everyday use, requires sturdy construction, the best materials, and accessibility for quick repairs when necessary. All of these requisites are embodied in Type "R" Simple and Multi-power Buckets.

The Type "R" Simple Power Bucket is of the 2-line type and is constructed almost entirely of steel. It opens wide and is especially adapted to the handling of any loose material.

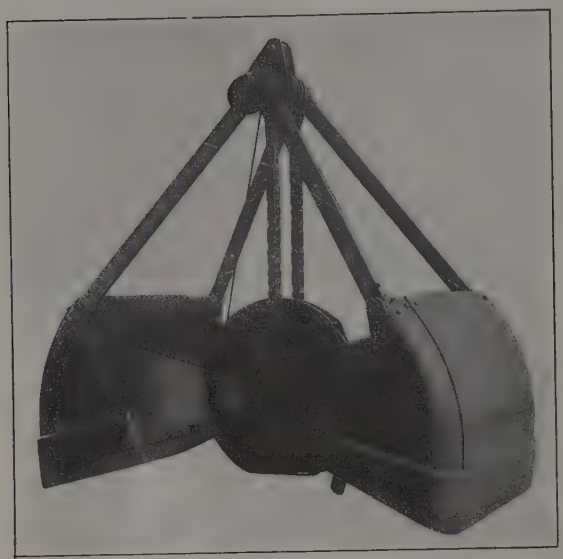


Fig. 2675—Type "R" Simple Power Clam Shell Bucket

A powerful closing arrangement is provided; it consists of two flat-link steel chains which wind on a round spindle. At the center of the spindle is keyed a large-diameter power wheel upon which the hoisting line winds. When the weight of the bucket is thrown upon the hoisting line, the power wheel together with the spindle is caused to revolve, winding the closing chains upon the spindle. The fact that the power wheel is of large diameter and the spindle of small diameter, accounts for the great closing power developed. The bale arms are forged steel, and the spindle is cast steel with bronze bushings.

The scoops are fitted with heavy reinforcing plates which are beveled to provide sharp edges for cutting the material to be handled. The plates are usually made of flange steel and are easily replaced when repairs are necessary. When the service is unusually severe, the bucket may be fitted with manganese reinforcing plates, which are much more durable than the ordinary steel plates.

Rope guards and deflector sheaves are provided so as to keep the closing line in its proper place at all times, thus preventing it from becoming fouled.

The Type "R" Multi-Power Bucket, as the name implies, has a multiplied closing power which makes it adaptable to the handling of all substances which are heavy and difficult to dig. This bucket may be used with or without teeth, depending upon the material to be handled.

The closing arrangement is of the same general type as the Type "R" simple power bucket, except that 2-part closing chains are used which in effect are the same as two 2-part lines. The chain is of the common round link variety which is easy to procure when replacements are necessary.

Different styles of scoops are furnished with this type of bucket as experience has shown that a style of scoop which will work successfully when handling one kind of material may not work successfully in other classes of materials.

The bucket operates very rapidly, considering the closing power developed. It opens extremely wide, and permits the maximum power to be developed at the time when the scoops start to close, at which time it is always desirable to have abundant power available, in order that the scoops may be completely filled with the material being handled. The operation of opening, or discharging material, is accomplished without a large amount of the closing line unwinding from the power wheel.

The opening and closing lines can be kept taut at all times with this bucket, which permits opening or closing of the bucket the instant the weight is thrown on either the opening or the closing line. These are important factors which make for speedy and efficient operation.

The proper relation of three outstanding factors, the weight, the operating speed and the closing power determine the efficiency of a clam shell bucket. All of these factors are dependent on each other and must be properly balanced in order to obtain the best result. A bucket may operate rapidly but lack closing power, or it may have sufficient closing power and lack weight. Type "R" Buckets are properly balanced and therefore efficient in operation.

Fig. 2676—Type "R" Multi-Power Clam Shell Bucket with Toothed Cutting Edges

Car-Dumping Machines of 100-Ton Capacity

The primary object of a car dumper is to handle a large volume of coal, rapidly and at a minimum cost to all concerned. To reduce the depreciation in value, which takes place as a result of breakage, coal must be handled as little as possible and very carefully. With a car dumper only one handling is required.

The McMyler Interstate Car Dumper is a development of the original equipment which was designed and built about 25 years ago. All of the most important parts are covered by patents and are used exclusively on this particular dumper. Considering the

Fig. 2677—Start of Actual Dumping Operation on a McMyler Interstate Car-Dumping Machine

amount of coal handled and the fact that a carload is handled at one time, the first impression is that a car dumper must be cumbersome and complicated. This, however, is not the case. While the dumper is ruggedly built, it is simple in design and operation.

To operate a car dumper efficiently and reduce the breakage of the coal to a minimum, experience has established the fact that the coal must be dumped at a fixed height relative to the boat. When light a boat naturally is high out of the water. As the volume of coal increases the boat settles. This McMyler Interstate machine will dump at any desired elevation and mechanism is also provided so that the pan may be raised or lowered to maintain its relative position to the point where the car is dumped.

The car to be dumped is brought up to the dumper on an inclined approach track, by means of a rope-operated "Barney" car. Arriving at the dumper, the car is run on an "L" shaped cradle. The cradle and car are then raised to the proper elevation and rotated through an arc of 160 deg. As the car starts to rise it is automatically secured to the cradle by means of four clamps. The coal is dumped into a triangular shaped pan which is hinged to a girder running between the two front posts. This pan discharges into a telescopic chute which provides an improved method for trimming the cargo of coal, and eliminates 80 per cent of the usual cost.

After the car has been dumped, operation of the dumper is reversed, which releases the clamps on the car and brings it to a level with the approach track. The empty car is pushed off the cradle by the next loaded car coming on and, passing down an incline, returns to the yard by means of a "kick-back."

The cost of operation is very low, as is also the cost of upkeep. Several of these dumpers have been in operation over twenty years, and replacements have consisted principally of wire ropes.

The rate of operation provides for unloading 25 to 50 cars per hour. The variation is due, not to the possibilities of the dumper, but rather to the yard layout. Usually the machine will dump more cars than can be handled in an ordinary yard. This emphasizes the fact that careful thought must be given to the track layout as well as to the dumper. Cars of any size or weight may be handled without any adjustments.

The capacity provided allows for handling cars up to 100-tons, that is, cars containing 100 tons of coal. The earlier designs of dumpers were built to handle a 30-ton car which then was considered a large car. Later a dumper was designed to handle a 50-ton car, and a large number of dumpers were built of this size. Then came the 75-ton cars, and a dumper was designed to meet this condition.

A 100-ton car then appeared on a few roads, and in order to provide for the possible use of this equipment generally, purchasers of car dumpers desired apparatus that would handle the 100-ton car. Most of the dumpers built within the last three or four years have been built for handling a 100-ton car, and while a dumper of this capacity is not essential at most ports at the present time, it is very inconvenient to have dumper equipment that will not handle all sizes of cars that come to it. The 100-ton dumper therefore has been installed by most purchasers and is strongly recommended because it

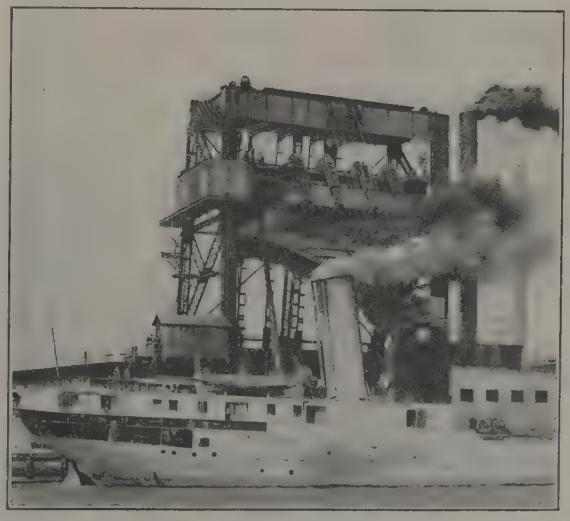


Fig. 2578—Full Dumping Position, McMyler Interstate Car Dumping Machine. The Telescopic Chute and Method of Clamping Cars are Plainly Shown

provides for the future and because the large factor of safety and long life is an advantage even though the larger equipment does not come into general use.

For other products and branch offices, see classified and alphabetical indexes.

Fig. 2679—Industrial Portable Rail Saw. Builder, Industrial Works.

Fig. 2680—Weed Burner Car. The Commonwealth Steel Company.

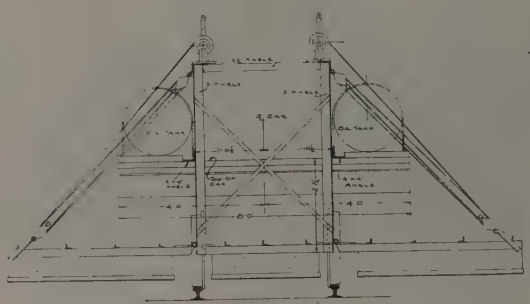


Fig. 2681—Weed Burner Car. The Macleod Company.

Fig. 2682—Weed Killer and Track Spraying Equipment. Chipman Chemical Engineering Company.

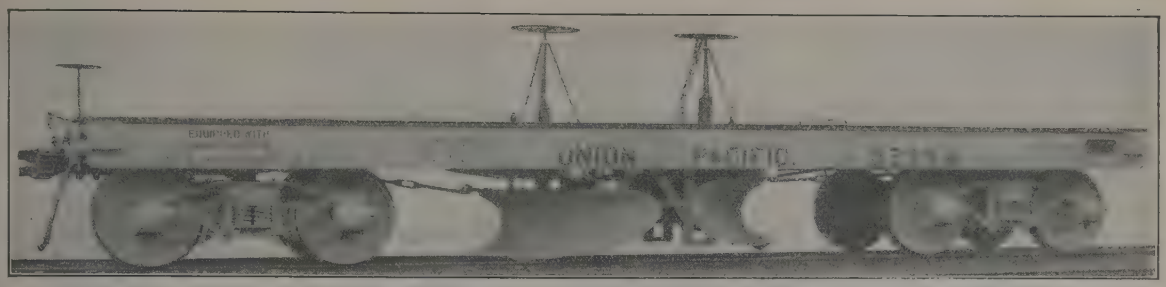


Fig. 2683—Ballast Distributing Plow. Builder, Rodger Ballast Car Company.

Fig. 2684—Ballast Unloader for Plowing from Tops of Cars. Marion Steam Shovel Company.

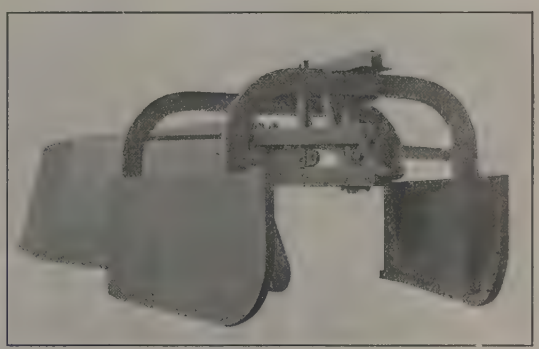


Fig. 2685—Ballast Plow or Unloader for Plowing from Tops of Cars. Bucyrus Company.

Fig. 2686—Steel Frame 50-Ton Side Dump Car. Inside Length, 36 ft. 4 in.; Inside Width, 9 ft. 3 in.; Inside Height, 5 ft. 2 in. Builder, The Eastern Car Company.

Fig. 2688—Snow Sweeper for Railroad Yard Service. Builder, The J. G. Brill Company.

Fig. 2689—Snow Sweeper for Railroad Yard Service. Builder, The J. G. Brill Company.

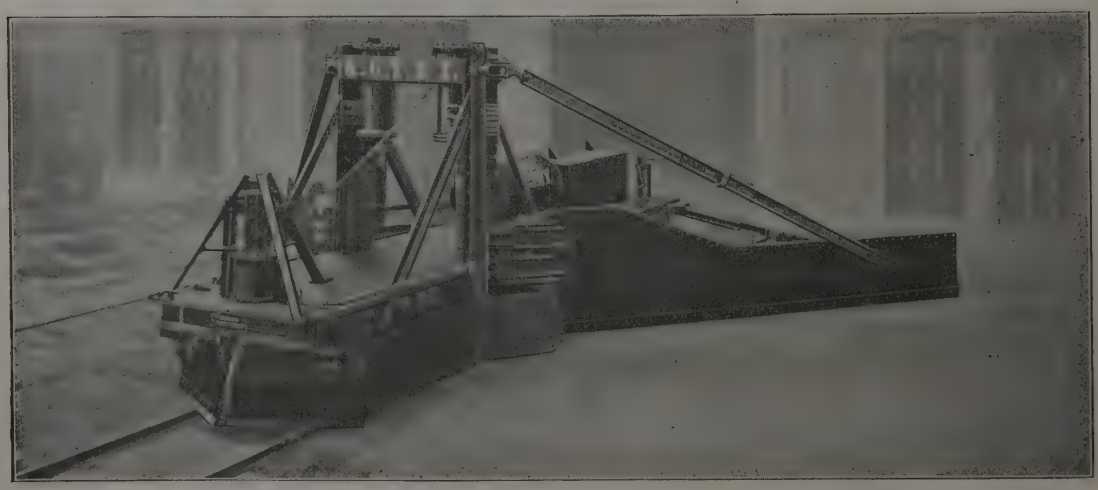


Fig. 2690—Ballast Spreader. The Wings Are Operated By Compressed Air.
Builder, The O. F. Jordan Company.

Fig. 2691—Snow Flanger Car Similar to Car Shown in Fig. 2692. Delaware & Hudson Company.

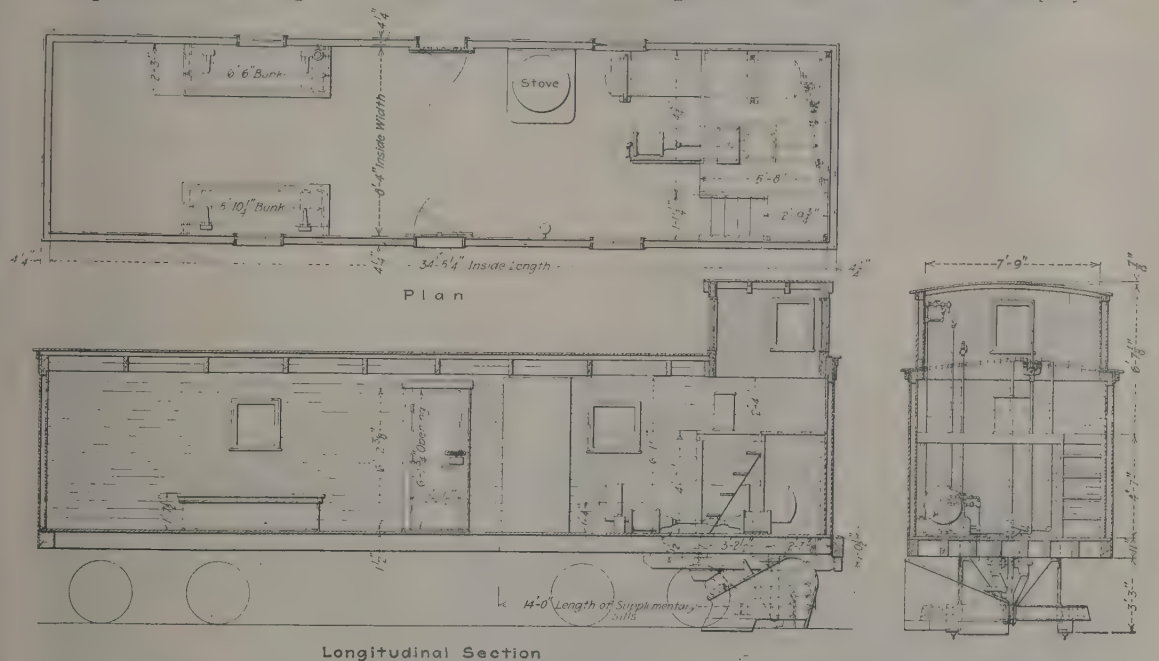


Fig. 2692—General Arrangement of Snow Flanger Car. Canadian Government Railways.
(See Fig. 2691 for Similar Car.)

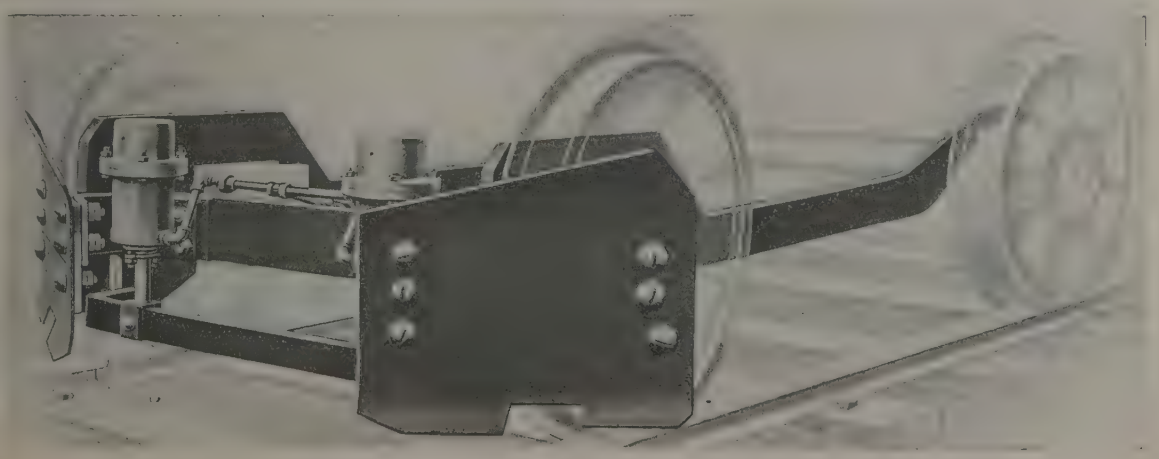


Fig. 2693—Q. & C. Snow Flanger. Q. & C. Company.

Fig. 2694—Rotary Snow Plow in Use on the Canadian Pacific. Specially Designed Six-Wheel Trucks; Boiler of Locomotive Type; Working Pressure 200 lb.; 317 2-in. Tube and 44 sq. ft. of Grate Area; Vertical Engine with Two 20 in. x 24 in. Cylinders; Tender Capacity 7,000 Imperial Gallons of Water and 10 Tons of Coal.

Fig. 2695—All-Steel Single Track Snow Plow for Canadian Pacific Railway. Canadian Car & Foundry Company.

(Drawing of similar plow shown in Fig. 2696.)

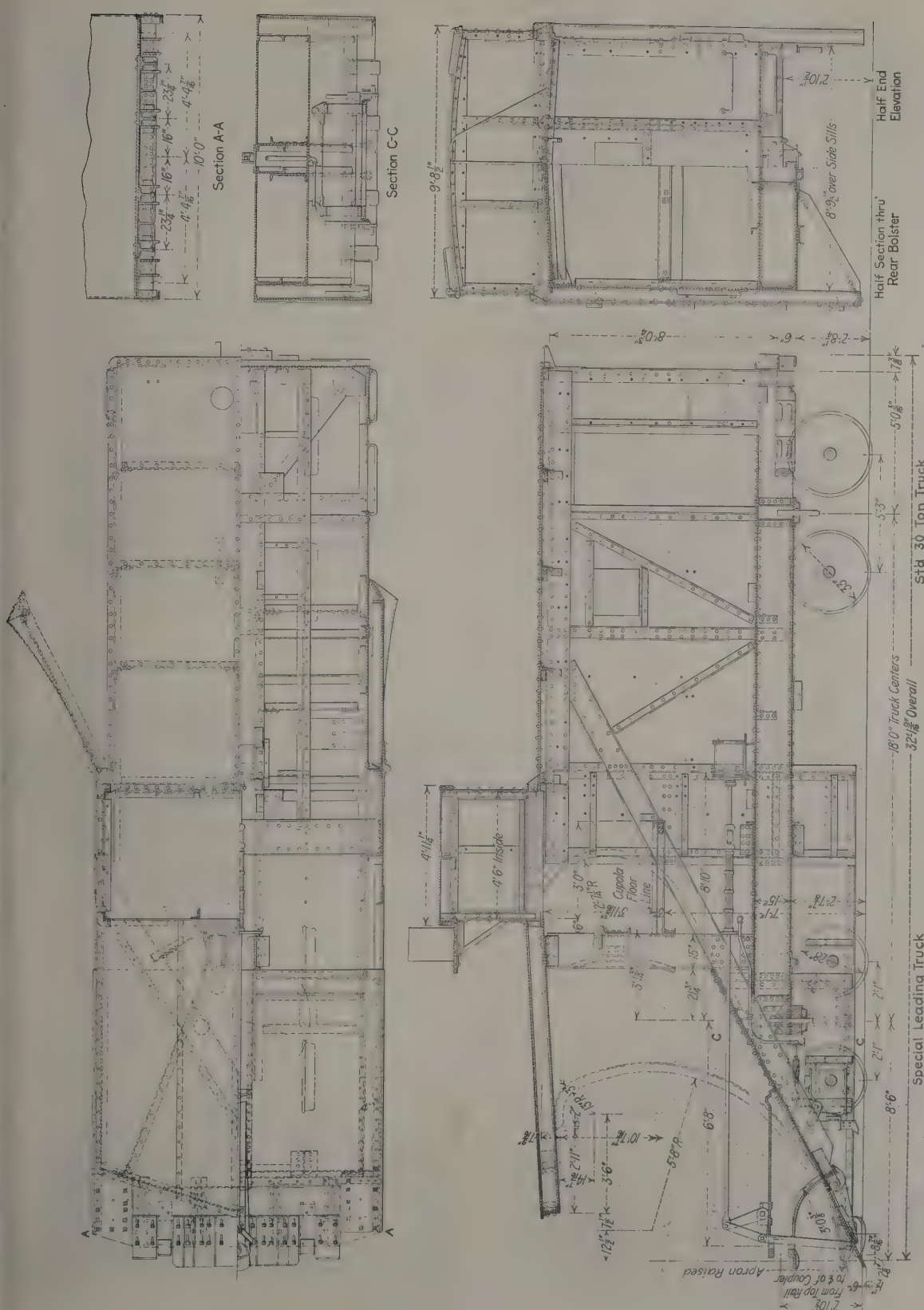


Fig. 2696—General Arrangement of All-Steel Snow Plow for the Canadian Government Railways. Builder, Canadian Car & Foundry Company.
(*Similar plow shown in Fig. 2695.*)

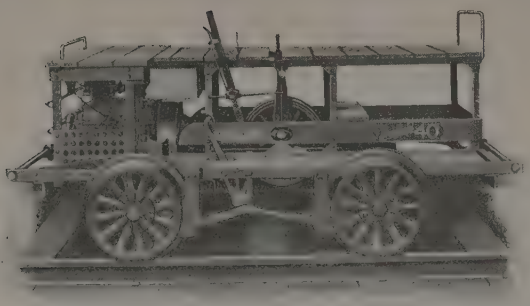


Fig. 2697—No. 40 Motor Car for Bridge Gang and Heavy Section Work.

Fig. 2698—No. 41 Kerosene Motor Light Inspection Car.

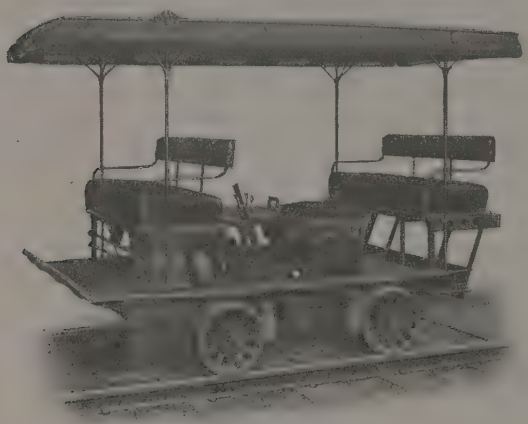


Fig. 2699—No. 42 Inspection Car.

Fig. 2700—No. 32 Gasoline Motor Section Car.

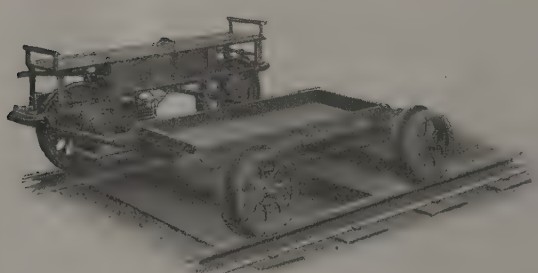


Fig. 2701—No. 36 Signal Maintainer's Motor Car.

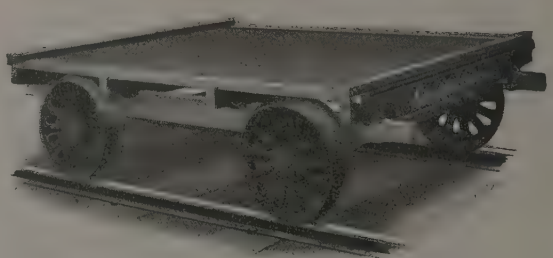


Fig. 2702—No. 4 Standard Gauge Push Car.

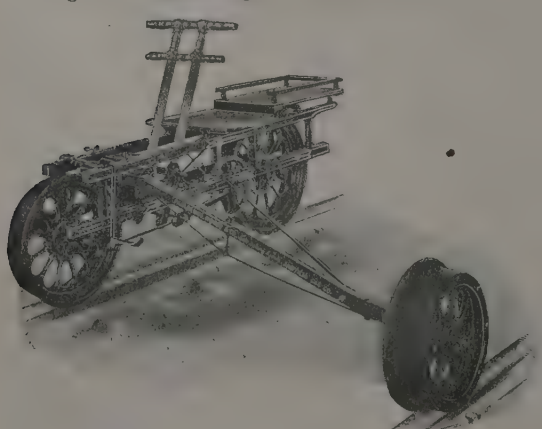


Fig. 2703—Ball Bearing Velocipede Car.

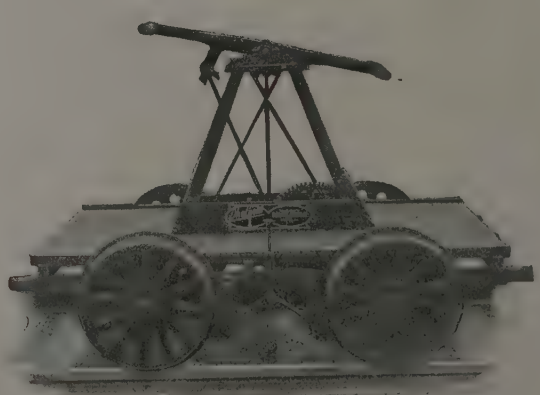


Fig. 2704—No. 1 Standard Section Hand Car.

Fig. 2705—Mudge Class E1, 4 H. P. Inspection Car, 3-Man Capacity

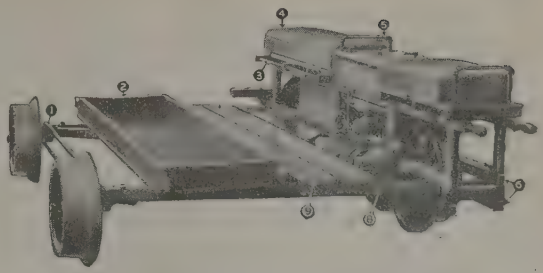


Fig. 2706—Mudge Class G2, 6 H. P. Inspection Car, 4-Man Capacity.

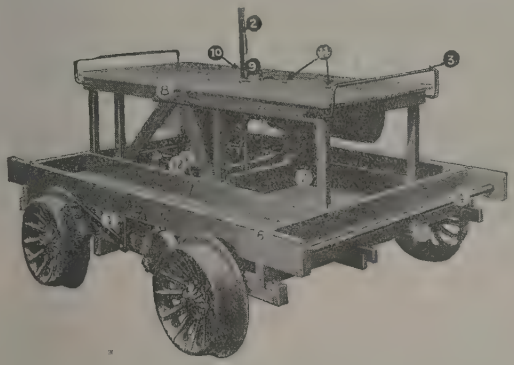


Fig. 2707—Mudge Class GS2, 12 H. P. Bridge Gang Motor Car.

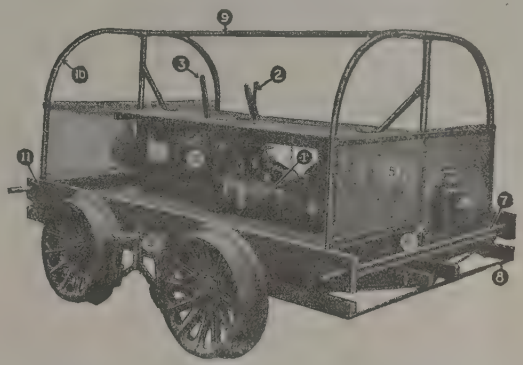


Fig. 2708—Mudge Class GS3, 6 H. P. Section Motor Car, Equipped with Mudge Safety Railings.

Mudge & Company.

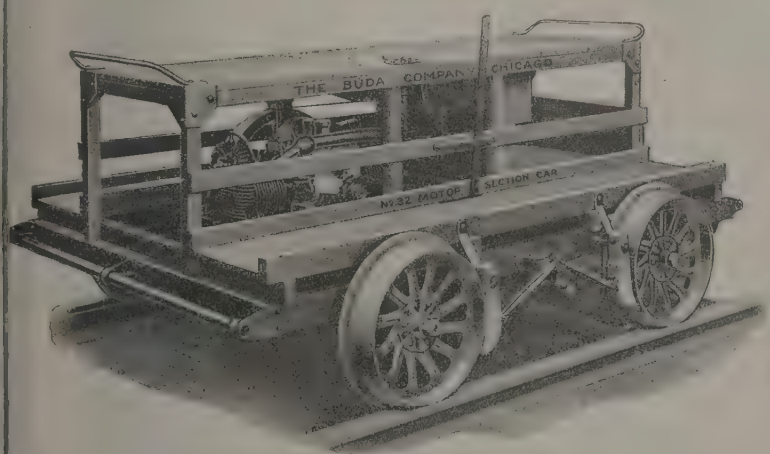


Fig. 2709—Buda No. 32 Motor Car. The Buda Company.

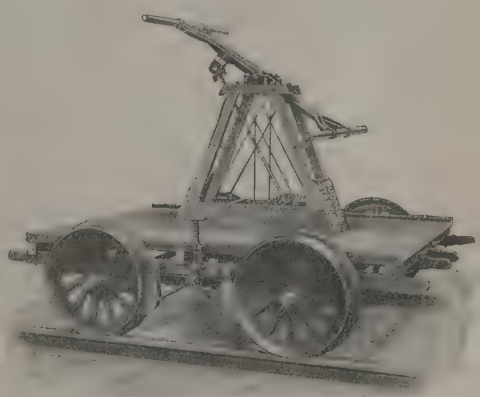


Fig. 2710—No. 1 Hand Car. The Buda Company.

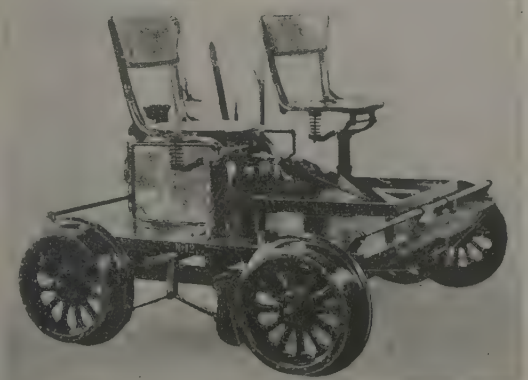


Fig. 2711—Class M-212 Motor Inspection Car. Fairmont Gas Engine & Railway Motor Car Company.

Fig. 2712—General Class M-218 SA Featherweight Inspection Car. Fairmont Gas Engine & Railway Motor Car Company.

Car End.

Locomotive End.

Fig. 2713– Interior of Pennsylvania Railroad Air Brake Instruction Car.

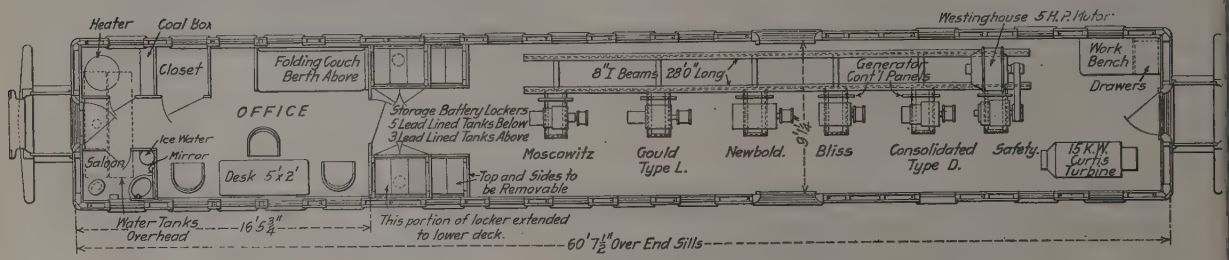


Fig. 2714—Floor Plan of Pennsylvania Railroad Train Lighting Instruction Car.

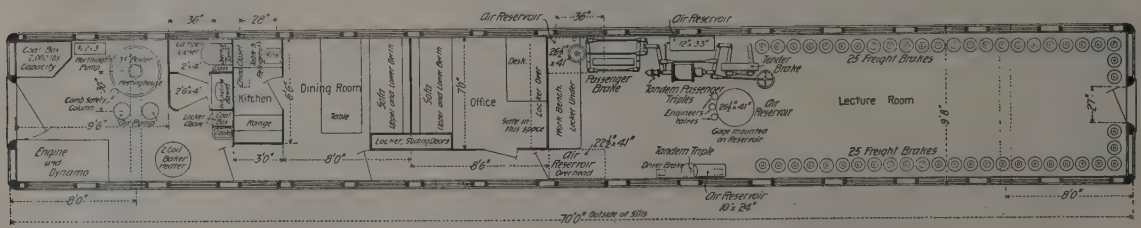


Fig. 2715—Floor Plan of International Correspondence Schools Air Brake Instruction Car. Interior View is Shown in Fig. 2716.

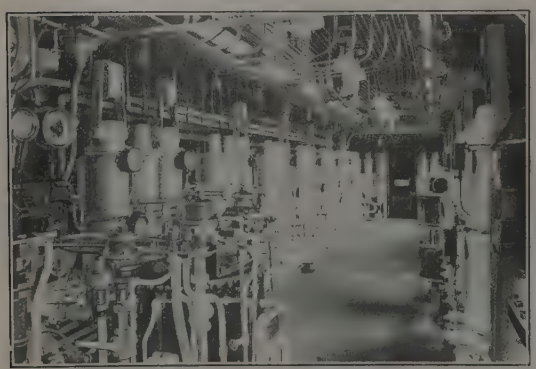


Fig. 2716—Interior View of Air Brake Instruction Car. International Correspondence Schools.
(See Fig. 2715 for Floor Plan.)

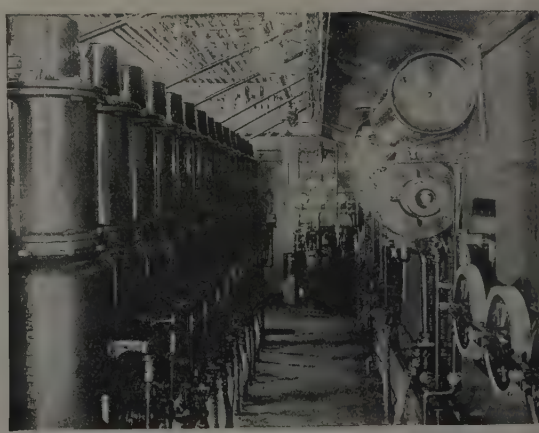


Fig. 2717—Interior View of the Westinghouse Air Brake Company's Air Brake Instruction Car.

Fig. 2718—Interior View of Fuel Instruction Car in Use on the Delaware, Lackawanna & Western.

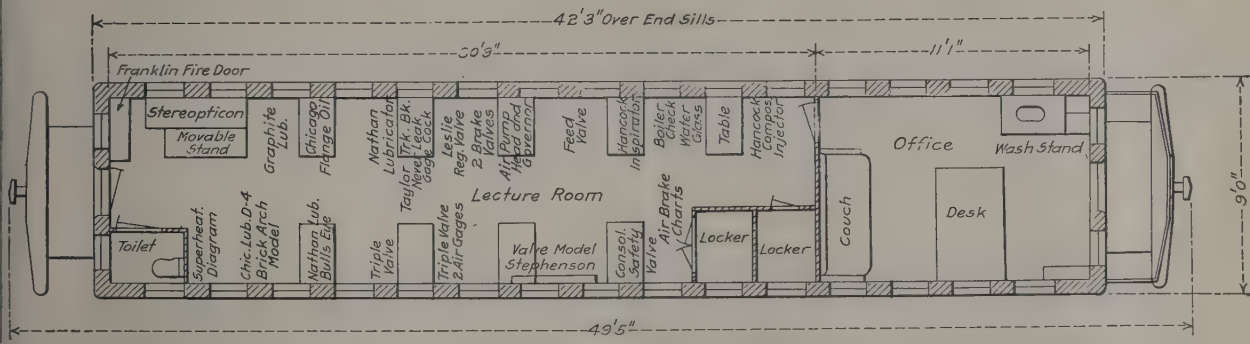


Fig. 2719—Floor Plan of Delaware, Lackawanna & Western Fuel Instruction Car. Shown in Fig. 2718.

Fig. 2720—Steel Frame Dynamometer Car. Weight, 91,000 lb.; Dynamometer Capacity, 1,000,000 lb. Builder, Atchison, Topeka & Santa Fe Railway.

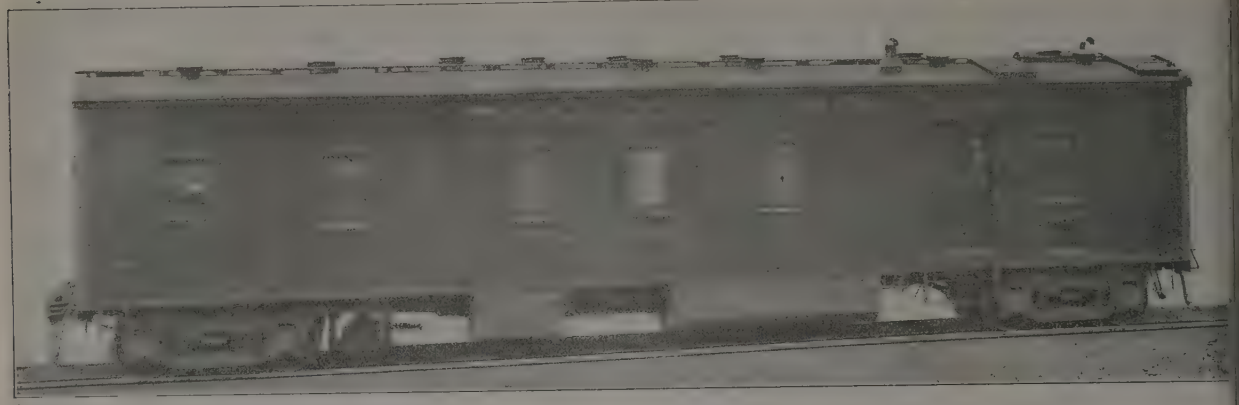


Fig. 2721—Dynamometer Car for the Southern Railway. Builder, The Burr Company.
(*See also Figs.* 2722-2733.)

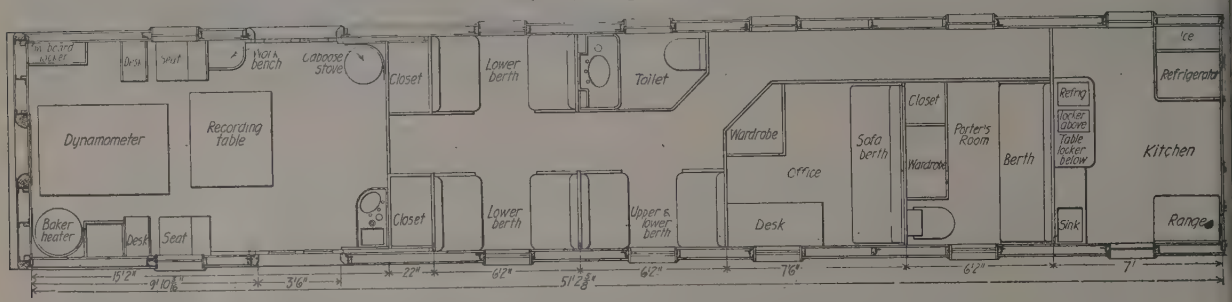


Fig. 2722—General Plan, Dynamometer Car for the Southern Railway.
Length over End Sills 51 ft.; Inside Width 10 ft. 8 in.; Length of Dynamometer Compartment 15 ft. 2 in.

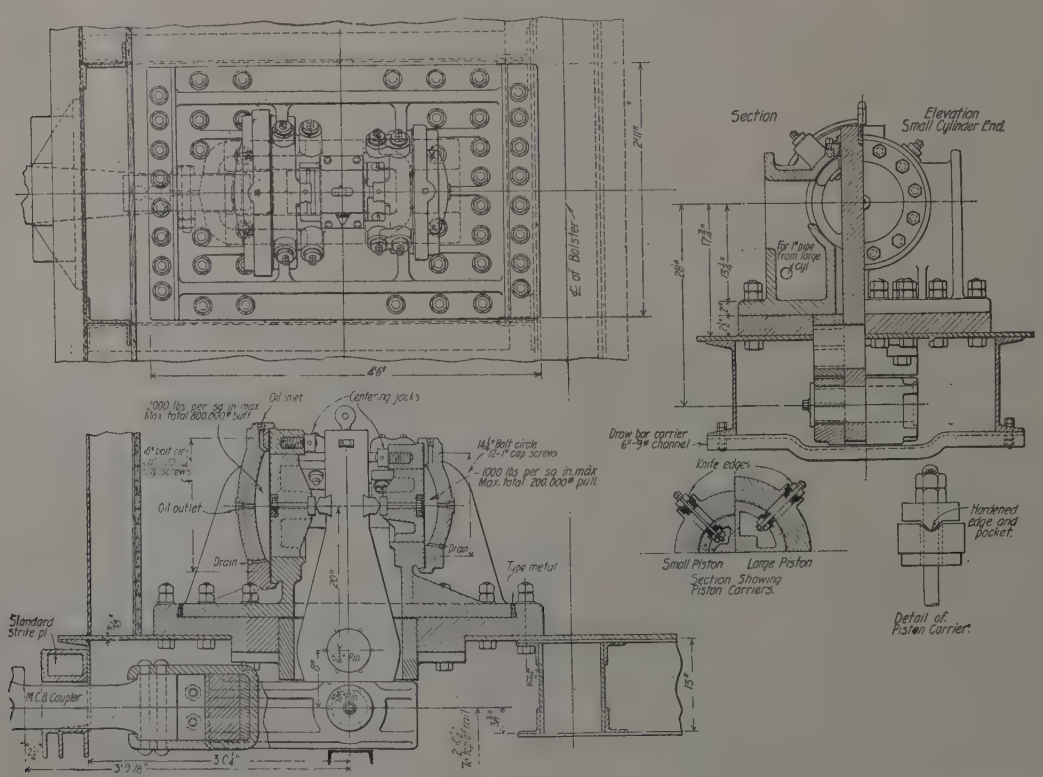


Fig. 2723—Weighing Head Assembly, Dynamometer Car.
The Burr Company.

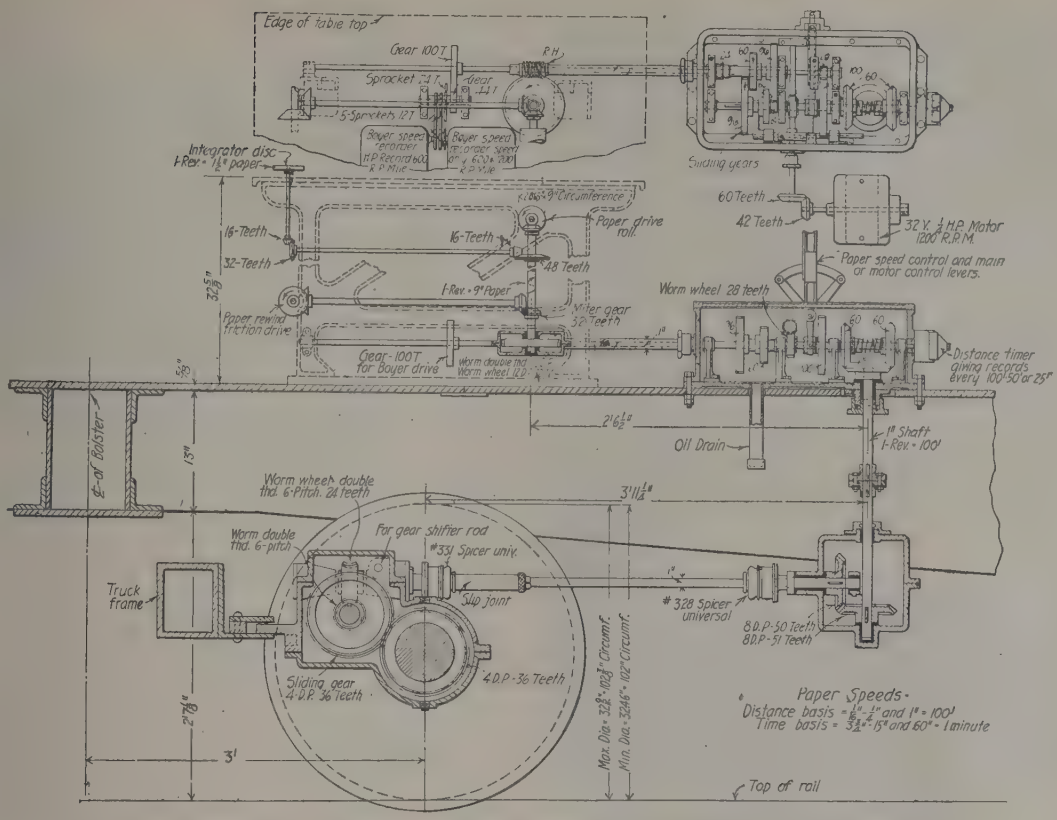


Fig. 2724—Assembly of Transmission Mechanism for Paper Drive, Dynamometer Car.

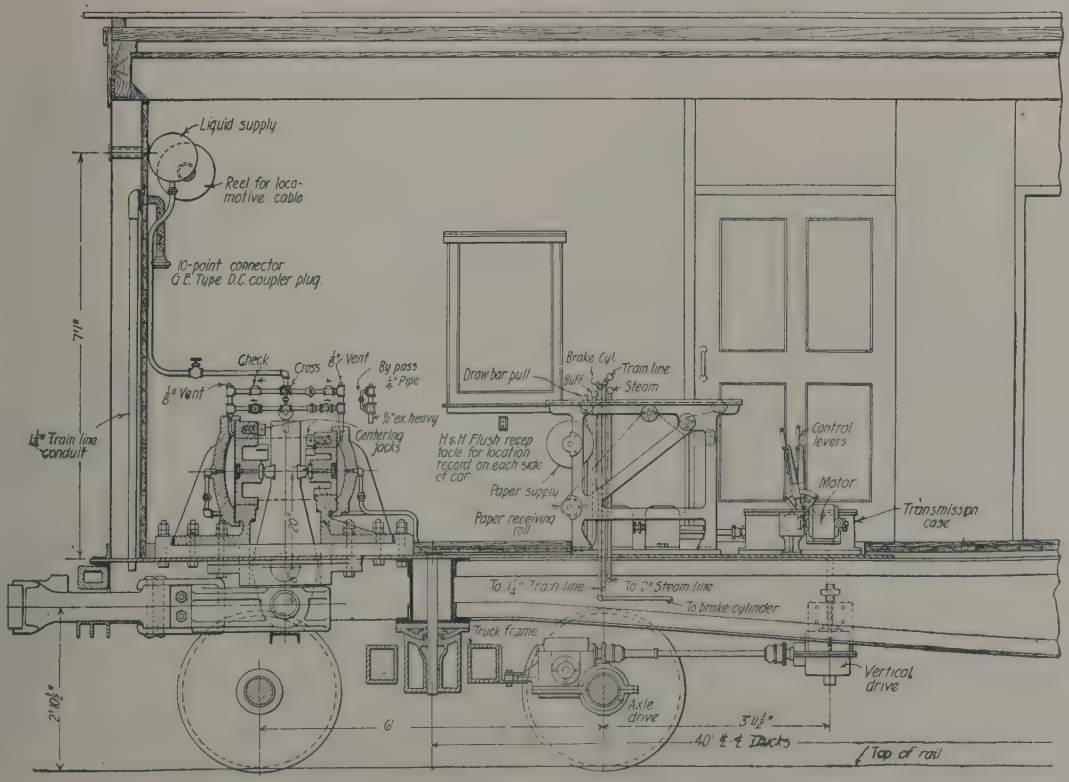


Fig. 2725—Longitudinal Section Through Forward End of Dynamometer Car.
The Burr Company.

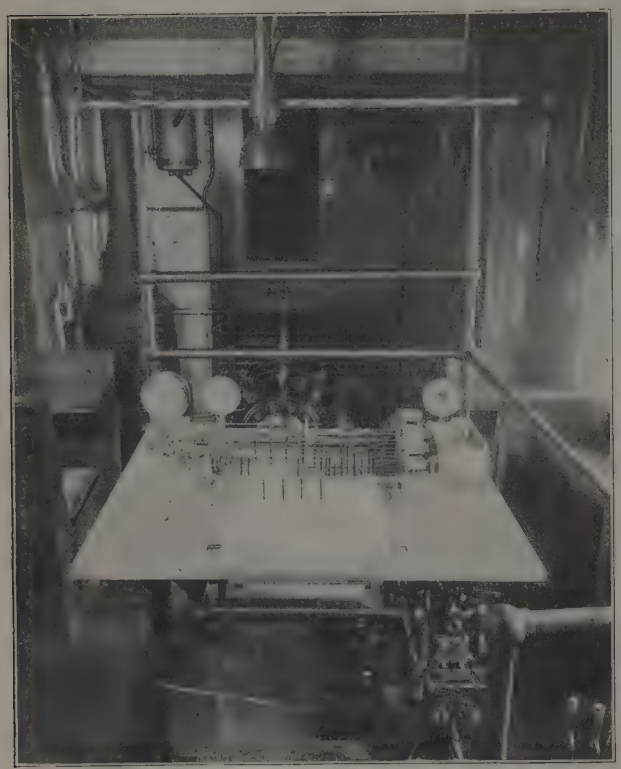


Fig. 2726—Interior of Dynamometer Compartment.

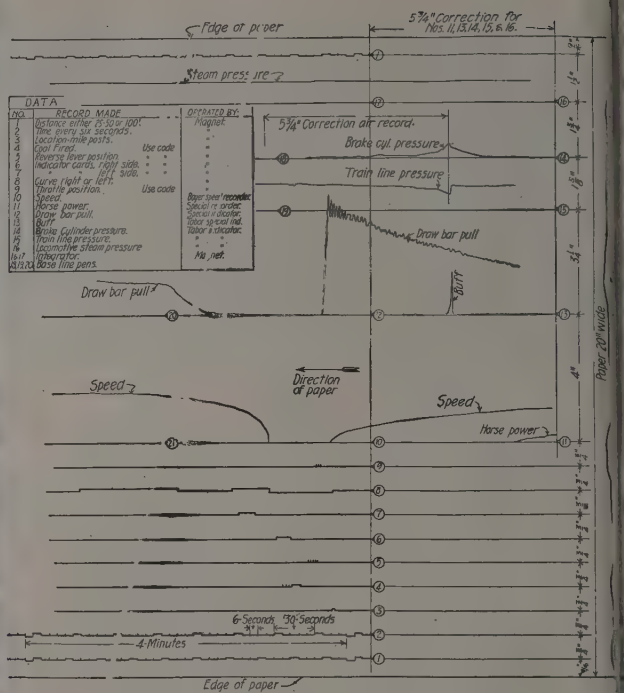


Fig. 2727—Typical Autographic Record.

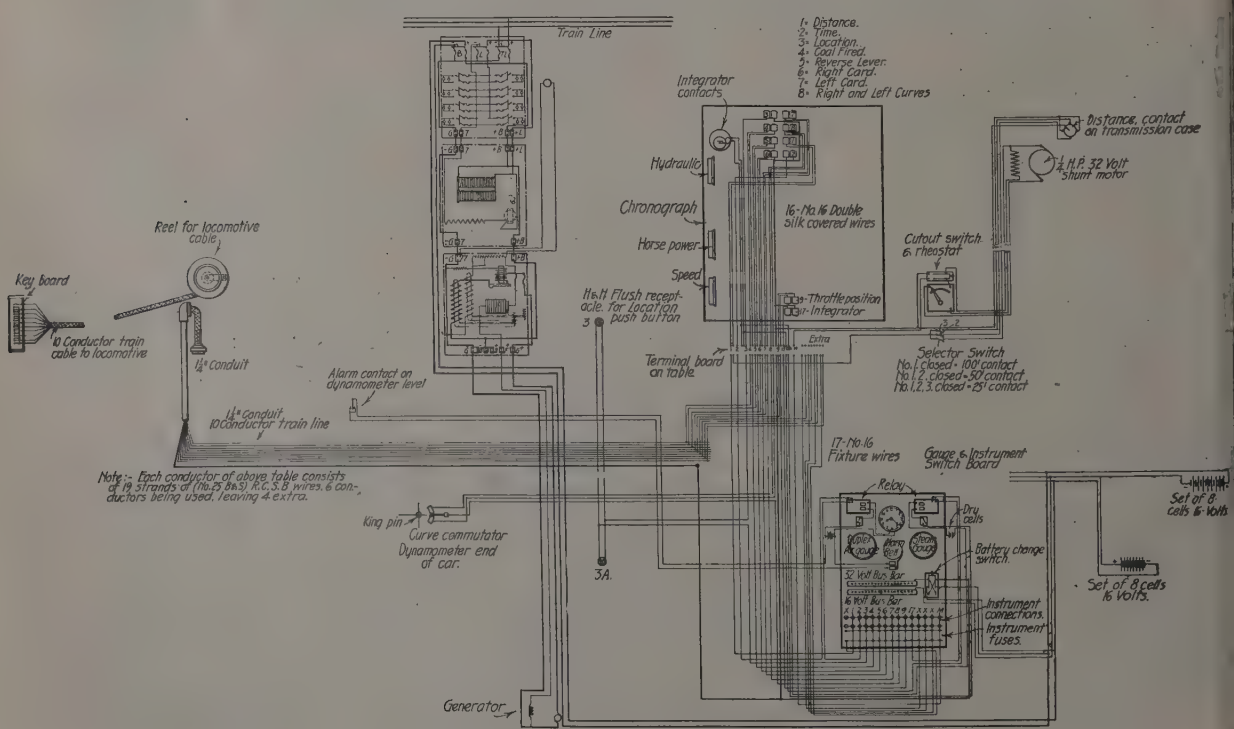
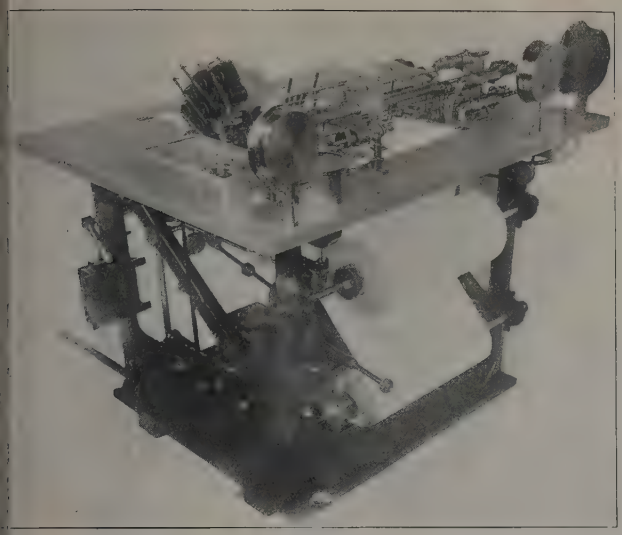

Train Line
1- Distance.
2- Time.
3- Location.
4- Coal Fired.
5- Reverse Lever.
6- Right Card.
7- Left Card.
8- Right and Left Curves
Integrator contacts
Hydraulic
Chronograph
Horse power
Speed
16- No. 16 Double Silk covered wires
Nos. 11 Flush receptacle for Location push button
39- Throttle position
37- Integrator
Extra
Terminal board on table
Distance, contact on transmission case
1/4 H.P. 32 Volt shunt motor
Cutout switch & rheostat
Selector Switch
No. 1 closed - 100' contact
No. 1, 2 closed - 50' contact
No. 1, 2, 3 closed - 25' contact
17- No. 16 Fixture wires
Gauge & Instrument Switch Board
Relay
Dry cells
Battery change switch.
32 Volt Bus Bar
16 Volt Bus Bar
Instrument connections
Instrument fuses.
Set of 8 cells 16 Volts.
Set of 8 cells 16 Volts
Reel for locomotive cable
Key board
10 Conductor train cable to locomotive
1 1/4" Conduit
1 1/4" Conduit 10 Conductor train line
Alarm contact on dynamometer level
Note:- Each conductor of above table consists of 19 strands of (No. 25 B.&S.) R.C.S.B. wires, 6 conductors being used, leaving 4 extra.
King pin
Curve commutator Dynamometer end of car.
3A.
Generator

Fig. 2728—Wiring Diagram for Dynamometer Car.
The Burr Company.



ig. 2729—Rear View of Recording Table, Dynamometer Car.

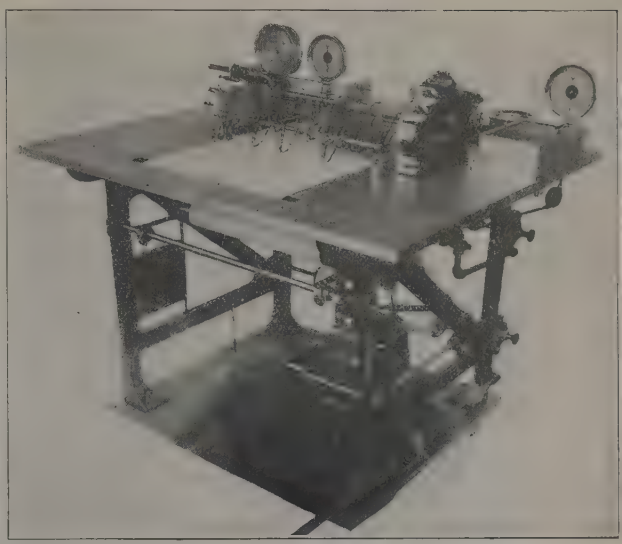


Fig. 2730—Front View of Recording Table, Dynamometer Car.

Note.—The table shown in Figs. 409-410 records: location, rawbar pull, speed, time, distance, train line pressure, brake ylinder pressure, steam pressure, buffing shocks, integration f drawbar pull diagram, horsepower at drawbar, curve right r left, positions of throttle and of the reverse lever.

The speed record is made by means of a Boyer recorder, hile a second Boyer recorder is provided for furnishing ne speed element of the horsepower computer.

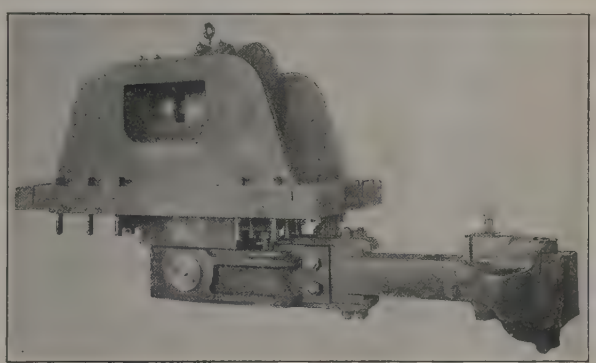


Fig. 2731—Drawbar and Weighing Head Assembly. Dynamometer Car.

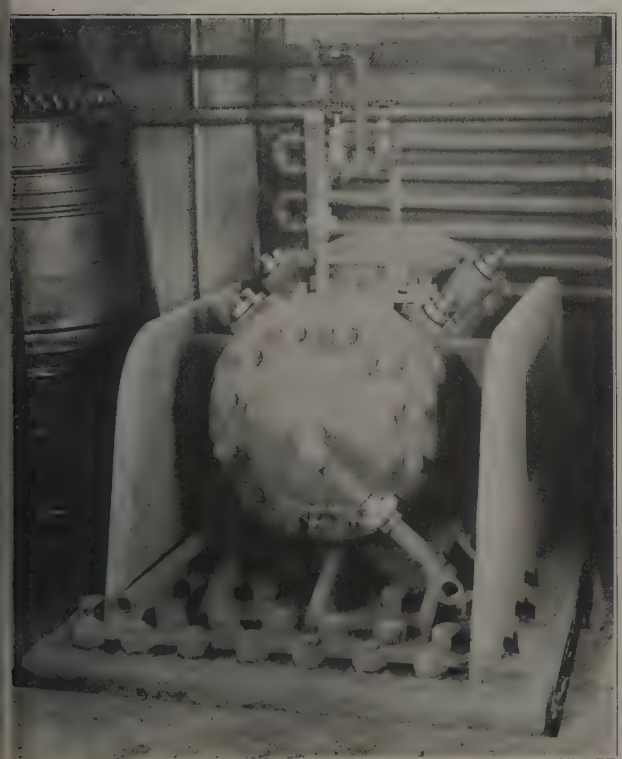


Fig. 2732—Weighing Head, Dynamometer Car.

Fig. 2733—Integrating Apparatus, Dynamometer Car.

Fig. 2734—Test Weight Car, 80,000 lb. Capacity. Pennsylvania Railroad.
(*See also Figs. 2735 and 2737.*)

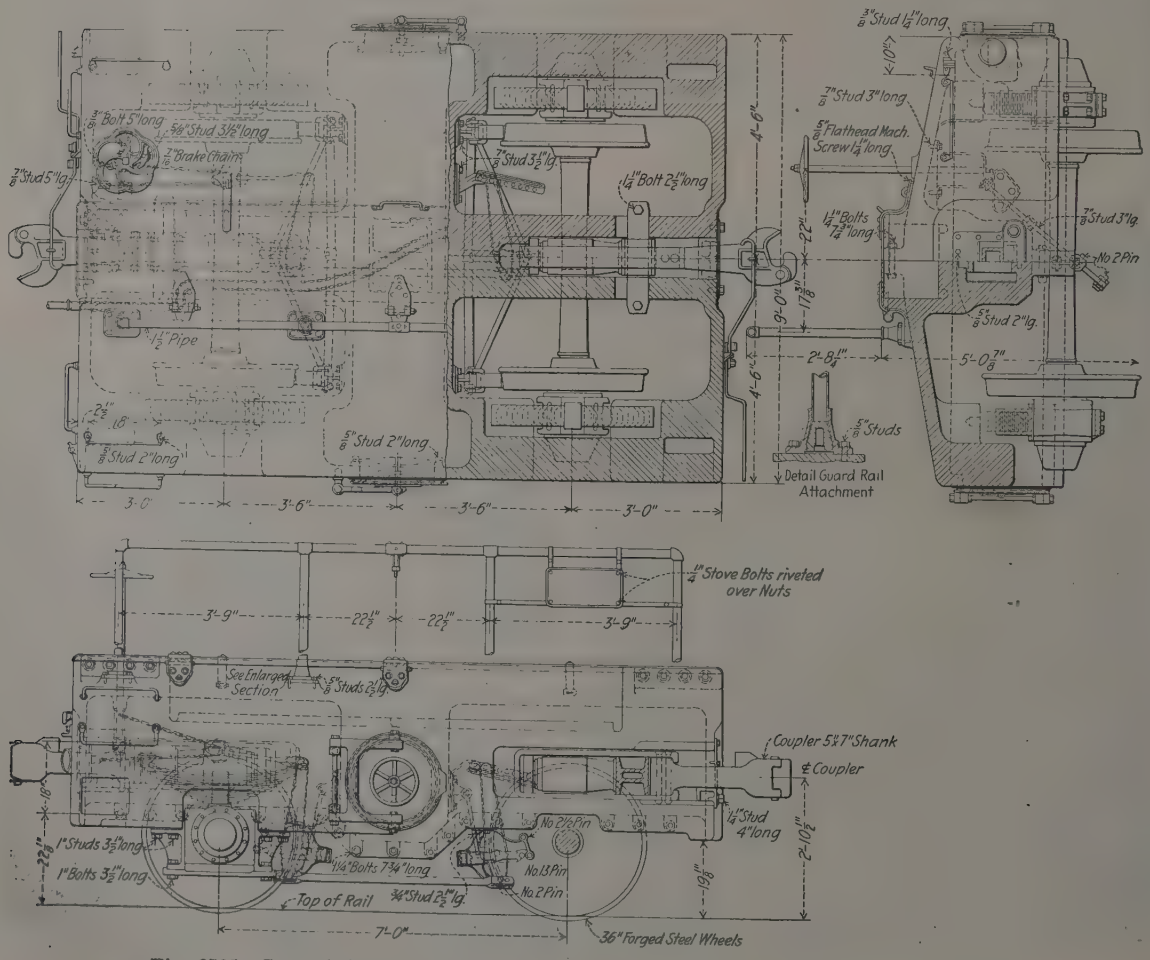


Fig. 2735—General Arrangement of Test Weight Car Shown in Figs. 2734 and 2737.

Fig. 2736—Test Weight Car Similar to Car Shown in Fig. 2734.
U. S. Government Bureau of Standards, Department of Commerce.

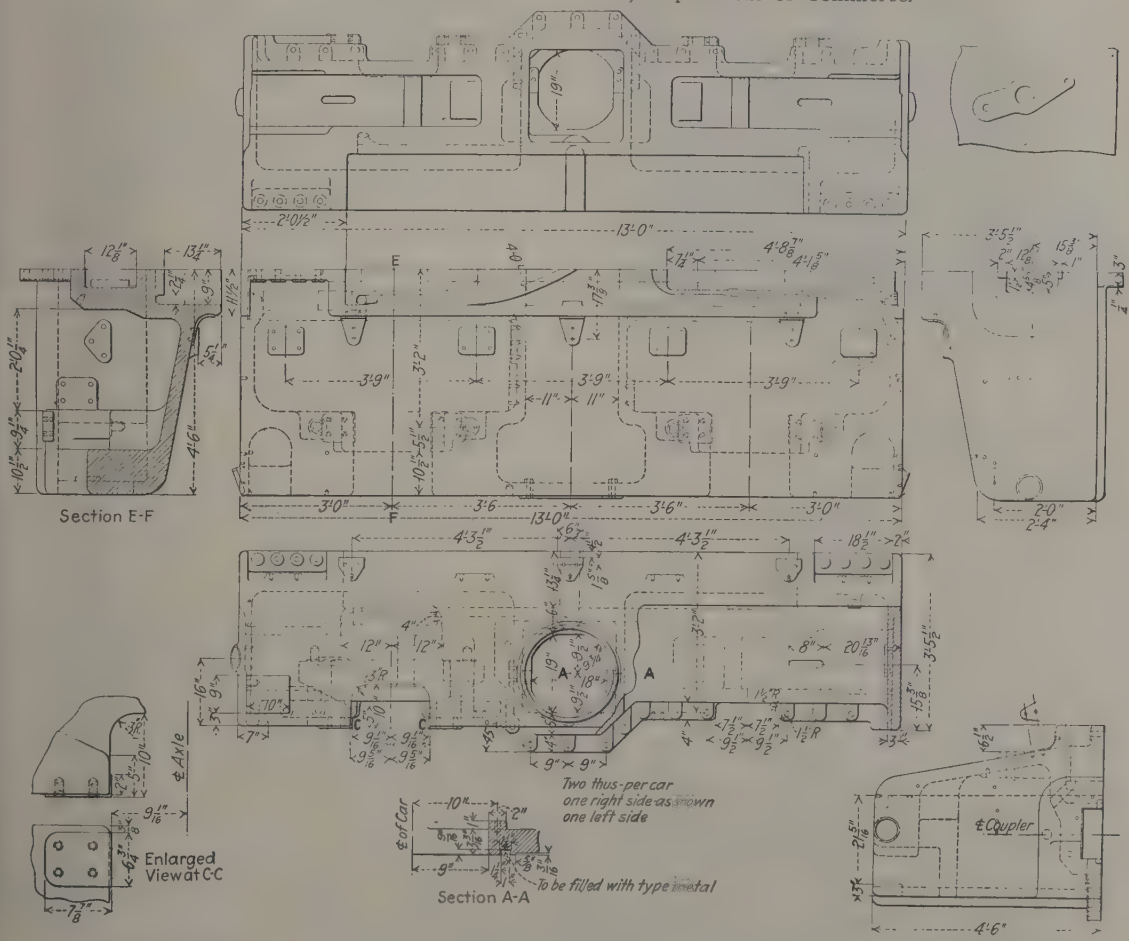


Fig. 2737—Details of Main Body of Pennsylvania Test Weight Car Shown in Figs. 2734-2735.

Fig. 2738—Clearance Car for Pennsylvania Railroad.

(*See also Fig. 2739.*)

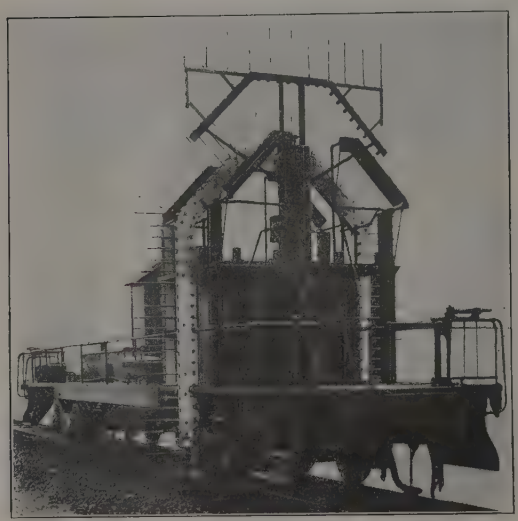


Fig. 2739—Front Elevation of Clearance Car Shown in Fig. 2738.

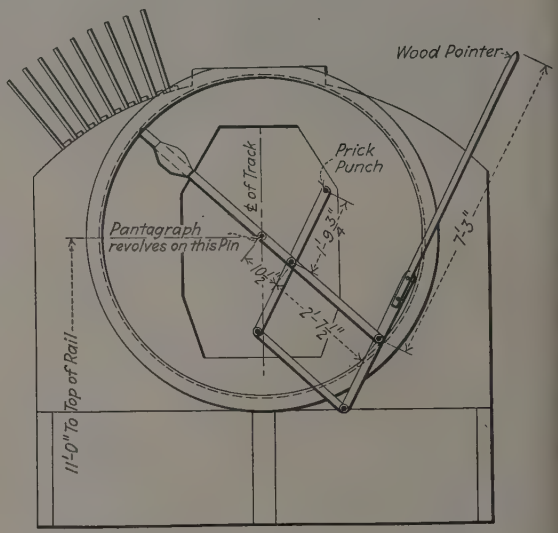


Fig. 2740—Pantagraph as Used on New York Central Clearance Car Shown in Fig. 2741.

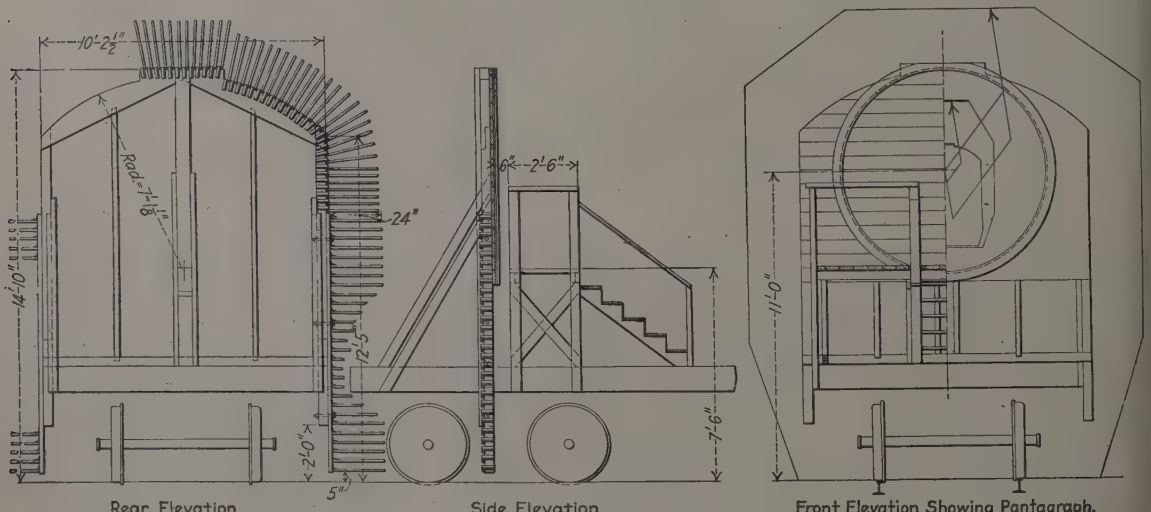


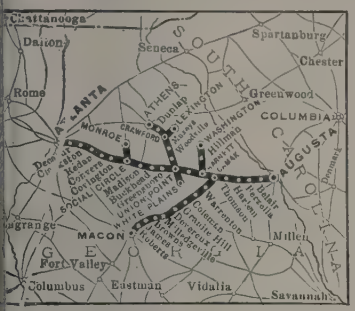
Fig. 2741—Clearance Car as Operated on New York Central Lines.

(*See also Fig. 2740.*)

CLEARANCE AND WEIGHT LIMITS.

UNITED STATES RAILROAD ADMINISTRATION.
WALKER D. HINES, Director General of Railroads.

GEORGIA RAILROAD.



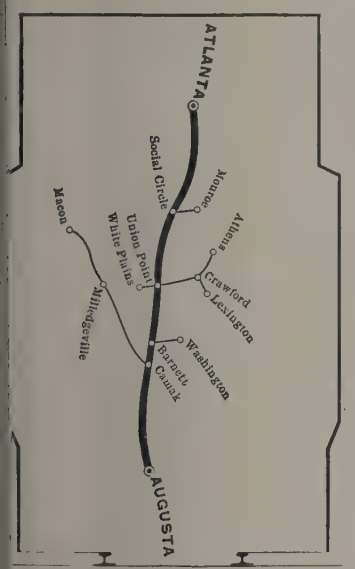


Diagram No. 1.
Atlanta and Augusta.

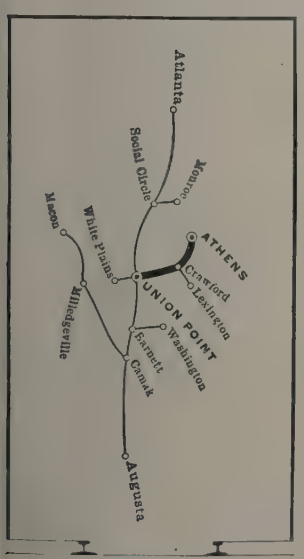


Diagram No. 2.
Union Point and Athens.

LOCAL.

Heights above Top of Rail.		Atlanta, Ga. and Augusta, Ga. Division. Diagram No. 1 Width ft. in.		Union Point, Ga. and Athens, Ga. Division. Diagram No. 2 Width ft. in.		Camak, Ga. and Macon, Ga. Division. Diagram No. 3 Width ft. in.		Barnett, Ga. and Washington, Ga. Division. Diagram No. 4 Width ft. in.		Bell St., Atlanta and Atlanta Terminal. Division. Diagram No. 5 Width ft. in.		Heights above Top of Rail.
ft.	in.											ft. in.
22	0											22 0
21	6											21 6
21	0											21 0
20	9											20 9
20	6											20 6
20	3											20 3
20	0											20 0
19	9	10	10									19 9
19	6	"	"									19 6
19	3	"	"	10	4							19 3
19	0	"	"	"	"							19 0
18	9	"	"	"	"							18 9
18	6	"	"	"	"	12	2					18 6
18	3	"	"	"	"	"	"					18 3
18	0	"	"	"	"	"	"					18 0
17	9	"	"	"	"	"	"					17 9
17	6	"	"	"	"	"	"					17 6
17	3	"	"	"	"	"	"					17 3
17	0	"	"	"	"	"	"					17 0
16	9	"	"	"	"	"	"					16 9
16	6	"	"	"	"	"	"					16 6
16	3	"	"	"	"	"	"					16 3
16	0	"	"	"	"	"	"			10	0	16 0
15	9	"	"	"	"	"	"			"	"	15 9
15	6	"	"	"	"	"	"			"	"	15 6
15	3	"	"	"	"	"	"			"	"	15 3
15	0	"	"	"	"	"	"			"	"	15 0
14	9	"	"	"	"	"	"			"	"	14 9
14	6	"	"	"	"	"	"			"	"	14 6
14	3	10	10	"	"	"	"			10	0	14 3
14	2			"	"	"	"					14 2
14	1			"	"	"	"					14 1
14	0	12	2	"	"	"	"			12	2	14 0
13	9	"	"	"	"	"	"			"	"	13 9
13	6	"	"	"	"	"	"			"	"	13 6
13	3	"	"	"	"	"	"			"	"	13 3
13	0	"	"	"	"	"	"			"	"	13 0
12	6	"	"	"	"	"	"			"	"	12 6
12	0	"	"	"	"	"	"			"	"	12 0
11	6	"	"	"	"	"	"			"	"	11 6
11	0	"	"	"	"	"	"			"	"	11 0
10	6	"	"	"	"	"	"			"	"	10 6
10	0	"	"	"	"	"	"			"	"	10 0
9	6	"	"	"	"	"	"			"	"	9 6
9	0	"	"	"	"	"	"			"	"	9 0
8	6	"	"	"	"	"	"			"	"	8 6
8	0	"	"	"	"	"	"			"	"	8 0
7	6	"	"	"	"	"	"			"	"	7 6
7	0	"	"	"	"	"	"			"	"	7 0
6	6	"	"	"	"	"	"			"	"	6 6
6	0	"	"	"	"	"	"			"	"	6 0
5	6	"	"	"	"	"	"			"	"	5 6
5	0	12	2	"	"	12	2			12	2	5 0
4	6			"	"							4 6
4	0	11	2	"	"	11	6	10	5	11	2	4 0
3	9	"	"	"	"	"	"	"	"	"	"	3 9
3	6	"	"	"	"	"	"	"	"	"	"	3 6
3	3	"	"	"	"	"	"	"	"	"	"	3 3
3	0	"	"	"	"	"	"	"	"	"	"	3 0
2	9	"	"	"	"	"	"	"	"	"	"	2 9
2	6	"	"	"	"	"	"	"	"	"	"	2 6
2	3	"	"	"	"	"	"	"	"	"	"	2 3
2	0	"	"	"	"	"	"	"	"	"	"	2 0
1	9	"	"	"	"	"	"	"	"	"	"	1 9
1	6	"	"	"	"	"	"	"	"	"	"	1 6
1	3	"	"	"	"	"	"	"	"	"	"	1 3
1	0	"	"	"	"	"	"	"	"	"	"	1 0
0	9	"	"	"	"	"	"	"	"	"	"	0 9
0	6	"	"	"	"	"	"	"	"	"	"	0 6
0	3	"	"	"	"	"	"	"	"	"	"	0 3
0	0	11	2	10	4	11	6	10	5	11	2	0 0
	A	10%		10%		10%		10%		10%		
	B											

No Obstructions in Height or Width above 4 feet.

Note A—MAXIMUM GROSS WEIGHT OF CAR AND LADING SHOWN UNDER EACH COLUMN.
Note B—LIMIT OF LOAD WEIGHT ABOVE MARKED CAPACITY.

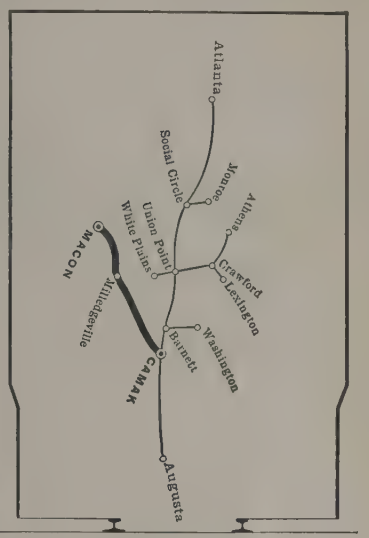


Diagram No. 3.
Camak and Macon.

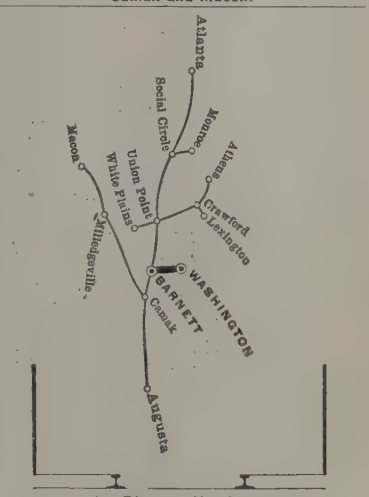


Diagram No. 4.
Barnett and Washington.

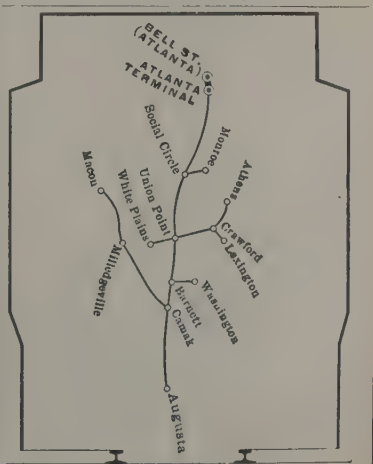


Diagram No. 5.
Bell St., Atlanta and Atlanta Terminal.

Fig. 2742—Typical Clearance Diagrams. Courtesy of the Railway Equipment and Publication Company.

BOSTON, MASS.—Gateway.

THROUGH CLEARANCES GROUPED TO SHOW SEPARATE ROUTES VIA RESPECTIVE POINTS NAMED.

CLEARANCE LIMITATION TABLE.

BOSTON, MASS. (To or From Points Given Below).

Heights above Top of Rail.	1 Albany, N. Y. 1a Boston & Albany.	1b Boston & Maine. Rutland.	1c Boston & Maine.	2 Binghamton, N. Y. 2a Boston & Albany. Delaware & Hudson.	2b Boston & Maine. Rutland. Delaware & Hudson.	2c Boston & Maine. Delaware & Hudson.	3 Buffalo, N. Y. 3a Boston & Maine. Rutland. New York Central.	3b Boston & Albany. New York Central.	3c Boston & Maine. New York Central.	4 Montreal, Que. 4a Boston & Maine. Canadian Pacific.	4b Boston & Maine. Central Vermont.	5 New York, N. Y. 5a N. Y., N. H. & H. Note C	5b N. Y., N. H. & H. Note D	5c N. Y., N. H. & H. Note E	6 Philadelphia, Pa. 6a (Via New York). N. Y., N. H. & H. C. R. R. of N. J.—P. & R.	6b (Via New York). N. Y., N. H. & H. Pennsylvania.	6c (Via Maybrook.) N. Y., N. H. & H.—N. Y., L. E. & W. R.—Pennsylvania.	7 Portland, Me. 7a Boston & Maine.	8 Quebec, Que. 8a Boston & Maine. Quebec Central.	8b Boston & Maine. Grand Trunk.	9 Washington, D. C. 9a (Via New York). N. Y., N. H. & H.—P. & R. C. R. R. of N. J.—P. & R.	9b (Via New York). N. Y., N. H. & H. Pennsylvania.	9c (Via Maybrook). N. Y., N. H. & H.—N. Y., L. E. & W. R.—Pennsylvania.	Heights above Top of Rail.
	Width	Width	Width	Width	Width	Width	Width	Width	Width	Width		Width	Width		Width	Width	Width	Width	Width	Width	Width	Width	Width	Width	
ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
22 0												7 0													22 0
21 9																									21 9
21 6																									21 6
21 3																									21 3
21 0																									21 0
20 9																									20 9
20 6																									20 6
20 3																									20 3
20 0																									20 0
19 9																									19 9
19 6																									19 6
19 3																									19 3
19 0																									19 0
18 9																									18 9
18 6																									18 6
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18 0																									18 0
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17 6																									17 6
17 3																									17 3
17 0																									17 0
16 9																									16 9
16 6																									16 6
16 3																									16 3
16 0																									16 0
15 9																									15 9
15 6																									15 6
15 3																									15 3
15 0										7 0		7 0	6 0		7 0	7 0	7 0	7 0		7 0		5 8	7 0	7 0	15 0
14 9	8 0	4 6		8 0	4 6		4 6	8 0				7 0	6 6		7 0	7 0	7 0	7 0	9 0			6 4	7 0	7 0	14 9
14 6	8 8	10 3		8 8	8 9		10 8	8 8				8 6	7 1		8 6	8 6	8 6	8 6	9 6			7 0	8 6	8 6	14 6
14 3	9 0			9 0				9 0				8 6	7 7		8 6	8 6	8 6	8 6	9 10			7 5	8 6	8 6	14 3
14 0	9 10	10 6		9 10	10 6		10 6	9 10				9 10	8 1		9 10	9 10	9 10	9 10	10 3		8 6	8 0	9 10	9 10	14 0
13 9	9 10	" "		9 10	" "		" "	9 10				9 10	8 7		9 10	9 10	9 10	9 10	10 6			8 4	9 10	9 10	13 9
13 6	10 8	" "		10 6	" "		" "	10 2				10 2	9 2		10 2	10 2	10 2	10 2	" "		9 6	9 0	10 2	10 2	13 6
13 3	" "	" "		" "	" "		" "	" "				10 2	9 8		10 2	10 2	10 2	10 2	" "			9 2	10 2	10 2	13 3
13 0	" "	" "		" "	" "		" "	10 6				10 6	10 3		10 6	10 6	10 6	10 6	" "		9 11	9 8	9 6	10 6	13 0
12 9	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		10 6	9 11	" "	" "	" "	12 9
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12 3	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	12 3
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10 6	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	10 6
10 3	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	10 3
10 0	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	10 0
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9 6	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	9 6
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8 6	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	8 6
8 3	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	8 3
8 0	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	8 0
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7 6	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	7 6
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4 6	" "	" "		" "	" "		10 6	10 6	10 6			" "	" "		" "	" "	" "	" "	" "		" "	" "	10 3	" "	" "	4 6
4 3	10 8	" "		10 6	" "		10 5	10 5	10 5			" "	" "		10 6	" "	" "	" "	" "		" "	" "	" "	" "	" "	4 3
4 0	" "	" "		" "	" "		" "	" "	" "			" "	" "		" "	" "	" "	" "	" "		" "	" "	" "	" "	" "	4 0
3 9	10 5	" "		10 5	" "		" "	" "	" "			" "	" "		10 5	" "	" "	" "	" "		" "	" "	10 2	" "	" "	3 9
3 6	" "	" "		" "	" "		" "	" "	" "			" "	" "		10 5	" "	" "	" "	" "		" "	" "	10 1	" "	" "	3 6
3 3	" "	" "		" "	" "		" "	" "	" "			" "	" "		10 4	10 6	10 8	" "	" "		" "	" "	10 2	10 6	10 8	3 3
3 0	" "	" "		" "	" "		" "	" "	" "	10 6		" "	" "	10 6	10 3	10 8	10 3	" "	" "		" "	" "	10 3	10 3	10 3	3 0
2 9	" "	10 6		" "	10 6		" "	10 5		9 6		" "	" "		10 3	" "	" "	" "		" "	9 6	" "	10 4	" "	2 9
2 6	" "	10 0		" "	10 0		" "	10 0				" "	" "		9 9	" "	" "	" "		" "	" "	" "	9 9	" "	2 6
2 3	" "	" "		" "	" "		" "	" "				" "	" "		" "	" "	" "	" "		10 6	" "	" "	" "	" "	2 3
2 0	10 5	" "		10 5	" "		10 0	10 5	10 5			" "	" "		10 3	10 3	10 3	" "		9 4	" "	10 0	" "	10 3	10 3	2 0
1 9	10 4	" "		10 4	" "		" "	" "				" "	" "		10 2	10 2	10 2	" "		" "	" "	" "	" "	10 2	10 2	1 9
1 6	10 2	10 0	10 6	10 2	10 0	10 6				9 6		9 11	9 11		9 9	11 9	11 9	11 9		9 6	9 9	9 6	9 9	11 9	11 9	1 6
1 3	10 0	9 2	9 2	10 0	9 2	9 2				9 4		9 8	9 8		8 6	9 9	8 9	9 8	9 4	9 4	9 0	8 6	9 5	9 8	9 8	1 3
1 0	9 11	" "	" "	9 11	" "	" "	9 2	9 9	9 2	9 5		9 5	9 5		8 4	9 5	9 5	9 5	9 2	" "	" "	8 4	9 2	9 5	9 5	1 0
0 9	9 9	" "	" "	9 9	" "	" "	" "	" "	" "	9 2		8 8	8 8		8 8	8 8	8 8	8 8	9 0	9 4	9 0	8 4	8 2	8 8	8 8	0 9
0 6	9 8	9 2	9 2	9 8	9 2	9 2	9 2	9 2	9 2	9 4		8 8	8 8		8 8	8 8	8 8	8 8					8 3	8 8	8 8	0 6
0 3	9 5			9 6								8 8	8 8													0 3
0 0																										0 0
A		185000	185000		185000	185000					140000								185000				185000		
B		10%	10%		10%	10%				10%	10%								10%		10%		10%		

Note A—MAXIMUM GROSS WEIGHT OF CAR AND LADING SHOWN UNDER EACH COLUMN.

Note B—LIMIT OF LOAD WEIGHT ABOVE MARKED CAPACITY.

Note C—Via Shore Line from Boston, Mass. (Freight Terminal) to New York City (Woodlawn, Harlem River and Fresh Pond Junction).

Note D—Via Shore Line from Boston, Mass. (South Station) to New York City (Woodlawn, Harlem River, Fresh Pond Junction and Bay Ridge).

Note E—Via Shore Line from Boston, Mass. (Freight Terminal) to New York City (Bay Ridge).

Fig. 2743—"Boston Gateway." Line Clearance. Courtesy of the Railway Equipment & Publication Company.

Safety Appliances

THE DEVELOPMENT OF SAFETY APPLIANCES for American railway equipment was a matter of keen interest for many years prior to the enactment of the "Safety Appliance Act," established by act of Congress, approved April 14, 1910.

One of the features of the early M. C. B. conventions was the annual address of E. A. Moseley, then secretary of the Interstate Commerce Commission, on subjects relating to the developing of safety appliances. The address in 1903 is reported on page 52 of the Proceedings for that year. In 1904 Mr. Moseley spoke particularly on the inspection services that had been inaugurated. Mr. Moseley's remarks at other conventions will be found in the 1905 Proceedings, page 50; 1906, page 61; 1907, page 56; and 1908, page 56.

A report of a special committee on standards for the protection of trainmen will be found in the 1908 M. C. B. Proceedings, page 374. See also 1910 Proceedings, page 386; 1911 Proceedings, page 222.

In 1893 a Recommended Practice was adopted on safety appliances under the subheads as given. In 1896 some changes were made, especially in regard to handholds, and by the elimination of various details from drawing. In 1902 it was changed to Standard.

In 1905 Sheet M. C. B. 19 was revised to more clearly define the location of safety appliances on cars. Also, the lower round of the end ladder with wooden rails was made straight instead of having an offset.

In 1906 the position of the brake shaft and location of roof handholds were modified.—Proceedings 1906.

In 1907 Sheet 19 was devoted entirely to illustrating these standards.

In 1908 a thorough revision was made of both text and drawings in order to make their meaning and intent clear and adaptable to all existing types of car equipment, and to be capable of but one interpretation.

In 1909 reference to wooden tread 1½ by 2 inches was omitted from Sheet on account of them not being applicable to certain types of cars.

In 1911 the United States Safety Appliance Standards, as contained in the order of the Interstate Commerce Commission, dated March 13, 1911, were adopted as standard.

Conference Rulings of the Interstate Commerce Commission

ISSUED DECEMBER 9, 1911

328. November 6, 1911. Safety Appliances—Cars of Special Construction.—Locomotives while equipped with snow plows or flangers are to be regarded as cars of special construction within the meaning of the order of March 13, 1911.

329. Safety Appliances—Order of March 13, 1911, Construed.—The order entitled "United States Safety Appliance Standard," adopted on March 13, 1911, is interpreted with respect to the details mentioned as follows:

1. That gondola and ballast cars with swinging side doors at ladder locations may be considered as cars of special construction.

Ladders and handholds need not be applied to swinging side doors.

A side vertical handhold shall be placed on corner post of such cars as nearly as possible over sill step.

2. That high-side gondola and ballast cars with end platforms 18 inches or more in length may be considered as cars of special construction.

Ladders shall be placed on such cars as prescribed for high-side gondola and hopper cars, with sill step under ladder, or as near under ladder as car construction will permit. Ends and side of cars to be equipped with handholds in the same manner as flat cars.

3. Ladders—Spacing of Ladder Treads.—That the spacing of top ladder treads shall be taken from eave of roof at side of car, whether latitudinal running board is used or not. (Shown on plates illustrating United States Safety Appliance Standards, issued July 1, 1911.

4. Box and Other House Cars, Automobile Cars with Swinging End Doors—End Ladders:

That these cars may come under the head of cars of special construction, as per clause on page 37 of the order; and the end ladders placed as nearly as possible to designated location.

ISSUED JANUARY 13, 1913

Safety Appliances—Cars of Special Construction.—Order of March 13, 1911, construed:

The order entitled "United States Safety Appliance Standards," adopted on March 13, 1911, is interpreted with respect to the details mentioned, as follows:

1. High-side, drop-bottom ore cars of narrow construction are to be regarded as cars of special construction. On such cars offset sill steps may be applied where, owing to the construction of car, the standard sill step would foul the oil box and prevent the proper opening of the lid.

2. Air hose are not to be regarded as fixtures, as that word is used in that part of the order relating to "End-ladder Clearance."

ISSUED DECEMBER 8, 1920

Cars of special construction, as contemplated by the Commission's order of March 13, 1911, are cars which can not be equipped with safety appliances as prescribed in the order for any of the specified classes enumerated therein.

In the construction of new equipment which does not conform to the specified classes designated in the order, plans shall be submitted to the Commission prior to construction of such cars for the purpose of determining the location and application thereto of all safety appliances required by statute and order of the Commission of March 13, 1911.

At a general session of the Interstate Commerce Commission, held at its office in Washington, D. C., on the 13th day of March, A. D. 1911, the following was promulgated.

IN THE MATTER OF DESIGNATING THE NUMBER, DIMENSIONS, LOCATION, AND MANNER OF APPLICATION OF CERTAIN SAFETY APPLIANCES.

Whereas by the third section of an act of Congress approved April 14, 1910, entitled "An act to supplement 'An

act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes and their locomotives with driving-wheel brakes, and for other purposes,' and other safety appliance acts, and for other purposes," it is provided, among other things, "That within six months from the passage of this act the Interstate Commerce Commission, after hearing, shall designate the number, dimensions, location, and manner of application of the appliances provided for by section two of this act and section four of the act of March second, eighteen hundred and ninety-three, and shall give notice of such designation to all common carriers subject to the provisions of this act by such means as the Commission may deem proper, and thereafter said number, location, dimensions, and manner of application as designated by said Commission shall remain as the standards of equipment to be used on all cars subject to the provisions of this act, unless changed by an order of said Interstate Commerce Commission, to be made after full hearing and for good cause shown; and failure to comply with any such requirement of the Interstate Commerce Commission shall be subject to a like penalty as failure to comply with any requirements of this act: *Provided*, That the Interstate Commerce Commission may, upon full hearing and for good cause, extend the period within which any common carrier shall comply with the provisions of this section with respect to the equipment of cars actually in service upon the date of the passage of this act;" and

Whereas hearings in the matter of the number, dimensions, location, and the manner of application of the appliances, as provided in said section of said act, were held before the Interstate Commerce Commission at its office in Washington, D. C., on September 29th and 30th and October 7th, 1910, respectively; and February 27th, 1911;

Now, therefore, in pursuance of and in accordance with the provisions of said section three of said act, and superseding the Commission's order of October 13, 1910.

It is ordered, That the number, dimensions, location, and

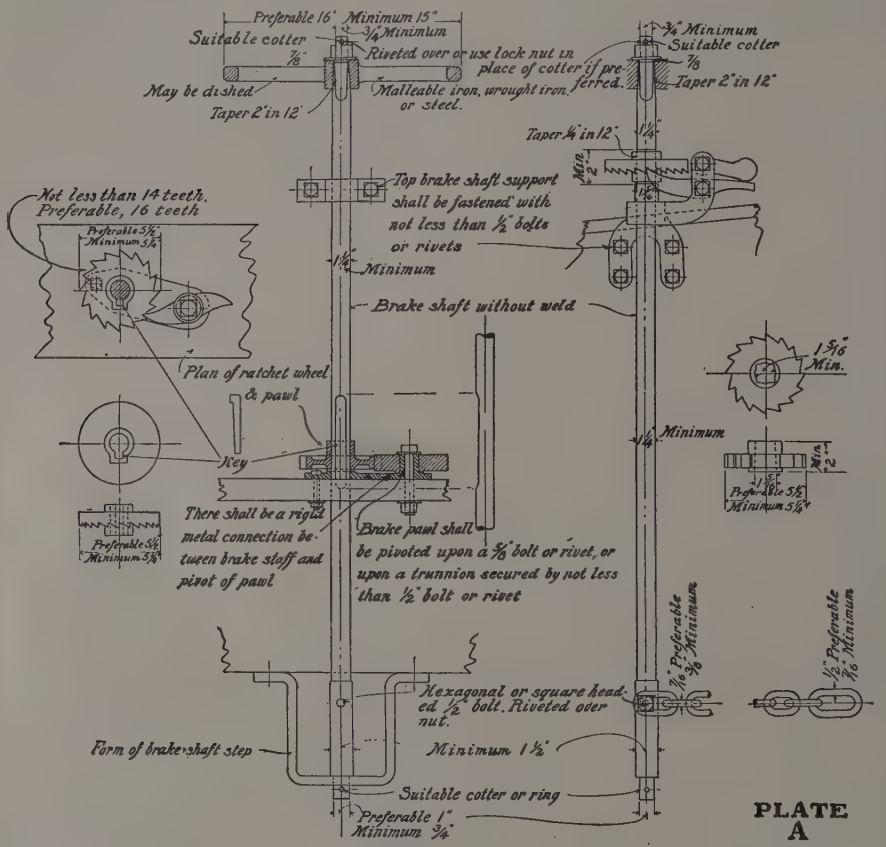

Preferable 16" Minimum 15"
Suitable cotter
3/4" Minimum
Riveted over or use lock nut in place of cotter if preferred.
7/8"
May be dished
Taper 2" in 12"
Malleable iron, wrought iron or steel.
3/4" Minimum
Suitable cotter
7/8"
Taper 2" in 12"
Taper 3/4" in 12"
1 1/4"
Min. 2"
Top brake shaft support shall be fastened with not less than 1/2" bolts or rivets
Not less than 14 teeth. Preferable, 16 teeth
Preferable 5 1/2" Minimum 5 1/4"
1 1/4" Minimum
Brake shaft without weld
Plan of ratchet wheel & pawl
Key
1 5/16" Min.
1 1/4" Minimum
Min. 2"
Preferable 5 1/2" Minimum 5 1/4"
There shall be a rigid metal connection between brake staff and pivot of pawl
Preferable 5 1/2" Minimum 5 1/4"
Brake pawl shall be pivoted upon a 5/8" bolt or rivet, or upon a trunnion secured by not less than 1/2" bolt or rivet
7/16" Preferable 3/8" Minimum
1/2" Preferable 7/16" Minimum
Hexagonal or square headed 1/2" bolt. Riveted over nut.
Form of brake-shaft step
Minimum 1 1/2"
Suitable cotter or ring
Preferable 1" Minimum 3/4"
PLATE A

FIG. 2744—STANDARD AND SAFETY APPLIANCES FOR BRAKE WHEEL, SHAFT, ETC.

manner of application of the appliances provided for by section two of the act of April 14, 1910, and section four of the act of March, 2, 1893, shall be as follows:

Box and Other House Cars

HAND BRAKES

Number.—Each box or other house car shall be equipped with an efficient hand-brake which shall operate in harmony with the power brake thereon.

The hand-brake may be of any efficient design, but must provide the same degree of safety as the design shown on Plate A in Fig. 2744.

Dimensions.—The brake shaft shall not be less than one and one-fourth (1¼) inches in diameter, of wrought iron or steel without weld.

The brake wheel may be flat or dished, not less than fifteen (15) preferably sixteen (16), inches in diameter, of malleable iron, wrought iron or steel.

Location.—The hand-brake shall be so located that it can be safely operated while car is in motion.

The brake-shaft shall be located on end of car, to the left

APPLIANCE	DIMENSIONS	PREFERABLY	MAXIMUM	MINIMUM
BRAKE SHAFT	A	-	22"	17"
RUNNING BOARD- (WIDTH)	B	20"	-	18"
" (CLEARANCE)	C	-	10"	6"
SILL STEPS (LENGTH OF TREAD)	D	12"	-	10"
" " (HEIGHT ABOVE RAIL)	E	22"	24"	-
LADDERS (SPACING FROM ROOF)	F	-	18"	12"
" & HANDHOLDS (CLEARANCE)	G	2½"	-	2"
ROOF HANDHOLDS (FROM EDGE OF ROOF)	H	-	15"	8"
HOR. SIDE & END HANDHOLDS (LENGTH)	I	24"	-	16"
" " " " (HEIGHT)	J	-	30"	24"

@ ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
& HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

ALL BOLTS & RIVETS ⅝" MIN. DIA.
BOLTS ⅝" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½"

BOX & OTHER HOUSE CARS
PLATE C

THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.

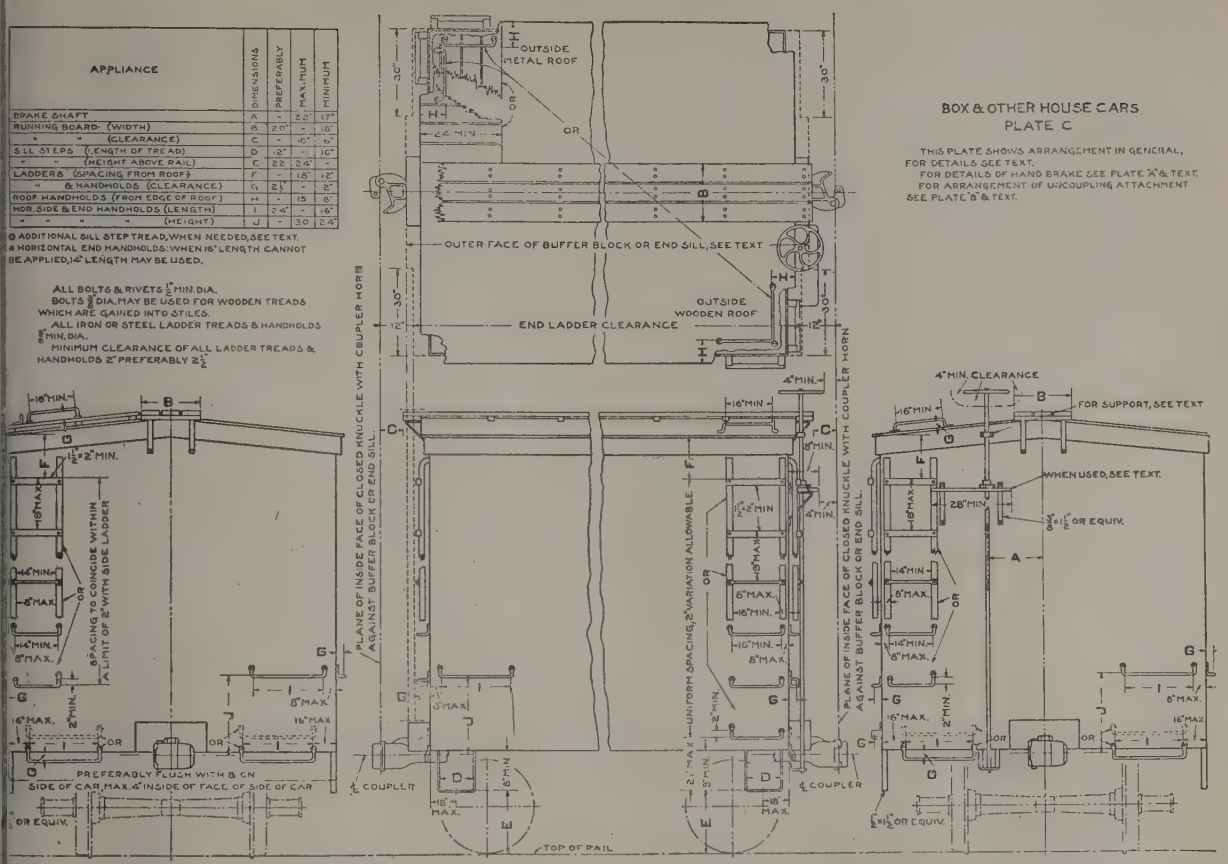

OUTSIDE METAL ROOF
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
OUTSIDE WOODEN ROOF
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
UNIFORM SPACING, 2" VARIATION ALLOWABLE
SPACING TO COINCIDE WITHIN A LIMIT OF 2" WITH SIDE LADDER
PREFERABLY FLUSH WITH B OR SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
4" MIN. CLEARANCE
FOR SUPPORT, SEE TEXT
WHEN USED, SEE TEXT.
TOP OF RAIL

FIG. 2745—STANDARD SAFETY APPLIANCES FOR BOX AND OTHER HOUSE CARS.

APPLIANCE	DIMENSIONS	PREFERABLY	MAXIMUM	MINIMUM
BRAKE SHAFT	A	-	22"	17"
RUNNING BOARD (WIDTH)	B	20"	-	18"
" (CLEARANCE)	C	-	10"	6"
@ SILL STEPS (LENGTH OF TREAD)	D	12"	-	10"
" " (HEIGHT ABOVE RAIL)	E	22"	24"	-
LADDERS (SPACING FROM ROOF)	F	-	18"	12"
" & HANDHOLDS (CLEARANCE)	G	2½"	-	2"
ROOF HANDHOLDS (FROM EDGE OF ROOF)	H	-	15"	8"
* HOR. SIDE & END HANDHOLDS (LENGTH)	I	24"	-	16"
" & VERT. SIDE & END HANDHOLDS (HEIGHT)	J	-	30"	24"
ADDITIONAL HOR. END HANDHOLDS "	K	-	60"	30"
VERTICAL END HANDHOLDS (LENGTH)	L	24"	-	18"

@ ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
* HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

ALL BOLTS & RIVETS ⅝" MIN. DIA.
BOLTS ⅝" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ⅝" MIN. DIA.
MIN. CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½".

BOX & OTHER HOUSE CARS
(WITH PLATFORM END SILLS)
PLATE D

THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.

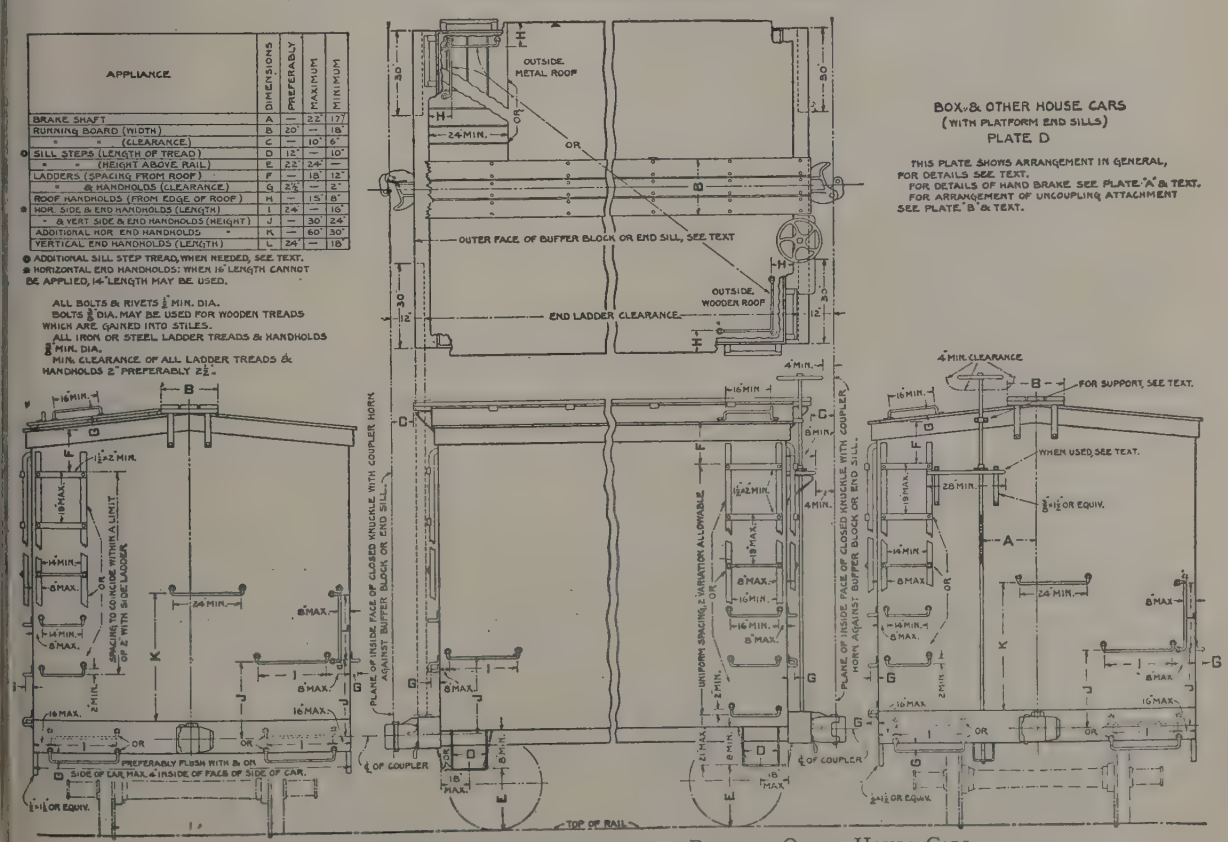

OUTSIDE METAL ROOF
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
OUTSIDE WOODEN ROOF
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
UNIFORM SPACING, 2" VARIATION ALLOWABLE
SPACING TO COINCIDE WITHIN A LIMIT OF 2" WITH SIDE LADDER
PREFERABLY FLUSH WITH B OR SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
4" MIN. CLEARANCE
FOR SUPPORT, SEE TEXT
WHEN USED, SEE TEXT.
TOP OF RAIL

FIG. 2746—STANDARD SAFETY APPLIANCES FOR BOX AND OTHER HOUSE CARS.

of and not less than seventeen (17) nor more than twenty-two (22) inches from center.

Manner of application.—There shall be not less than four (4) inches clearance around rim of brake wheel.

Outside edge of brake wheel shall be not less than four (4) inches from a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler-horn against the buffer block or end sill.

Top brake-shaft support shall be fastened with not less than one-half (½) inch bolt or rivets. (Plate A. Fig. 2744.)

A brake-shaft step shall support the lower end of brake shaft. A brake-shaft step which will permit the brake chain to drop under the brake shaft shall not be used. U-shaped form of brake-shaft step is preferred. (See Plate A.)

Brake shaft shall be arranged with a square fit at its upper end to secure the hand-brake wheel; said square fit shall be not less than seven-eighths (⅞) of an inch square. Square-fit taper; nominally two (2) in twelve (12) inches. (See Plate A.)

Brake chain shall be of not less than three-eighths (⅜), preferably seven-sixteenths (7/16) inch, wrought iron or steel, with a link on the brake-rod end of not less than seven-sixteenths (7/16), preferably one-half (½) inch, wrought iron or steel, and shall be secured to brake-shaft drum by not less than one-half (½) inch hexagon or square-headed bolt. Nut on said bolt shall be secured by riveting end of bolt over nut. (See Plate A.)

Lower end of brake shaft shall be provided with a trunnion of not less than three-fourths (¾), preferably one (1), inch in diameter, extending through brake-shaft step and held in operating position by a suitable cotter or ring. (See Plate A.)

Brake-shaft drum shall be not less than one and one-half (1½) inches in diameter. (See Plate A.)

Brake ratchet wheel shall be secured to brake shaft by a key or square fit; said square fit shall be not less than one and five-sixteenths (1 5/16) inches square. When ratchet wheel with square fit is used, provision shall be made to prevent ratchet wheel from rising in shaft to disengage brake pawl. (See Plate A.)

Brake ratchet wheel shall be not less than five and one-fourth (5¼), preferably five and one-half (5½) inches in diameter and shall have not less than fourteen (14), preferably sixteen (16), teeth. (See Plate A.)

If brake ratchet wheel is more than thirty-six (36) inches from brake wheel, a brake-shaft support shall be provided to support this extended upper portion of brake shaft; said brake-shaft support shall be fastened with not less than one-half (½) inch bolts or rivets.

The brake pawl shall be pivoted upon a bolt or rivet not less than five-eighths (⅝) of an inch in diameter, or upon a trunnion secured by not less than one-half (½) inch bolt or rivet, and there shall be a rigid metal connection between brake shaft and pivot of pawl.

Brake wheel shall be held in position on brake shaft by a nut on a threaded extended end of brake shaft; said threaded portion shall be not less than three-fourths (¾) of an inch in diameter; said nut shall be secured by riveting over or by the use of a lock-nut or suitable cotter.

Brake wheel shall be arranged with a square fit for brake shaft in hub of said wheel; taper of said fit, nominally two (2) in twelve (12) inches. (See Plate A.)

BRAKE STEP

If brake step is used, it shall be not less than twenty-eight (28) inches in length. Outside edge shall be not less than eight (8) inches from face of car and not less than four (4) inches from a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill.

Manner of application.—Brake step shall be supported by not less than two metal braces having a minimum cross-sectional area three-eighths (⅜) by one and one-half (1½) inches or equivalent, which shall be securely fastened to body of car with not less than one-half (½) inch bolts or rivets.

RUNNING BOARDS

Number.—One (1) longitudinal running board.

On outside-metal-roof cars two latitudinal extensions.

Dimensions.—Longitudinal running board shall be not less than eighteen (18), preferably 20 inches in width.

Latitudinal extensions shall be not less than twenty-four (24) inches in width.

Location.—Full length of car, center of roof.

On outside-metal-roof cars there shall be two (2) latitudinal extensions from longitudinal running board to ladder locations, except on refrigerator cars where such extensions can not be applied on account of ice hatches.

Manner of application.—Running boards shall be continuous from end to end and not cut or hinged at any point: *Provided,* That the length and width of running boards may be made up of a number of pieces securely fastened to saddle blocks with screws or bolts.

The ends of longitudinal running board shall be not less than six (6) nor more than ten (10) inches from a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill; and if more than four (4) inches from edge of roof of car, shall be securely supported their full width by substantial metal braces.

Running boards shall be made of wood and securely fastened to car.

SILL STEPS

Number.—Four (4).

Dimensions.—Minimum cross-sectional area one-half (½) by one and one-half (1½) inches, or equivalent, of wrought iron or steel.

Minimum length of tread, 10 preferably 12 inches.

Minimum clear depth, eight (8) inches.

Location.—One (1) near each end on each side of car, so that there shall be not more than eighteen (18) inches from end of car to center of tread of sill step.

Outside edge of tread of step shall be not more than four (4) inches inside of face of side of car, preferably flush with side of car.

Tread shall be not more than twenty-four (24), preferably not more than twenty-two (22), inches above the top of rail.

Manner of application.—Sill steps exceeding twenty-one (21) inches in depth shall have an additional tread.

Sill steps shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than ½ inch rivets.

LADDERS

Number.—Four (4).

Dimensions.—Minimum clear length of tread: Side ladders, sixteen (16) inches; end ladders, 14 inches.

Maximum spacing between ladder treads, 19 inches.

Top ladder tread shall be located not less than twelve (12) nor more than 18 inches from roof at eaves.

Spacing of side ladder treads shall be uniform, within a limit of two (2) inches from top ladder tread to bottom tread of ladder.

Maximum distance from bottom tread of side ladder to top tread of sill step, twenty-one (21) inches.

End ladder treads shall be spaced to coincide with treads of side ladders, a variation of two (2) inches being allowed. Where construction of car will not permit the application of a tread of end ladder to coincide with

bottom tread of side ladder, the bottom tread of end ladder must coincide with second tread from bottom of side ladder.

Hardwood treads, minimum dimensions one and one-half (1½) by two (2) inches.

Iron or steel treads, minimum diameter five-eighths (⅝) of an inch.

Minimum clearance of treads, two (2), perferably two and one-half (2½), inches.

Location.—One (1) on each side, not more than eight (8) inches from right end of car; one (1) on each end, not more than eight (8) inches from left side of car; measured from inside edge of ladderstile or clearance of ladder treads to corner of car.

Manner of application.—Metal ladders without stiles near corners of cars shall have foot guards or upward projections not less than two (2) inches in height near inside end of bottom treads.

Stiles of ladders will serve as foot guards.

Ladders shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets. Three-eighths (⅜) inch bolts may be used for wooden treads which are gained into stiles.

END-LADDER CLEARANCE

No part of car above end-sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake wheel, brake step, running board or uncoupling lever shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

ROOF HANDHOLDS

Number.—One (1) over each ladder.

One (1) right-angle handhold may take the place of two (2) adjacent specified roof handholds, provided the dimensions and locations coincide, and that an extra leg is securely fastened to car at point of angle.

Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Dimensions.—Minimum clear length, sixteen (16) inches.

Minimum clearance, two (2), preferably two and one-half (2½) inches.

Location.—On roof of car: One (1) parallel to treads of each ladder, not less than eight (8), nor more than fifteen (15), inches from edge of roof, *except* on refrigerator cars where ice hatches prevent, when location may be nearer edge of roof.

Manner of application.—Roof handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Four (4).

[*Tread of side ladder is a side handhold.*]

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, sixteen (16) inches, preferably twenty-four (24) inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—Horizontal: One (1) near each end of each side of car.

Side handholds shall be not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler, *except* as provided above, where tread of ladder is a handhold. Clearance of outer end of handhold shall be not more than eight (8) inches from end of car.

Manner of application.—Side handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

HORIZONTAL END HANDHOLDS

Number—Eight (8) or more. (Four (4) on each end of car.)

[*Tread of end ladder is an end handhold.*]

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, sixteen (16) inches, preferably twenty-four (24) inches.

A handhold fourteen (14) inches in length may be used where it is impossible to use one sixteen (16) inches in length.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) near each side on each end of car, not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler *except* as provided above, when tread of end ladder is an end handhold. Clearance of outer end of handhold shall be not more than eight (8) inches from side of car.

One (1) near each side of each end of car on face of end sill or sheathing over end sill, projecting outward or downward. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

On each end of cars with platform end sills six (6) or more inches in width, measured from end post or siding and extending entirely across end of car, there shall be one additional end handhold not less than twenty-four (24) inches in length, located near center of car, nor less than thirty (30) nor more than sixty (60) inches above platform end sill.

Manner of application.—Horizontal end handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

VERTICAL END HANDHOLDS

Two (2) on full-width platform end-sill cars, as heretofore described.

Number. Dimensions. Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, eighteen (18), preferably twenty-four (24), inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) on each end of car opposite ladder, not more than eight (8) inches from side of car; clearance of bottom end of handhold shall be not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler.

Manner of application.—Vertical end-handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

UNCOUPLING-LEVERS

Number.—Two (2).

Dimensions.—Uncoupling levers may be either single or double, and of any efficient design.

Handles of uncoupling levers, *except* those shown on Plate B—Fig. 2747—or of similar designs, shall be not more than six (6) inches from sides of car.

Uncoupling levers of design shown on Plate B and of

similar designs shall conform to the following prescribed limits:

Handles shall be not more than twelve (12), preferably nine (9), inches from sides of cars. Center lift arms shall be not less than seven (7) inches long.

Center of eye at end of center lift arm shall be not more than three and one-half (3½) inches beyond center of eye of uncoupling pin of coupler when horn of coupler is against the buffer block or end sill.

Ends of handles shall extend not less than four (4) inches below bottom of end sill, or shall be so constructed as to give a minimum clearance of two (2) inches around handle. Minimum drop of handles shall be twelve (12) inches; maximum, fifteen (15) inches over all. (See Plate B.)

Handles of uncoupling levers of the "rocking" or "push-down" type shall be not less than eighteen (18) inches from top of rail when lock block has released knuckle,

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand-brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on end of car to the left of, and not more than twenty-two (22) inches from, center.

Manner of application.—Same as specified for "Box and other house cars."

BRAKE STEPS

Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars."

LADDERS

Number.—Same as specified for "Box and other house cars."

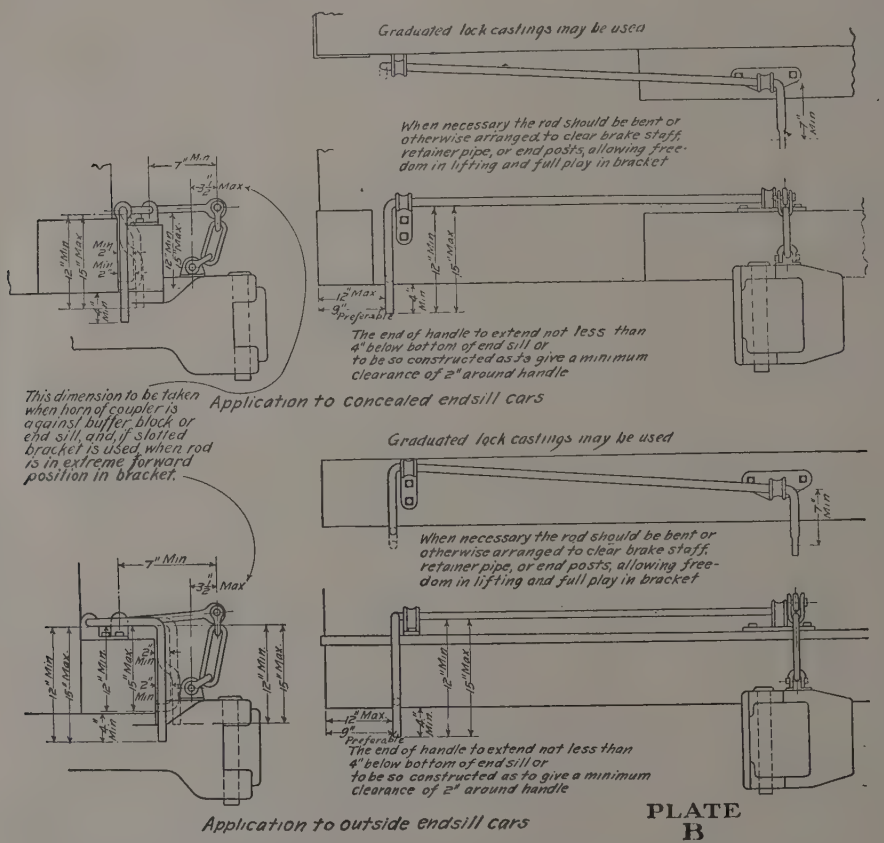

Graduated lock castings may be used
When necessary the rod should be bent or otherwise arranged to clear brake staff, retainer pipe, or end posts, allowing freedom in lifting and full play in bracket
The end of handle to extend not less than 4" below bottom of end sill or to be so constructed as to give a minimum clearance of 2" around handle
Application to concealed endsill cars
This dimension to be taken when horn of coupler is against buffer block or end sill, and if slotted bracket is used when rod is in extreme forward position in bracket.
Graduated lock castings may be used
When necessary the rod should be bent or otherwise arranged to clear brake staff, retainer pipe, or end posts, allowing freedom in lifting and full play in bracket
The end of handle to extend not less than 4" below bottom of end sill or to be so constructed as to give a minimum clearance of 2" around handle
Application to outside endsill cars
PLATE B

FIG. 2747—STANDARD SAFETY APPLIANCES. APPLICATION OF UNCOUPLING DEVICE.

and a suitable stop shall be provided to prevent inside arm from flying up in case of breakage.

One (1) on each end of car.

When single lever is used it shall be placed on left side of end of car.

Hopper Cars and High Side Gondolas with Fixed Ends

[*Cars with sides more than thirty-six* (36) *inches above the floor are high-side cars.*]

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars," *except* that top ladder tread shall be located not more than four (4) inches from top of car.

Location.—Same as specified for "Box and other house cars."

Manner of application.—Same as specified for "Box and other house cars."

SIDE HANDHOLDS

Same as specified for "Box and other house cars."

HORIZONTAL END HANDHOLDS

Same as specified for "Box and other house cars."

APPLIANCE	DIMENSIONS	PREFERABLY	MAXIMUM	MINIMUM
① SILL STEPS (LENGTH OF TREAD)	D	12"	-	10"
" " (HEIGHT ABOVE RAIL)	E	22"	24"	-
LADDERS & HANDHOLDS (CLEARANCE)	G	2½"	-	2"
* HOR. SIDE & END HANDHOLDS (LENGTH)	I	24"	-	16"
" " " " (HEIGHT)	J	-	30"	24"

① ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
* HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

ALL BOLTS & RIVETS ⅝" MIN. DIA.
BOLTS ⅝" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½".

HOPPER CARS & HIGH-SIDE GONDOLAS
WITH FIXED ENDS
(CARS WITH SIDES MORE THAN 36" ABOVE FLOOR)
PLATE E.

THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE 'A' & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE 'B' & TEXT.

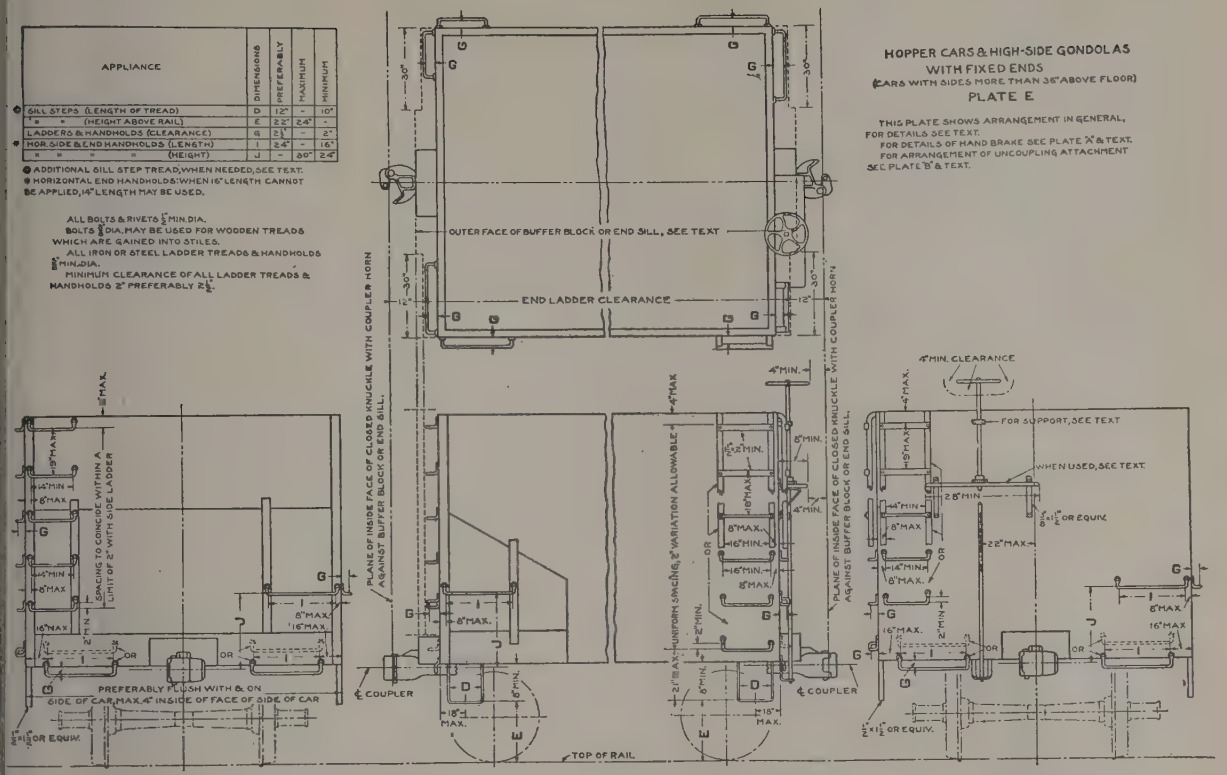

OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
SPACING TO COINCIDE WITHIN A LIMIT OF 2" WITH SIDE LADDER
UNIFORM SPACING, 2" VARIATION ALLOWABLE
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
4" MIN. CLEARANCE
FOR SUPPORT, SEE TEXT
WHEN USED, SEE TEXT
OR EQUIV.
℄ COUPLER
TOP OF RAIL

FIG. 2748—STANDARD SAFETY APPLIANCES FOR HOPPER CARS AND HIGH SIDE GONDOLAS WITH FIXED ENDS. CARS WITH SIDES MORE THAN 36 IN. ABOVE FLOOR.

APPLIANCE	DIMENSIONS	PREFERABLY	MAXIMUM	MINIMUM
① SILL STEPS (LENGTH OF TREAD)	D	12"	-	10"
" " (HEIGHT ABOVE RAIL)	E	22"	24"	-
LADDERS & HANDHOLDS (CLEARANCE)	G	2½"	-	2"
* HOR. SIDE & END HANDHOLDS (LENGTH)	I	24"	-	16"
HOR. & VERT. SIDE & END HANDHOLDS (HEIGHT)	J	-	30"	24"
ADDITIONAL HOR. END HANDHOLDS "	K	-	60"	30"
VERTICAL END HANDHOLDS (LENGTH)	L	24"	-	18"

① ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
* HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

ALL BOLTS & RIVETS ⅝" MIN. DIA.
BOLTS ⅝" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ⅝" MIN. DIA.
MIN. CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½".

HOPPER CARS & HIGH-SIDE GONDOLAS
WITH FIXED ENDS
(CARS WITH SIDES MORE THAN 36" ABOVE FLOOR)
(WITH PLATFORM END SILLS)
PLATE F.

THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE 'A' & TEXT
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE 'B' & TEXT.

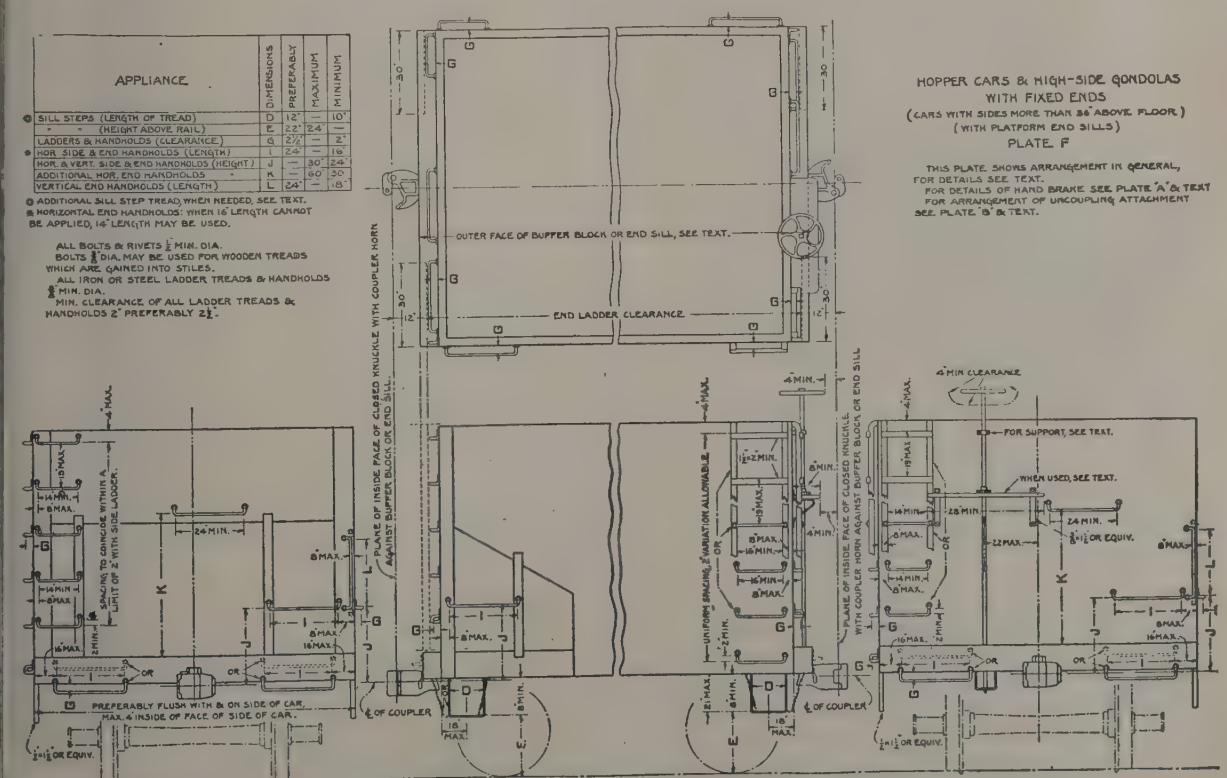

OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT.
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
SPACING TO COINCIDE WITHIN A LIMIT OF 2" WITH SIDE LADDER.
UNIFORM SPACING, 2" VARIATION ALLOWABLE
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR.
4" MIN CLEARANCE
FOR SUPPORT, SEE TEXT.
WHEN USED, SEE TEXT.
OR EQUIV.
℄ OF COUPLER

FIG. 2749—STANDARD SAFETY APPLIANCES FOR HOPPER CARS AND HIGH SIDE GONDOLAS WITH FIXED ENDS. CARS WITH SIDES MORE THAN 36 IN. ABOVE FLOOR. (WITH PLATFORM END SILLS.)

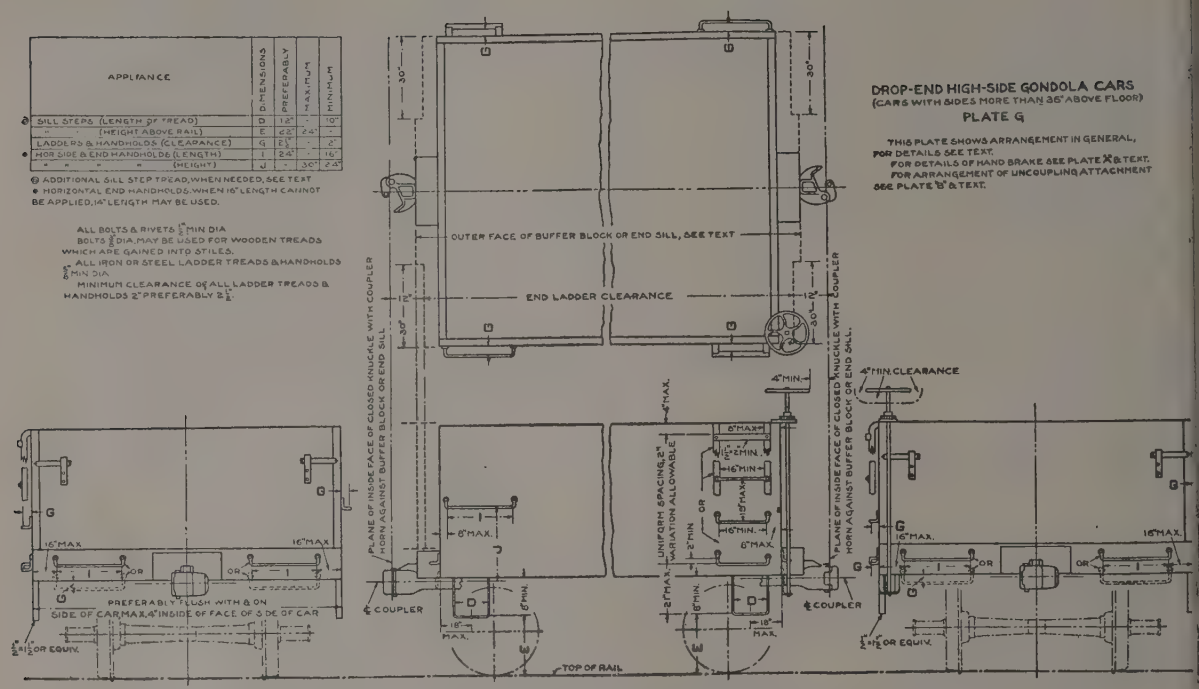

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD)
(HEIGHT ABOVE RAIL)
LADDERS & HANDHOLDS (CLEARANCE)
HOR. SIDE & END HANDHOLDS (LENGTH)
(HEIGHT)
ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT
HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
ALL BOLTS & RIVETS 5/8" MIN DIA
BOLTS 5/8" DIA MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS 5/8" MIN DIA
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2 1/2"
DROP-END HIGH-SIDE GONDOLA CARS
(CARS WITH SIDES MORE THAN 36" ABOVE FLOOR)
PLATE G
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE K & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE B & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
4" MIN CLEARANCE
UNIFORM SPACING, 2" VARIATION ALLOWABLE
PREFERABLY FLUSH WITH SIDE OF CAR MAX. 4" INSIDE OF FACE OF SIDE OF CAR
COUPLER
TOP OF RAIL

FIG. 2750—STANDARD SAFETY APPLIANCES FOR DROP END HIGH SIDE GONDOLA CARS. CARS WITH SIDES MORE THAN 36 IN. ABOVE FLOOR.

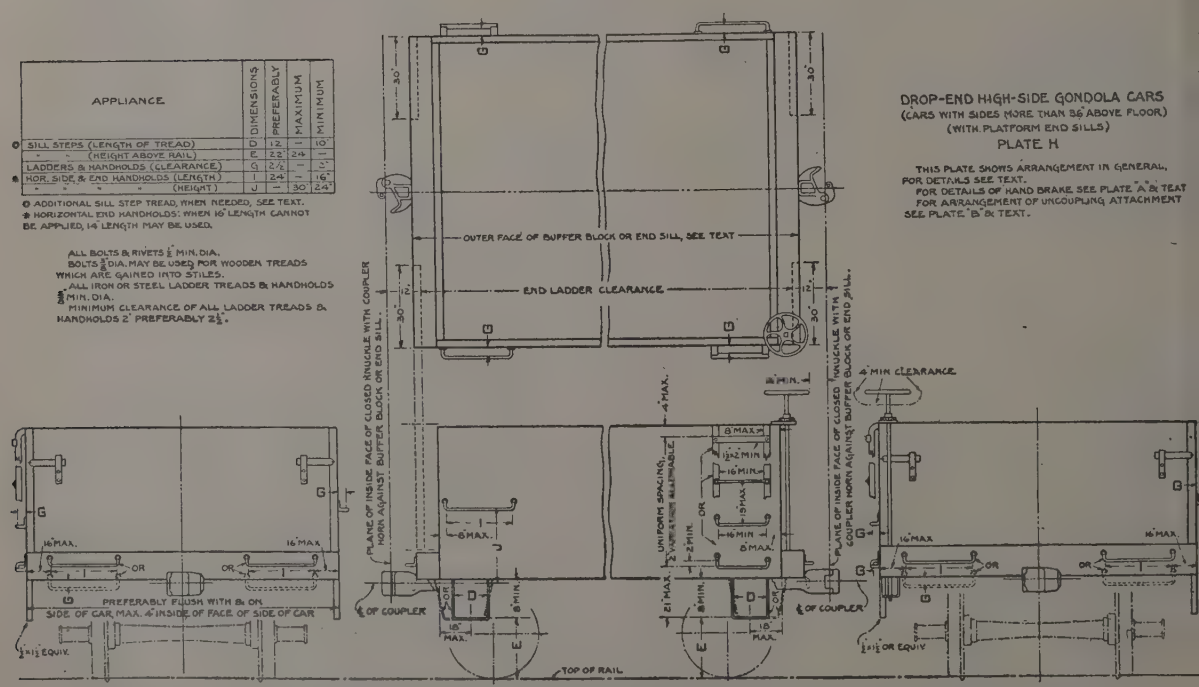

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD)
(HEIGHT ABOVE RAIL)
LADDERS & HANDHOLDS (CLEARANCE)
HOR. SIDE & END HANDHOLDS (LENGTH)
(HEIGHT)
ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
ALL BOLTS & RIVETS 5/8" MIN. DIA.
BOLTS 5/8" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS 5/8" MIN. DIA.
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2 1/2".
DROP-END HIGH-SIDE GONDOLA CARS
(CARS WITH SIDES MORE THAN 36" ABOVE FLOOR)
(WITH PLATFORM END SILLS)
PLATE H
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE A & TEXT
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE B & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
4" MIN CLEARANCE
UNIFORM SPACING, 2" VARIATION ALLOWABLE
PREFERABLY FLUSH WITH SIDE OF CAR MAX. 4" INSIDE OF FACE OF SIDE OF CAR
COUPLER
TOP OF RAIL

FIG. 2751—STANDARD SAFETY APPLIANCES FOR DROP END HIGH SIDE GONDOLA CARS. CARS WITH SIDES MORE THAN 36 IN. ABOVE FLOOR. WITH PLATFORM AND SILLS.

VERTICAL END HANDHOLDS

Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake wheel, brake step or uncoupling lever shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

Drop End High Side Gondola Cars

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars."

LADDERS

Number.—Two (2).

Dimensions.—Same as specified for "Box and other house cars," *except* that top ladder tread shall be located not more than four (4) inches from top of car.

Location.—One (1) on each side, not more than eight (8) inches from right end of car, measured from inside edge of ladder stile or clearance of ladder treads to corner of car.

Manner of application.—Same as specified for "Box and other house cars."

SIDE-HANDHOLDS

Same as specified for "Box and other house cars."

HORIZONTAL END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—One (1) near each side of each end of car on face of end sill. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake wheel or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills other than exceptions herein noted, shall extend beyond the outer face of buffer block.

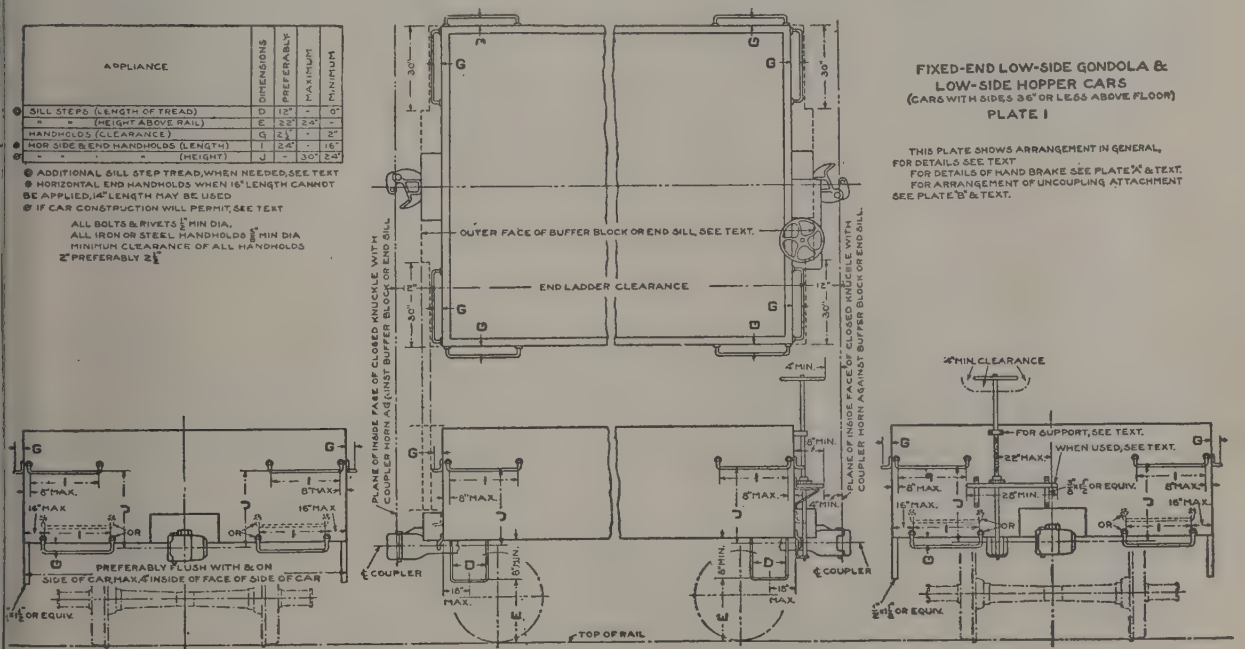

APPLIANCE
DIMENSIONS
PREFERABLY MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" - 9"
" " (HEIGHT ABOVE RAIL) E 22" 24" -
HANDHOLDS (CLEARANCE) G 2½" - 2"
HOR SIDE & END HANDHOLDS (LENGTH) I 24" - 16"
" " " " (HEIGHT) J - 30" 24"
① ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT
② HORIZONTAL END HANDHOLDS WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED
③ IF CAR CONSTRUCTION WILL PERMIT, SEE TEXT
ALL BOLTS & RIVETS ⅝" MIN DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN DIA
MINIMUM CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½"
FIXED-END LOW-SIDE GONDOLA & LOW-SIDE HOPPER CARS
(CARS WITH SIDES 36" OR LESS ABOVE FLOOR)
PLATE I
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT.
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
4" MIN. CLEARANCE
FOR SUPPORT, SEE TEXT.
WHEN USED, SEE TEXT.
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
COUPLER
TOP OF RAIL

FIG. 2752—STANDARD SAFETY APPLIANCES FOR FIXED END LOW SIDE GONDOLA AND LOW SIDE HOPPER CARS. CARS WITH SIDES 36 IN. OR LESS ABOVE FLOOR.

Fixed End Low Side Gondola and Low Side Hopper Cars

[*Cars with sides thirty-six* (36) *inches or less above the floor are low-side cars.*]

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on end of car, to the left of and not more than twenty-two (22) inches from center.

Manner of application.—Same as specified for "Box and other house cars."

BRAKE STEP

Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars."

SIDE HANDHOLDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each end on each side of car, not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler, if car construction will permit, but handhold shall not project above top of side. Clearance of outer end of handhold shall be not more than eight (8) inches from end of car.

Manner of application.—Same as specified for "Box and other house cars."

HORIZONTAL END HANDHOLDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—One (1) near each side on each end of car not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler, if car construction will permit. Clearance of outer end of handhold shall be not more than eight (8) inches from side of car.

One (1) near each side of each end of car on face of end sill, projecting outward or downward. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake-step, brake wheel or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

Drop End Low Side Gondola Cars

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

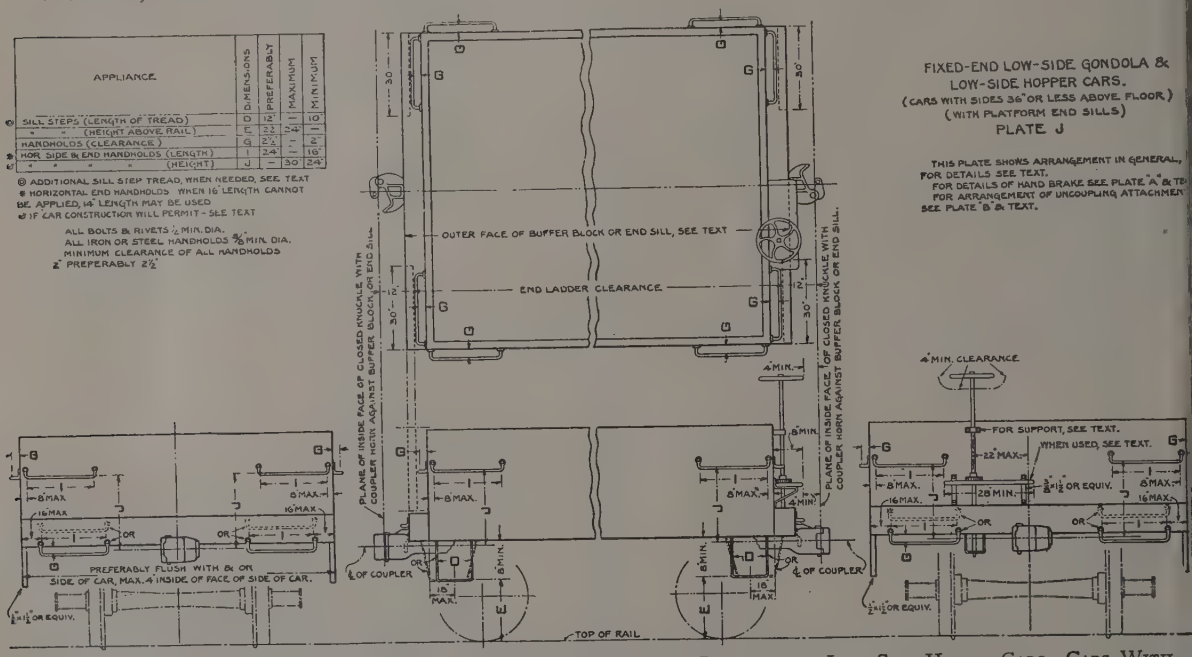

APPLIANCE
DIMENSIONS
PREFERABLY MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD)
(HEIGHT ABOVE RAIL)
HANDHOLDS (CLEARANCE)
HOR. SIDE & END HANDHOLDS (LENGTH)
(HEIGHT)
ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT
HORIZONTAL END HANDHOLDS WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED
IF CAR CONSTRUCTION WILL PERMIT - SEE TEXT
ALL BOLTS & RIVETS ½" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½"
FIXED-END LOW-SIDE GONDOLA & LOW-SIDE HOPPER CARS.
(CARS WITH SIDES 36" OR LESS ABOVE FLOOR)
(WITH PLATFORM END SILLS)
PLATE J
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TE-
FOR ARRANGEMENT OF UNCOUPLING ATTACHMEN SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
PREFERABLY FLUSH WITH SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR.
¼ OF COUPLER
TOP OF RAIL
FOR SUPPORT, SEE TEXT.
WHEN USED, SEE TEXT.

FIG. 2753—STANDARD SAFETY APPLIANCES FOR FIXED END LOW SIDE GONDOLA AND LOW SIDE HOPPER CARS. CARS WITH SIDES 36 IN. OR LESS ABOVE FLOOR. WITH PLATFORM END SILLS.

Dimensions—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars"; provided that top brake shaft support may be omitted.

SILL STEPS

Same as specified for "Box and other house cars."

SIDE HANDHOLDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each end of each

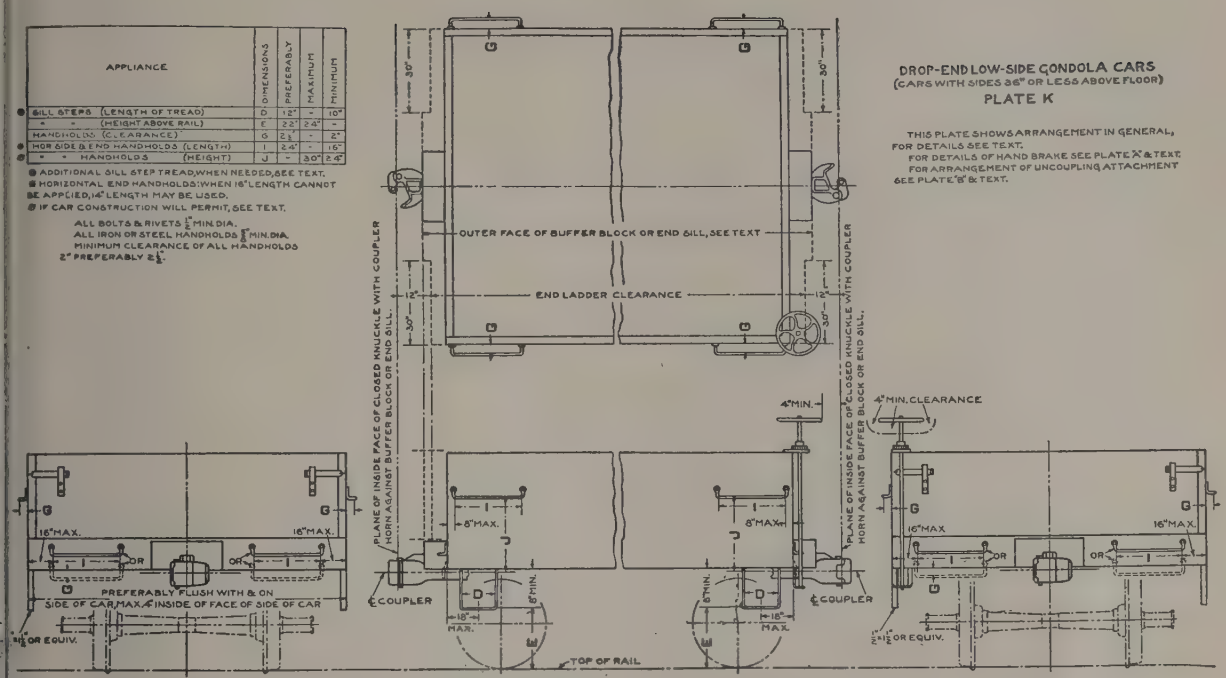

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" - 10"
" " (HEIGHT ABOVE RAIL) E 22" 24" -
HANDHOLDS (CLEARANCE) G 2½" - 2"
HOR. SIDE & END HANDHOLDS (LENGTH) I 24" - 16"
" " HANDHOLDS (HEIGHT) J - 30" 24"
● ADDITIONAL SILL STEP TREAD WHEN NEEDED, SEE TEXT.
✱ HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
◉ IF CAR CONSTRUCTION WILL PERMIT, SEE TEXT.
ALL BOLTS & RIVETS ⅝" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½".
DROP-END LOW-SIDE GONDOLA CARS
(CARS WITH SIDES 36" OR LESS ABOVE FLOOR)
PLATE K
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
4" MIN.
4" MIN. CLEARANCE
16" MAX.
8" MAX.
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
¾" x 1½" OR EQUIV.
℄ COUPLER
8" MIN.
18" MAX.
TOP OF RAIL

FIG. 2754—STANDARD SAFETY APPLIANCES FOR DROP END LOW SIDE GONDOLA CARS. CARS WITH SIDES 36 IN. OR LESS ABOVE FLOOR.

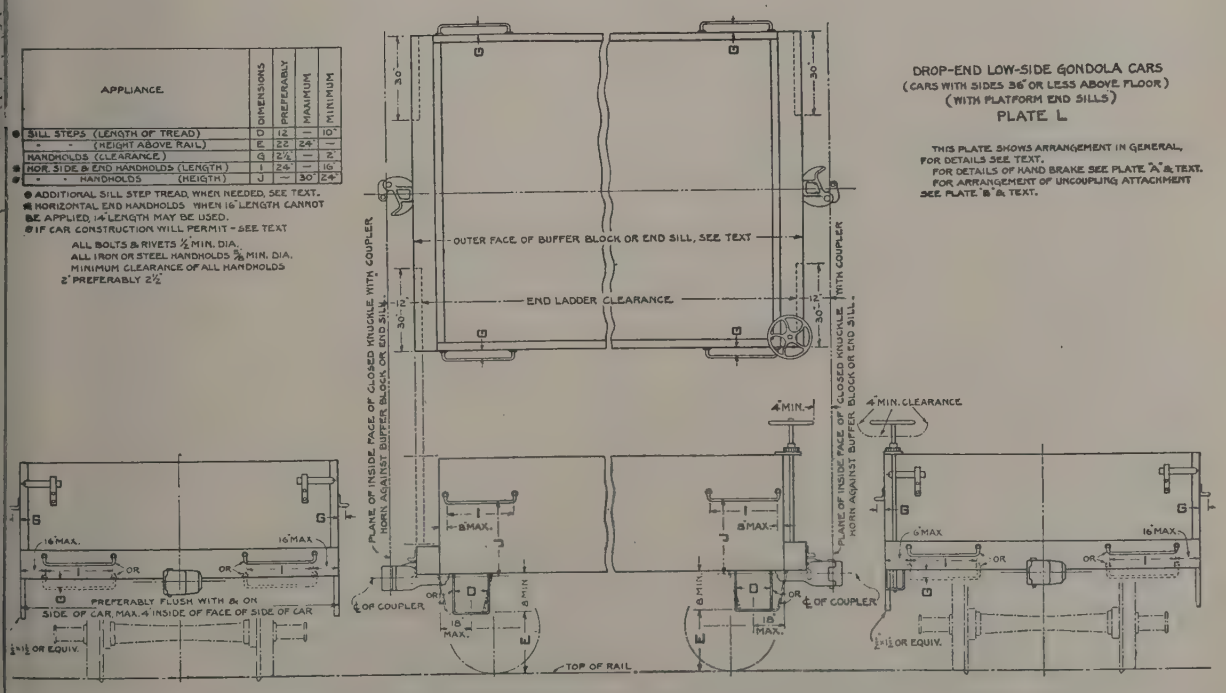

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12 — 10"
" " (HEIGHT ABOVE RAIL) E 22 24" —
HANDHOLDS (CLEARANCE) G 2½ — 2"
HOR. SIDE & END HANDHOLDS (LENGTH) I 24" — 16"
" " HANDHOLDS (HEIGHT) J — 30" 24"
● ADDITIONAL SILL STEP TREAD WHEN NEEDED, SEE TEXT.
✱ HORIZONTAL END HANDHOLDS WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
◉ IF CAR CONSTRUCTION WILL PERMIT - SEE TEXT
ALL BOLTS & RIVETS ½" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½"
DROP-END LOW-SIDE GONDOLA CARS
(CARS WITH SIDES 36" OR LESS ABOVE FLOOR)
(WITH PLATFORM END SILLS)
PLATE L
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
4" MIN.
4" MIN. CLEARANCE
16" MAX.
8" MAX.
6" MAX.
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
¾" x 1½" OR EQUIV.
℄ OF COUPLER
8" MIN.
18" MAX.
TOP OF RAIL

FIG. 2755—STANDARD SAFETY APPLIANCES FOR DROP END LOW SIDE GONDOLA CARS. CARS WITH SIDES 36 IN. OR LESS ABOVE FLOOR. WITH PLATFORM END SILLS.

side of car, not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler, if car construction will permit, but handhold shall not project above top of side. Clearance of outer end of handhold shall be not more than eight (8) inches from end of car.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each end of car on face of end sill. Clearance of outer end of handhold shall not be more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake wheel or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

Flat Cars

[*Cars with sides twelve* (12) *inches or less above the floor may be equipped the same as flat cars.*]

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on the end of car to the left of center, or on side of car not more than thirty-six (36) inches from right hand end thereof.

Manner of application.—Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars."

SIDE HANDHOLDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) on face of each side sill near each end. Clearance of outer end of handhold shall be not more than twelve (12) inches from end of car.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each side of each end of car on face of end sill. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

Tank Cars with Side Platforms

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars.

SIDE HANDHOLDS

Number.—Four (4) or more.

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) on face of each side sill near each end. Clearance of outer end of handhold shall be not more than twelve (12) inches from end of car.

If side safety railings are attached to tank bands, four (4) additional vertical handholds shall be applied, one (1) as nearly as possible over each sill step and securely fastened to tank or tank band.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each side of each end of car on face of end sill. Clearance of outer end of handhold not more than (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

TANK-HEAD HANDHOLDS

Number.—Two (2). [*Not required if safety railing runs around ends of tank.*]

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel. Minimum clearance, two (2), preferably two and one-half (2½), inches. Clear length of handholds shall extend to within six (6) inches of outer diameter of tank at point of application.

Location.—Horizontal: One (1) across each head of tank, not less than thirty (30) nor more than sixty (60) inches above platform.

Manner of application.—Tank-head handholds shall be securely fastened.

SAFETY RAILINGS

Number.—One (1) continuous safety railing running around sides and ends of tank, securely fastened to tank or tank bands at ends and sides of tank; or two (2) running full length of tank at sides, supported by posts.

Dimensions.—Not less than three-fourths (¾) iron.

Location.—Running full length of tank, either at side supported by posts or securely fastened to tank or tank bands, not less than thirty (30) nor more than sixty (60) inches above platform.

Manner of application.—Safety railings shall be securely fastened to tank body, tank bands or posts.

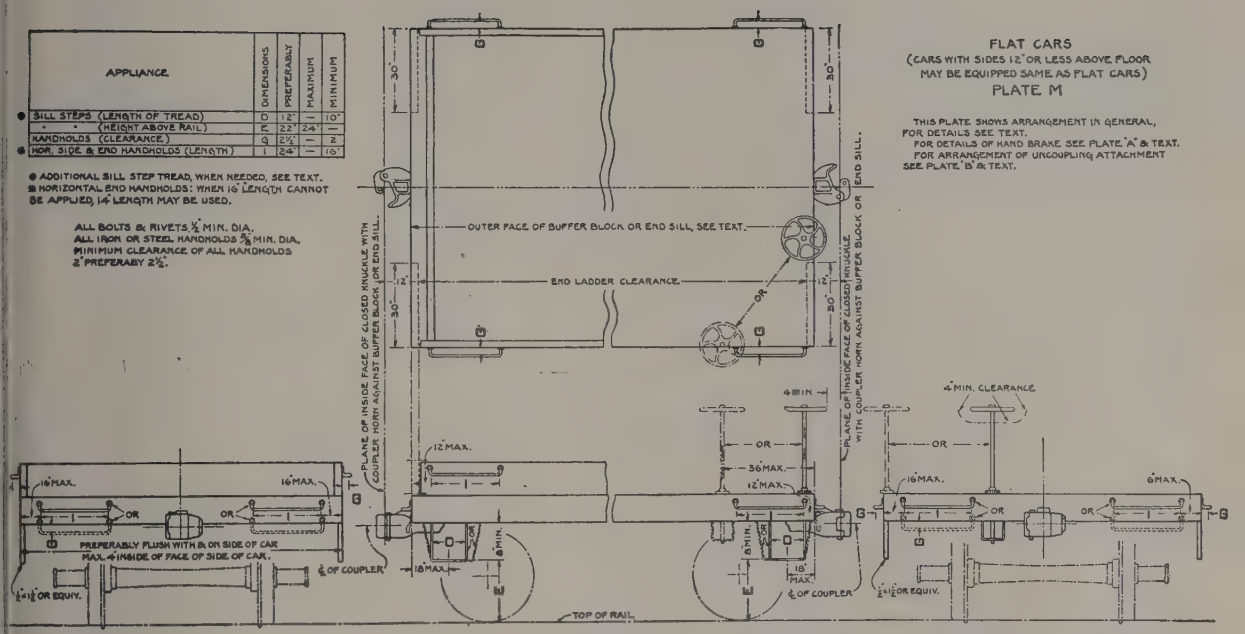

APPLIANCE
DIMENSIONS
PREFERABLY MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" — 10"
" " (HEIGHT ABOVE RAIL) E 22" 24" — 11"
HANDHOLDS (CLEARANCE) G 2½" — 2"
HOR. SIDE & END HANDHOLDS (LENGTH) I 24" — 16"
● ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
■ HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
ALL BOLTS & RIVETS ½" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½".
FLAT CARS
(CARS WITH SIDES 12" OR LESS ABOVE FLOOR MAY BE EQUIPPED SAME AS FLAT CARS)
PLATE M
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT.
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
PREFERABLY FLUSH WITH & ON SIDE OF CAR
MAX. 4" INSIDE OF FACE OF SIDE OF CAR.
℄ OF COUPLER
TOP OF RAIL
OR
4" MIN. CLEARANCE.
16" MAX.
6" MAX.
12" MAX.
36" MAX.
8" MIN.
18" MAX.
2½" OR EQUIV.

FIG. 2756—STANDARD SAFETY APPLIANCES FOR FLAT CARS. CARS WITH SIDES 12 IN. OR LESS ABOVE FLOOR MAY BE EQUIPPED SAME AS FLAT CARS.

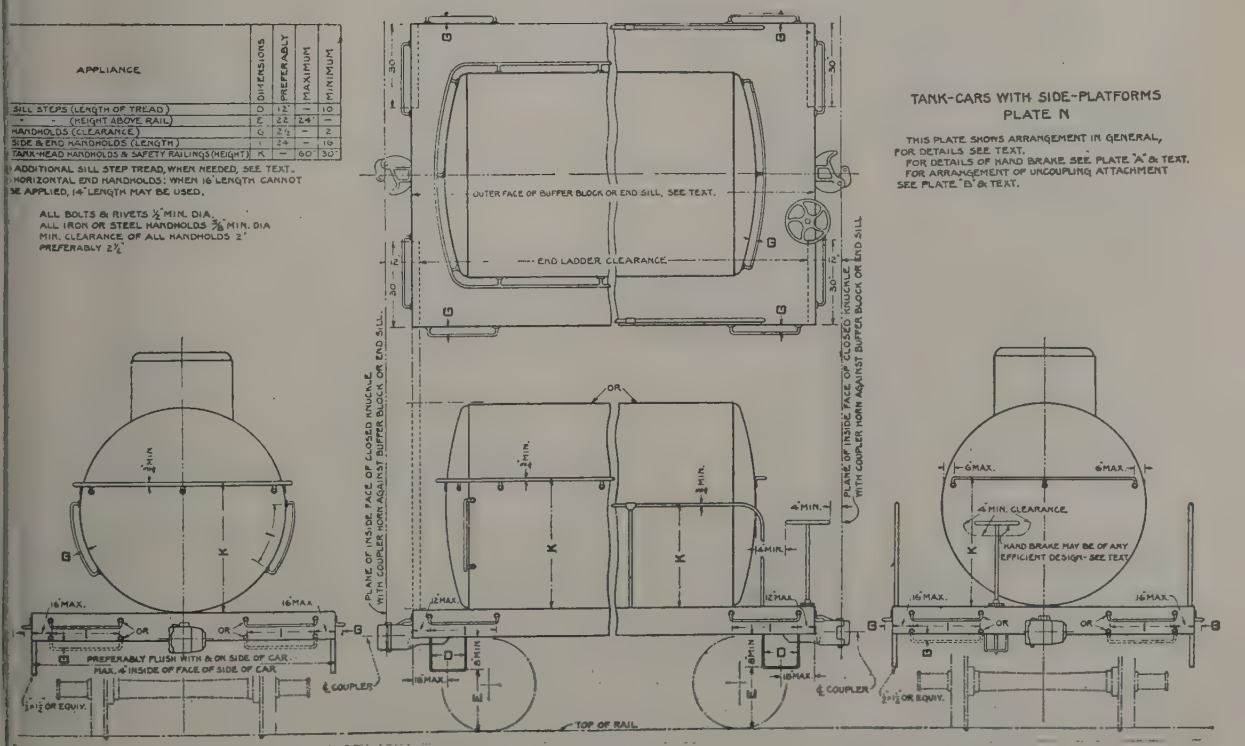

APPLIANCE
DIMENSIONS
PREFERABLY MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" — 10"
" " (HEIGHT ABOVE RAIL) E 22" 24" — 11"
HANDHOLDS (CLEARANCE) G 2½" — 2"
SIDE & END HANDHOLDS (LENGTH) — 24" — 16"
TANK-HEAD HANDHOLDS & SAFETY RAILINGS (HEIGHT) K — 60" 30"
ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
ALL BOLTS & RIVETS ½" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA
MIN. CLEARANCE OF ALL HANDHOLDS 2" PREFERABLY 2½"
TANK-CARS WITH SIDE-PLATFORMS
PLATE N
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE "A" & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE "B" & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT.
END LADDER CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL
PREFERABLY FLUSH WITH & ON SIDE OF CAR
MAX. 4" INSIDE OF FACE OF SIDE OF CAR
℄ COUPLER
TOP OF RAIL
OR
HAND BRAKE MAY BE OF ANY EFFICIENT DESIGN- SEE TEXT.
16" MAX.
6" MAX.
12" MAX.
8" MIN.
18" MAX.
2½" OR EQUIV.

FIG. 2757—STANDARD SAFETY APPLIANCES FOR TANK CARS WITH SIDE PLATFORMS.

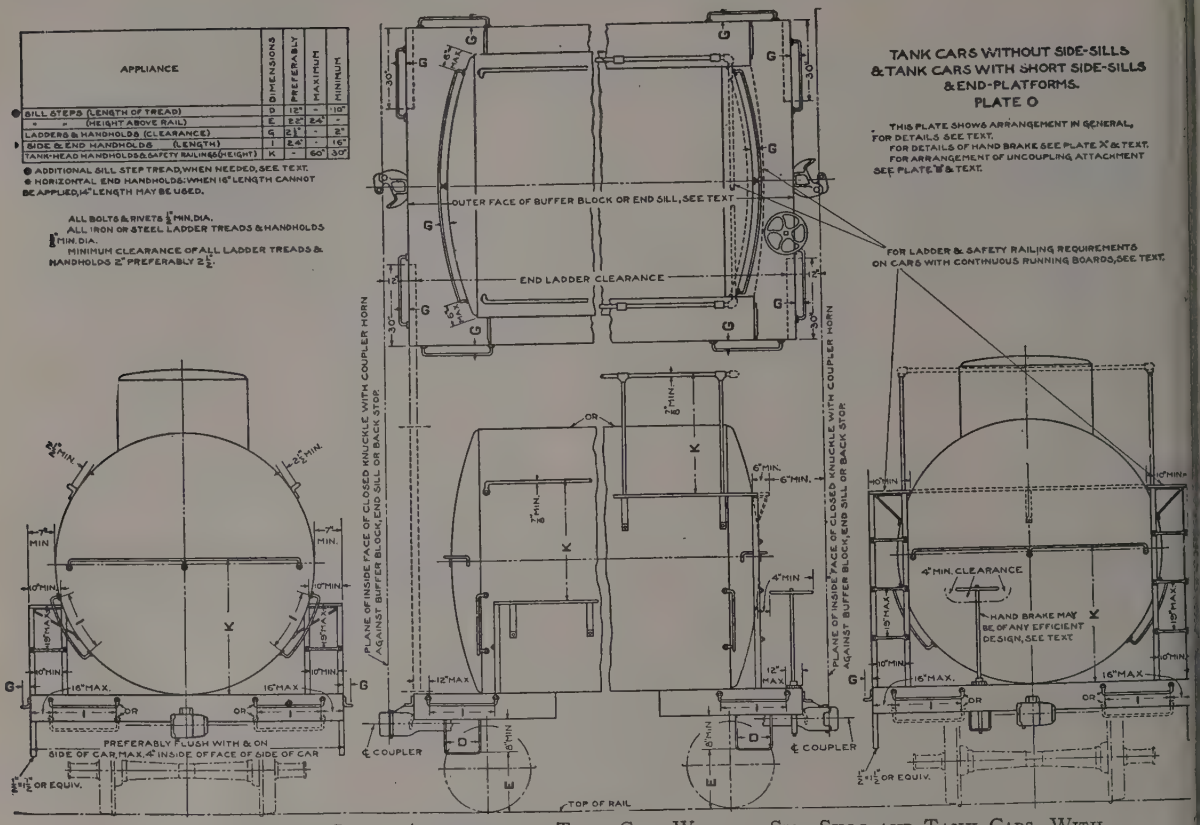

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" - 10"
" " (HEIGHT ABOVE RAIL) E 22" 24" -
LADDERS & HANDHOLDS (CLEARANCE) G 2½" - 2"
SIDE & END HANDHOLDS (LENGTH) I 24" - 16"
TANK-HEAD HANDHOLDS & SAFETY RAILINGS (HEIGHT) K - 60" 30"
● ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
● HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.
ALL BOLTS & RIVETS ⅝" MIN. DIA.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½".
TANK CARS WITHOUT SIDE-SILLS & TANK CARS WITH SHORT SIDE-SILLS & END-PLATFORMS.
PLATE O
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE X & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE B & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
FOR LADDER & SAFETY RAILING REQUIREMENTS ON CARS WITH CONTINUOUS RUNNING BOARDS, SEE TEXT.
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK, END SILL OR BACK STOP
4" MIN. CLEARANCE
HAND BRAKE MAY BE OF ANY EFFICIENT DESIGN, SEE TEXT
PREFERABLY FLUSH WITH & ON SIDE OF CAR, MAX. 4" INSIDE OF FACE OF SIDE OF CAR
COUPLER
TOP OF RAIL
OR EQUIV.

FIG. 2758—STANDARD SAFETY APPLIANCES FOR TANK CARS WITHOUT SIDE SILLS AND TANK CARS, WITH SHORT SIDE SILLS AND END PLATFORMS.

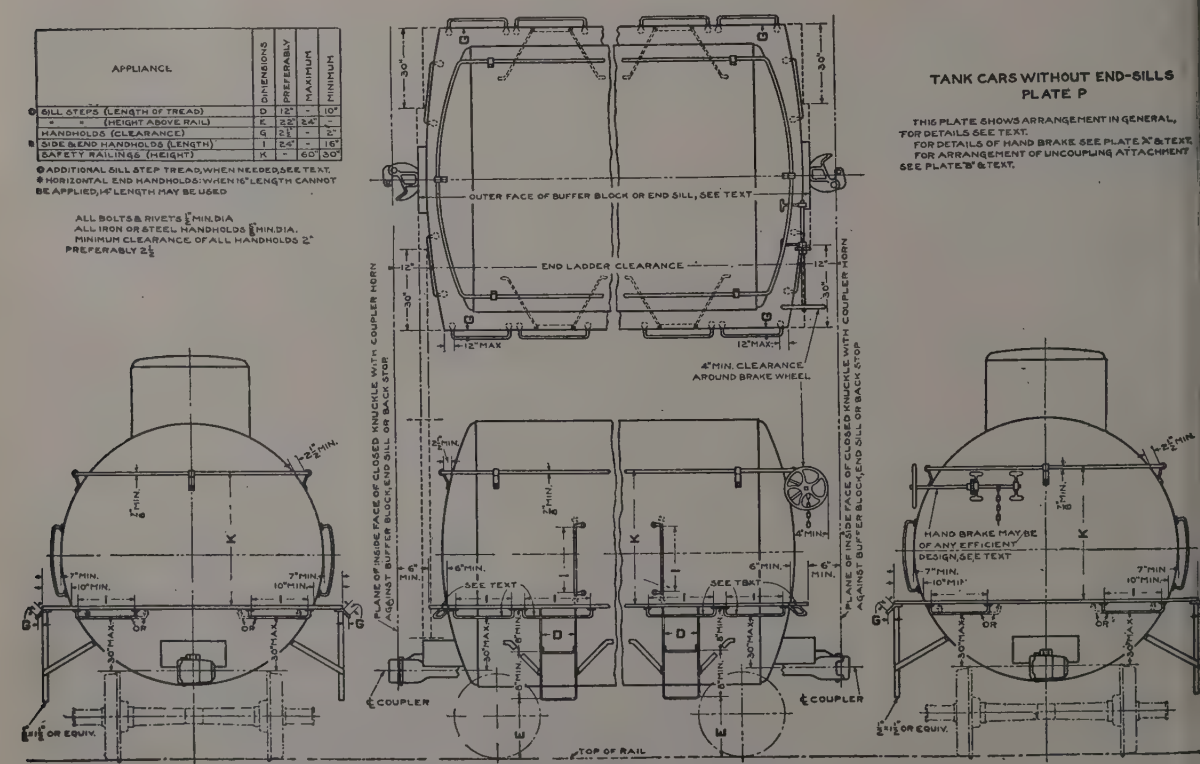

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
SILL STEPS (LENGTH OF TREAD) D 12" - 10"
" " (HEIGHT ABOVE RAIL) E 22" 24" -
HANDHOLDS (CLEARANCE) G 2½" - 2"
SIDE & END HANDHOLDS (LENGTH) I 24" - 16"
SAFETY RAILINGS (HEIGHT) K - 60" 30"
● ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
● HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED
ALL BOLTS & RIVETS ⅝" MIN. DIA
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MINIMUM CLEARANCE OF ALL HANDHOLDS 2"
PREFERABLY 2½"
TANK CARS WITHOUT END-SILLS
PLATE P
THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE X & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE B & TEXT.
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
4" MIN. CLEARANCE AROUND BRAKE WHEEL
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK, END SILL OR BACK STOP
HAND BRAKE MAY BE OF ANY EFFICIENT DESIGN, SEE TEXT
SEE TEXT
COUPLER
TOP OF RAIL
OR EQUIV.

FIG. 2759—STANDARD SAFETY APPLIANCES FOR TANK CARS WITHOUT END SILLS.

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake-shaft brackets, brake wheel or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

Tank Cars Without Side Sills and Tank Cars with Short Side Sills and End Platforms

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safetly operated while car is in motion.

The brake shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

RUNNING BOARDS

Number.—One (1) continuous running board around sides and ends; or two (2) running full length of tank, one (1) on each side.

Dimensions.—Minimum width on sides, ten (10) inches. Minimum width on ends, six (6) inches.

Location.—Continuous around sides and ends of cars. On tank cars having end platforms extending to bolsters, running boards shall extend from center to center of bolsters, one (1) on each side.

Manner of application.—If side running boards are applied below center of tank, outside edge of running boards shall extend not less than seven (7) inches beyond bulge of tank.

The running boards at ends of car shall be not less than six (6) inches from a point vertically above the inside face of knuckle when closed with coupler horn against the buffer block, end sill or backstop.

Running boards shall be securely fastened to tank or tank bands.

SILL STEPS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—One (1) near each end of each side under side handhold.

Outside edge of tread of step shall be not more than four (4) inches inside of face of side of car, preferably flush with side of car.

Tread shall be not more than twenty-four (24), preferably not more than twenty-two (22), inches above the top of rail.

Manner of application.—Same as specified for "Box and other house cars."

LADDERS

[*If running boards are so located as to make ladders necessary.*]

Number.—Two (2) on cars with continuous running-boards.

Four (4) on cars with side running boards.

Dimensions.—Minimum clear length of tread, ten (10) inches.

Maximum spacing of treads, nineteen (19) inches.

Hardwood treads, minimum dimensions one and one-half (1½) by two (2) inches.

Wrought-iron or steel treads, minimum diameter five-eighths (⅝) of an inch.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—On cars with continuous running boards, one (1) at right end of each side.

On cars with side running boards, one (1) at each end of each running board.

Manner of application.—Ladders shall be securely fastened with not less than one-half (½) inch bolts or rivets.

SIDE HANDHOLDS

Number.—Four (4) or more.

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) on face of each side-sill near each end on tank cars with short side sills, or one (1) attached to top of running board projecting outward above sill steps or ladders on tank cars without side sills. Clearance of outer end of handhold shall be not more than twelve (12) inches from end of car.

If side safety railings are attached to tank or tank bands four (4) additional vertical handholds shall be applied, one (1) over each sill step and securely fastened to tank or tank bands.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each side of each end of car on face of end sill. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and other house cars."

TANK-HEAD HANDHOLDS

Number.—Two (2). [*Not required if safety railing runs around ends of tank.*]

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—Horizontal: One (1) across each head of tank, not less than thirty (30) nor more than sixty (60) inches above platform on running board. Clear length of handholds shall extend to within six (6) inches of outer diameter of tank at point of application.

Manner of application.—Tank-head handholds shall be securely fastened.

SAFETY RAILINGS

Number.—One (1) running around sides and ends of tank, or two (2) running full length of tank.

Dimensions.—Minimum diameter, seven-eighths (⅞) of an inch, wrought iron or steel.

Minimum clearance, two and one-half (2½) inches.

Location.—Running full length of tank, not less than thirty (30) nor more than sixty (60) inches above platform or running board.

Manner of application.—Safety railings shall be securely fastened to tank or tank bands and secured against end-shifting.

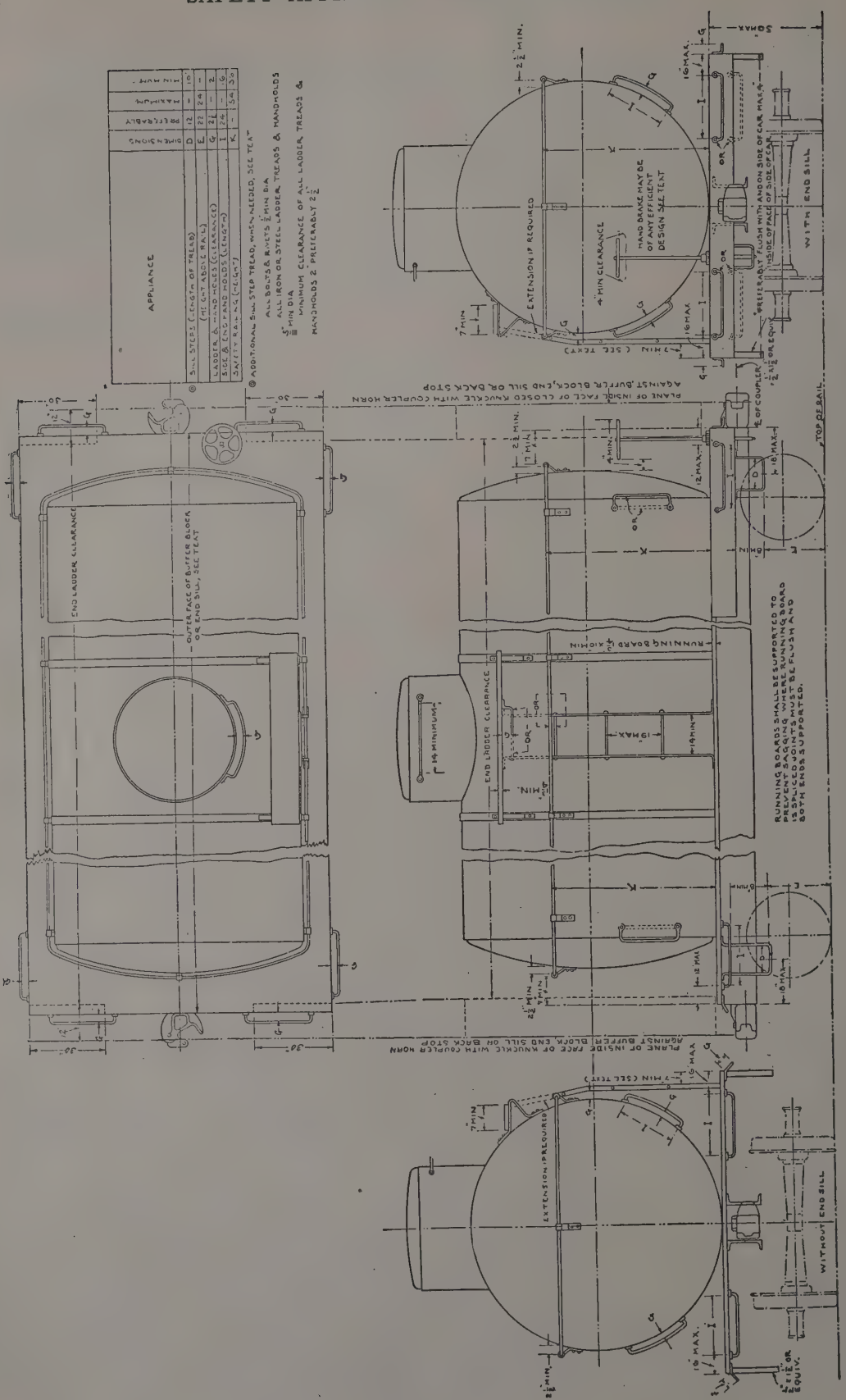

APPLIANCE
DIMENSIONS
PREFERABLY
MAXIMUM
MINIMUM
STEPS (LENGTH OF TREAD)
LADDER & HAND HOLES (CLEARANCE)
SIDE & END HAND HOLDS (LENGTH)
SAFETY RAILING (LENGTH)
ALL BOLTS & RIVETS ⅝" MIN DIA
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS
⅝" MIN DIA
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2 PREFERABLY 2½
WITH END SILL
WITHOUT END SILL
END LADDER CLEARANCE
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
RUNNING BOARD
EXTENSION IF REQUIRED
HAND BRAKE MAY BE OF ANY EFFICIENT DESIGN SEE TEXT
4" MIN CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK, END SILL OR BACK STOP
PLANE OF INSIDE FACE OF KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK END SILL OR BACK STOP
STOP PEDAL
RUNNING BOARDS SHALL BE SUPPORTED TO PREVENT SAGGING WHERE RUNNING BOARD IS NOT SUPPORTED BY FLUSH AND BOTH ENDS SUPPORTED.

FIG. 2760—STANDARD SAFETY APPLIANCES FOR TANK CARS BUILT AFTER JANUARY 1, 1917.

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake-shaft brackets, brake wheel, running boards or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same, above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

Tank Cars Without End-Sills

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion. The brake shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

BRAKE STEP

Same as specified for "Box and other house cars."

RUNNING BOARDS

Number.—One (1).

Dimensions.—Minimum width on sides, ten (10) inches. Minimum width on ends, six (6) inches.

Location.—Continuous around sides and ends of tank.

Manner of application.—If running boards are applied below center of tank, outside edge of running boards shall extend not less than seven (7) inches beyond bulge of tank.

Running boards at ends of car shall be not less than six (6) inches from a point vertically above the inside face of knuckle when closed with coupler horn against the buffer block, end sill or backstop.

Running boards shall be securely fastened to tank or tank bands.

SILL STEPS

Number.—Four (4). [*If tank has high running boards, making ladders necessary, sill steps must meet ladder requirements.*]

Dimensions.—Same as specified for "Box and other house cars."

Location.—One (1) near each end on each side, flush with outside edge of running board, as near end of car as practicable.

Tread not more than twenty-four (24) preferably not more than twenty-two (22), inches above the top of rail.

Manner of application.—Steps exceeding eighteen (18) inches in depth shall have an additional tread and be laterally braced.

Sill steps shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Four (4) or more.

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each end on each side of car over sill step, on running board, not more than two (2) inches back from outside edge of running board, projecting downward or outward.

Where such side handholds are more than eighteen (18) inches from end of car, an additional handhold must be placed near each end on each side not more than thirty (30) inches above center line of coupler.

Clearance of outer end of handhold shall be not more than twelve (12) inches from end of car.

If safety railings are on tank, four (4) additional vertical handholds shall be applied, one (1) over each sill step on tank.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each side on each end of car on running board, not more than two (2) inches back from edge of running board, projecting downward or outward, or on end of tank not more than thirty (30) inches above center line of coupler.

Manner of application.—Same as specified for "Box and other house cars."

SAFETY RAILINGS

Number.—One (1).

Dimensions.—Minimum diameter, seven-eighths (⅞) of an inch, wrought iron or steel.

Minimum clearance, two and one-half (2½) inches.

Location.—Safety railings shall be continuous around sides and ends of car, not less than thirty (30) nor more than sixty (60) inches above running board.

Manner of application.—Safety railings shall be securely fastened to tank or tank bands, and secured against end-shifting.

UNCOUPLING LEVERS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars," *except* that minimum length of uncoupling lever shall be forty-two (42) inches, measured from center line of end of car to handle of lever.

Location.—Same as specified for "Box and other house cars," *except* that uncoupling lever shall be not more than thirty (30) inches above center line of coupler.

END-LADDER CLEARANCE

No part of car above buffer block within thirty (30) inches from side of car, *except* brake shaft, brake-shaft brackets, brake wheel or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or back-stop, and no other part of end of car or fixtures on same, above buffer block, other than exceptions herein noted, shall extend beyond the face of buffer block.

Safety Appliances for Tank Cars Built After May 1, 1917

All tank cars built after May 1, 1917, or old tanks placed on new steel underframes after that date, must be equipped with safety appliances in accordance with the following specifications and Fig. 7. This arrangement conforms to the United States Safety Appliances, Standard.

END OF CAR

Shall be constructed with a platform similar to flat cars.

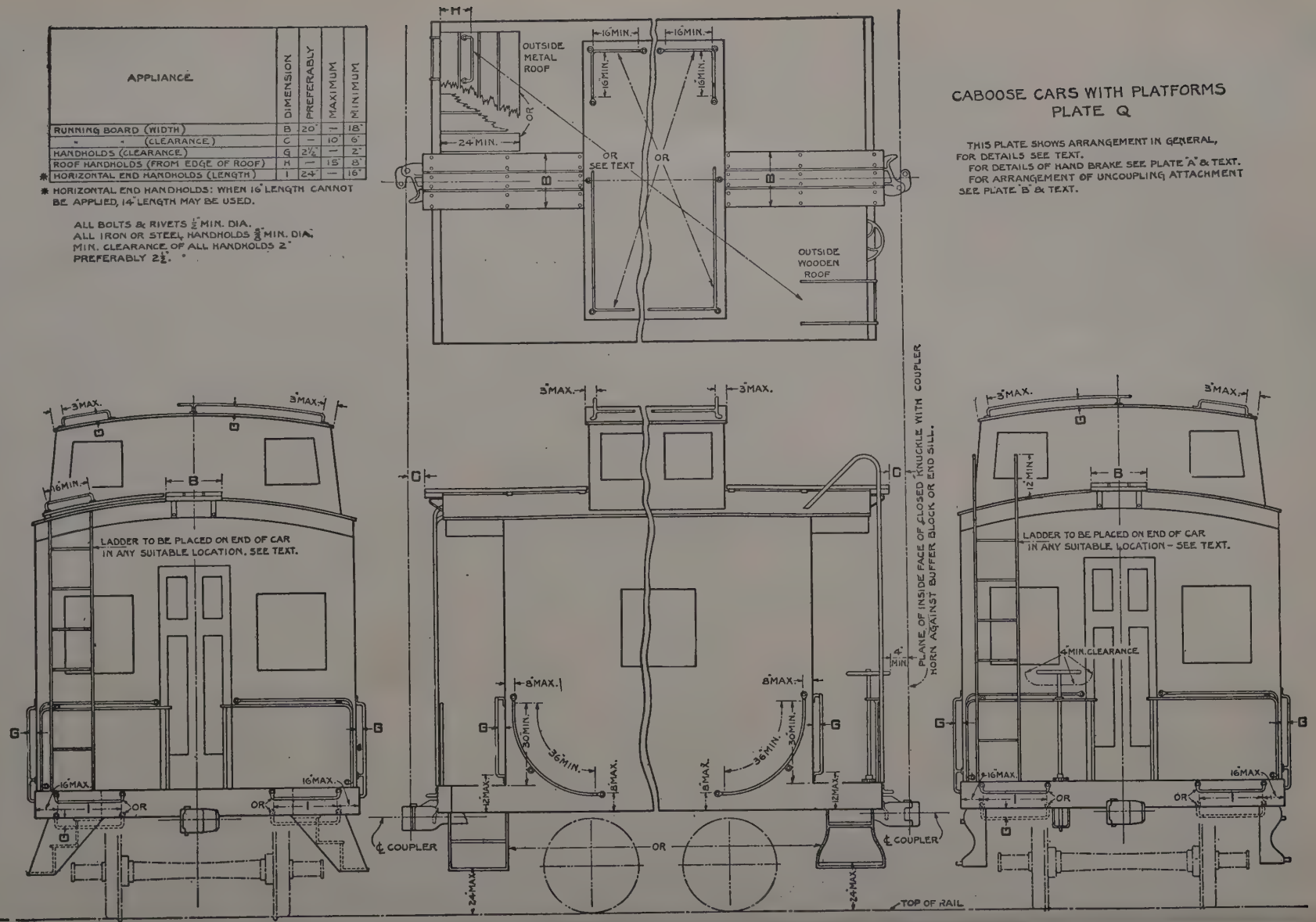
CABOOSE CARS WITH PLATFORMS
PLATE Q

THIS PLATE SHOWS ARRANGEMENT IN GENERAL, FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE 'A' & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE 'B' & TEXT.

APPLIANCE	DIMENSION	PREFERABLY	MAXIMUM	MINIMUM
RUNNING BOARD (WIDTH)	B	20"	—	18"
" " (CLEARANCE)	C	—	10"	6"
HANDHOLDS (CLEARANCE)	G	2½"	—	2"
ROOF HANDHOLDS (FROM EDGE OF ROOF)	H	—	15"	8"
* HORIZONTAL END HANDHOLDS (LENGTH)	I	24"	—	16"

* HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

ALL BOLTS & RIVETS ½" MIN. DIA.
ALL IRON OR STEEL HANDHOLDS ⅝" MIN. DIA.
MIN. CLEARANCE OF ALL HANDHOLDS 2"
PREFERABLY 2½".


OUTSIDE METAL ROOF
OUTSIDE WOODEN ROOF
OR
OR SEE TEXT
16" MIN.
24" MIN.
LADDER TO BE PLACED ON END OF CAR IN ANY SUITABLE LOCATION. SEE TEXT.
LADDER TO BE PLACED ON END OF CAR IN ANY SUITABLE LOCATION – SEE TEXT.
3" MAX.
16" MAX.
8" MAX.
30" MIN.
36" MIN.
12" MAX.
24" MAX.
4" MIN.
MIN. CLEARANCE
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
℄ COUPLER
TOP OF RAIL

Maximum height of platform from top of rail shall be fifty (50) inches.

HAND-BRAKES

Number.—Same as specified for "Box and Other House Cars."

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—Each hand-brake shall be so located that it can be safety operated while car is in motion. The brake-shaft shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and Other House Cars."

RUNNING-BOARDS

Number.—One continuous running-board around sides and ends. End platform shall form continuation of side running-board.

Dimensions.—Minimum thickness one and three-quarters (1¾) inches. Minimum width on sides, ten (10) inches.

Location.—Continuous around sides and ends of cars. End platform shall form continuation of side running-board.

Manner of application.—Outside edge of side running-board shall extend not less than seven (7) inches beyond bulge of tank, safety hand-railing and dome ladder. In case of large tanks, where road limits will not permit the clearances specified, the outer edge of running-boards shall extend not less than seven (7) inches beyond bulge of tank and the foot of ladder shall have a clearance of at least seven (7) inches from outer edge of running-board.

Outside edge of end-platform shall extend not less than seven (7) inches beyond bulge of tank-head and safety hand-railing.

Running-boards shall be supported to prevent sagging. Where running-boards are spliced, joints must be flush and both ends supported.

Running-boards shall be securely fastened to platform and running-board supports.

SILL STEPS

Number.—Same as specified for "Box and Other House Cars."

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—When located on side sill: Same as specified for "Box and Other House Cars." When located on running-board: One (1) near each end on each side, flush with outside edge of running-board, so that there shall be not more than eighteen (18) inches from end of car to center of tread of sill step. Tread shall be not more than twenty-four (24), preferably not more than twenty-two (22) inches above the top of rail.

Manner of application.—When located on side sill: Same as specified for "Box and Other House Cars." When located on running-board: Steps exceeding eighteen (18) inches in depth shall have an additional tread and be laterally braced. Sill steps shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Eight (8).

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—Four (4) horizontal: One (1) on face of each side sill near each end on tank cars with side sills; or one (1) near each end on each side of car over sill step, on running-board, projecting downward or outward. Clearance of outer end of handhold shall be not more than twelve (12) inches from end of car.

Four (4) vertical: One (1) as near as possible over each sill step, securely fastened to tank or tank band.

Manner of application.—Same as specified for "Box and Other House Cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and Other House Cars."

Location.—Horizontal: One (1) near each side of each end of car on face and end sill; or one (1) near each side on each end of car on platform, projecting downward or outward. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Same as specified for "Box and Other House Cars."

SAFETY RAILINGS

Number.—One (1) continuous running around sides and ends of tank.

Dimensions.—Minimum diameter, seven-eighths (⅞) of an inch, wrought iron or steel rod or one and one-quarter (1¼) inch pipe. Minimum clearance, two and one-half (2½) inches.

Location.—Running around sides and end of tank, not less than thirty-six (36) nor more than fifty-four (54) inches above platform or running-board.

Manner of application.—Safety-railings shall be securely fastened to tank or tank bands with a minimum of four brackets for each side of tank and one bracket on head at each end of tank, and secured against end shifting.

Uncoupling Levers.—Same as specified for "Box and Other House Cars."

End Ladder Clearance.—No part of car above end sills within thirty (30) inches from side of car, except buffer block, brake-shaft brackets, brake wheel, running-boards or uncoupling lever shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same, above end sills other than exceptions herein noted, shall extend beyond outer face of buffer block.

LADDER, DOME PLATFORM, DOME PLATFORM HANDHOLD AND DOME HANDHOLD

Number.—One (1) ladder, one (1) dome platform, one (1) dome platform handhold and one (1) dome handhold.

Dimensions.—Ladder: Ladder stiles three-eighths by two (⅜ by 2) inches or equivalent, wrought iron or steel.

Ladder treads, minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length of tread, fourteen (14) inches.

Minimum spacing of treads, nineteen (19) inches. Safety railing will be considered a ladder tread.

Minimum clearance of treads and ladder stiles, two (2), preferably two and one-half (2½) inches.

Dome Platform.—Minimum width, seven (7) inches; minimum thickness one and three-quarters (1¾) inches.

Dome Platform Brackets.—Three-eighths by one and one-half (⅜ by 1½) inches, or equivalent, wrought iron or steel.

Dome Platform and Dome Handholds.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, fourteen (14) inches, preferably sixteen (16) inches.

Minimum clearance, two (2) inches, preferably two and one-half (2½) inches.

Location.—On brake mast side of car leading to dome. When car is equipped with more than one dome, the step board shall be lengthened so that all dome covers will be accessible from same; or, ladder, dome platform and handholds provided leading to each dome.

Dome platform handhold to be applied in line with ladder, not more than two (2) inches back from outside edge of platform, projecting downward and outward with horizontal portion of handhold flush with or extending one (1) inch beyond edge of platform. Top ladder rung will be considered dome platform handhold if located within not less than two (2) or more than three (3) inches from bottom of dome platform. Dome handhold to be applied to dome over dome platform, in line with ladder.

Manner of application.—Ladders shall be securely fastened at bottom to running-board with not less than one-half (½) inch bolts with nuts underneath and riveted over, or with not less than one-half (½) inch rivets. Ladders shall be secured at top to safety railing or to under side of dome platform. If fastened to dome platform, the stiles shall be secured with not less than one-half (½) inch bolts riveted over nuts, or with one-half (½) inch rivets.

The dome platform shall be supported by wrought iron or steel brackets, which shall be securely fastened to tank or tank bands.

Dome platform handholds same as specified for "Box and Other House Cars."

Dome handholds shall be securely fastened.

NOTE.—In lieu of dome platform specified, any efficient design of platform encircling dome will be acceptable.

TANKS COVERED WITH JACKETS

On tanks covered with jackets, metal pads should be attached to the shell proper with studs or rivets, to which brackets should be fastened for securing the safety appliances attached to the tanks; or, the safety appliances (with the exception of the running-board brackets and dome-platform brackets) may be secured to the jackets reinforced with metal pads at point of attachment, which pads must extend at least two inches from center line of rivet holes.

The running-board brackets must be attached preferably to the underframe or to metal pads attached to shell proper. The dome-platform brackets must be attached to tank bands or to metal pads attached to shell proper. When the safety appliances are attached to the jacket covering of the tank, the jacket must be tightened so that there will be no danger of its slipping around.

Caboose Cars with Platforms

HAND BRAKES

Number.—Each caboose car shall be equipped with an efficient hand brake which shall operate in harmony with the power brake thereon.

The hand brake may be of an efficient design, but must provide the same degree of safety as the design shown on Plate A.

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft on caboose cars with platforms shall be located on platform to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

RUNNING BOARDS

Number.—One (1) longitudinal running board.

Dimensions.—Same as specified for "Box and other house cars."

Location.—Full length of car, center of roof. [*On caboose cars with cupolas, longitudinal running boards shall extend from cupola to ends of roof.*]

Outside-metal-roof cars shall have longitudinal extensions leading to ladder locations.

Manner of application.—Same as specified for "Box and other house cars."

LADDERS

Number.—Two (2).

Dimensions.—None specified.

Locations.—One (1) on each end.

Manner of application.—Same as specified for "Box and other house cars."

ROOF HANDHOLDS

Number.—One (1) over each ladder.

Where stiles of ladders extend twelve (12) inches or more above roof, no other roof handholds are required.

Dimensions.—Same as specified for "Box and other house cars."

Location.—On roof of caboose, in line with and running parallel to treads of ladder, not less than eight (8) nor more than fifteen (15) inches from edge of roof.

Manner of application.—Same as specified for "Box and other house cars."

CUPOLA HANDHOLDS

Number.—One (1) or more.

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) continuous handhold extending around top of cupola, not more than three (3) inches from edge of cupola roof.

Four (4) right-angle handholds, one (1) at each corner, not less than sixteen (16) inches in clear length from point of angle, may take the place of the one (1) continuous handhold specified, if locations coincide.

Manner of application.—Cupola handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside and riveted over, or with not less than one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, thirty-six (36) inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) near each end on each side of car, curving downward toward center of car from a point not less than thirty (30) inches above platform to a point not more than eight (8) inches from bottom of car. Top end of handhold shall be not more than eight (8) inches from outside face of end sheathing.

Manner of application.—Same as specified for "Box and other house cars."

END HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each side on each end of car on face of platform end sill. Clearance of outer end of handhold shall be not more than sixteen (16) inches from end of platform end sill.

Manner of application.—Same as specified for "Box and other house cars."

END PLATFORM HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) right-angle handhold on each side of each end, extending horizontally from door post to corner of car at approximate height of platform rail, then downward to within twelve (12) inches of bottom of car.

Manner of application.—Handholds shall be securely fastened with bolts, screws or rivets.

CABOOSE PLATFORM STEPS

Safe and suitable box steps leading to caboose platforms shall be provided at each corner of caboose.

Lower tread of step shall be not more than twenty-four (24) inches above top of rail.

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

Caboose Cars Without Platforms

HAND BRAKES

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

The brake shaft on caboose cars without platforms shall be located on end of car to the left of center.

Manner of application.—Same as specified for "Box and other house cars."

BRAKE STEP

Same as specified for "Box and other house cars."

RUNNING BOARDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Full length of car, center of roof. [*On caboose cars with cupolas, longitudinal running boards shall extend from cupola to ends of roof.*]

Outside metal-roof cars shall have latitudinal extensions leading to ladder locations.

Manner of application.—Same as specified for "Box and other house cars."

SILL STEPS

Same as specified for "Box and other house cars."

SIDE-DOOR STEPS

Number.—Two (2) [*if caboose has side doors*].

Dimensions.—Minimum length, five (5) feet.

Minimum width, six (6) inches.

Minimum thickness of tread, one and one-half (1½) inches.

Minimum height of backstop, three (3) inches.

Maximum height from top of rail to top of tread, twenty-four (24) inches.

Location.—One (1) under each side door.

Manner of application.—Side-door steps shall be supported by two (2) iron brackets having a minimum cross-sectional area seven-eighths (⅞) by three (3) inches or equivalent, each of which shall be securely fastened to car by not less than two (2) three-fourth (¾) inch bolts.

LADDERS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Same as specified for "Box and other house cars," *except* when caboose has side doors, then side ladders shall be located not more than eight (8) inches from doors.

Manner of application.—Same as specified for "Box and other house cars."

END-LADDER CLEARANCE

No part of car above end sills within thirty (30) inches from side of car, *except* buffer block, brake shaft, brake wheel, brake step, running board or uncoupling lever, shall extend to within twelve (12) inches of a vertical plane parallel with end of car and passing through the inside face of knuckle when closed with coupler horn against the buffer block or end sill, and no other part of end of car or fixtures on same above end sills, other than exceptions herein noted, shall extend beyond the outer face of buffer block.

ROOF HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—One (1) over each ladder, on roof in line with and running parallel to treads of ladder, not less than eight (8) nor more than fifteen (15) inches from edge of roof.

Where stiles of ladders extend twelve (12) inches or more above roof, no other roof handholds are required.

Manner of application.—Roof handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

CUPOLA HANDHOLDS

Number.—One (1) or more.

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) continuous cupola handhold extending around top of cupola, not more than three (3) inches from edge of cupola roof.

Four (4) right-angle handholds, one (1) at each corner, not less than sixteen (16) inches in clear length from point of angle, may take the place of the one (1) continuous handhold specified, if locations coincide.

Manner of application.—Cupola handhold shall be securely fastened with not less than one-half (½) inch bolts with nuts outside and riveted over, or with not less than one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Four (4).

Dimensions.—Same as specified for "Box and other house cars."

Location.—Horizontal: One (1) near each end on each side of car, not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler. Clearance of outer end of handhold shall be not more than eight (8) inches from end of car.

Manner of application.—Same as specified for "Box and other house cars."

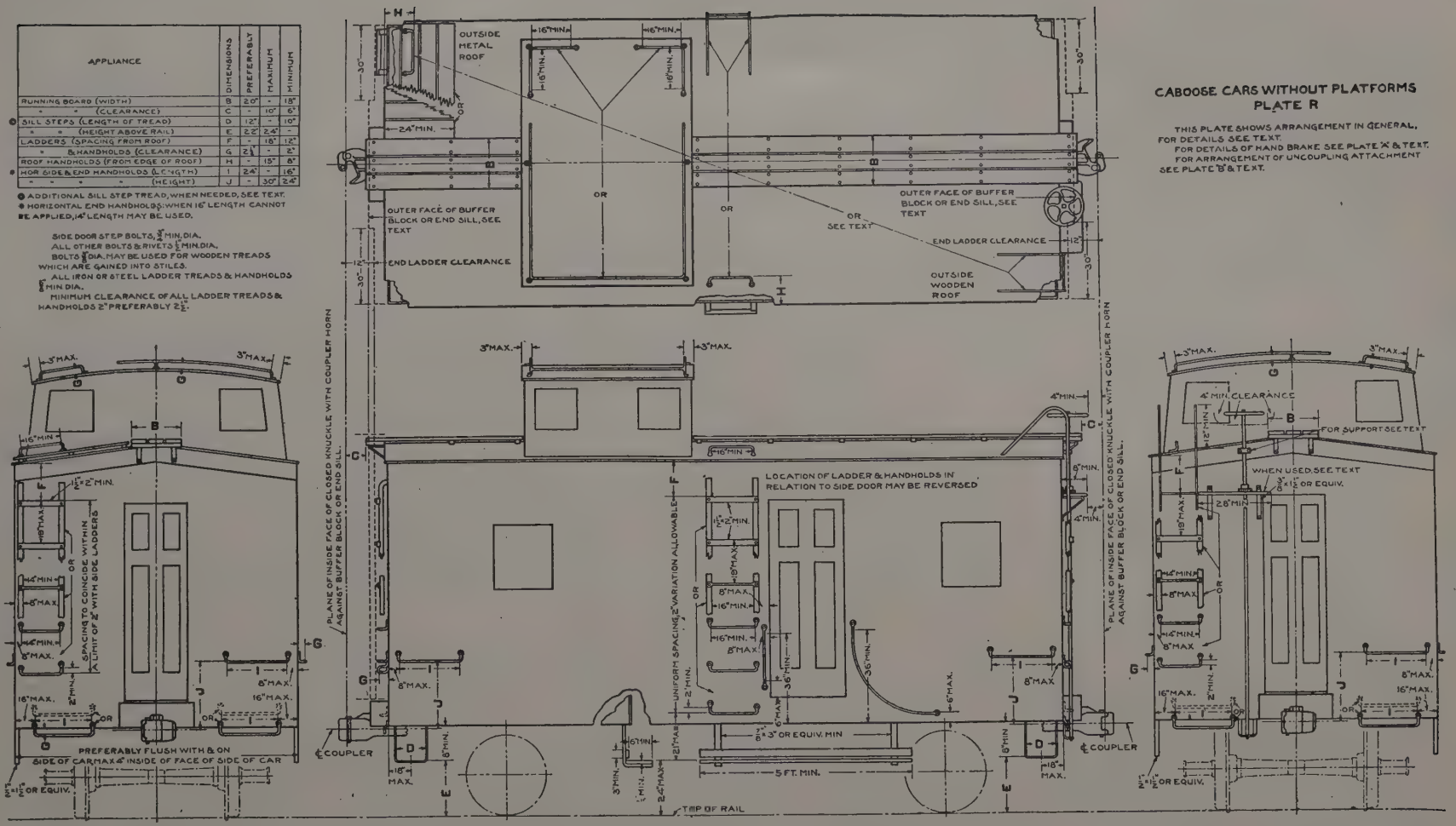
SIDE DOOR HANDHOLDS

Number.—Four (4): Two (2) curved, two (2) straight.

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) curved handhold, from a point at


CABOOSE CARS WITHOUT PLATFORMS
PLATE R
THIS PLATE SHOWS ARRANGEMENT IN GENERAL. FOR DETAILS SEE TEXT.
FOR DETAILS OF HAND BRAKE SEE PLATE 'A' & TEXT.
FOR ARRANGEMENT OF UNCOUPLING ATTACHMENT SEE PLATE 'B' & TEXT.
OUTSIDE METAL ROOF
OUTSIDE WOODEN ROOF
OUTER FACE OF BUFFER BLOCK OR END SILL, SEE TEXT
END LADDER CLEARANCE
LOCATION OF LADDER & HANDHOLDS IN RELATION TO SIDE DOOR MAY BE REVERSED
PLANE OF INSIDE FACE OF CLOSED KNUCKLE WITH COUPLER HORN AGAINST BUFFER BLOCK OR END SILL.
UNIFORM SPACING ± VARIATION ALLOWABLE
SPACING TO COINCIDE WITHIN A LIMIT OF 2" WITH SIDE LADDERS
PREFERABLY FLUSH WITH & ON SIDE OF CAR
MAX. INSIDE OF FACE OF SIDE OF CAR
℄ COUPLER
TOP OF RAIL
5 FT. MIN.
4" MIN. CLEARANCE
FOR SUPPORT SEE TEXT
WHEN USED, SEE TEXT
OR EQUIV.

APPLIANCE	DIMENSIONS	PREFERABLY	MAXIMUM	MINIMUM
RUNNING BOARD (WIDTH)	B	20"	-	18"
" " (CLEARANCE)	C	-	10"	6"
① SILL STEPS (LENGTH OF TREAD)	D	12"	-	10"
" " (HEIGHT ABOVE RAIL)	E	22"	24"	-
LADDERS (SPACING FROM ROOF)	F	-	18"	12"
" & HANDHOLDS (CLEARANCE)	G	2½"	-	2"
ROOF HANDHOLDS (FROM EDGE OF ROOF)	H	-	15"	8"
② HOR SIDE & END HANDHOLDS (LENGTH)	I	24"	-	16"
" " " " (HEIGHT)	J	-	30"	24"

① ADDITIONAL SILL STEP TREAD, WHEN NEEDED, SEE TEXT.
② HORIZONTAL END HANDHOLDS: WHEN 16" LENGTH CANNOT BE APPLIED, 14" LENGTH MAY BE USED.

SIDE DOOR STEP BOLTS ⅝" MIN. DIA.
ALL OTHER BOLTS & RIVETS ½" MIN. DIA.
BOLTS ⅜" DIA. MAY BE USED FOR WOODEN TREADS WHICH ARE GAINED INTO STILES.
ALL IRON OR STEEL LADDER TREADS & HANDHOLDS ½" MIN. DIA.
MINIMUM CLEARANCE OF ALL LADDER TREADS & HANDHOLDS 2" PREFERABLY 2½".

Fig. 2762—Standard Safety Appliance for Caboose Cars Without Platforms.

side of each door opposite ladder, not less than thirty-six (36) inches above bottom of car curving away from door downward to a point not more than six (6) inches above bottom of car.

One (1) vertical handhold at ladder side of each door, from a point not less than thirty-six (36) inches above bottom of car to a point not more than six (6) inches above level of bottom of door.

Manner of application.—Side-door handholds shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

HORIZONTAL END HANDHOLDS

Number.—Same as specified for "Box and other house cars."

Dimensions.—Same as specified for "Box and other house cars."

Location.—Same as specified for "Box and other house cars," *except* that one (1) additional end handhold shall be on each end of car with platform end sills as heretofore described, unless car has door in center of end. Said handhold shall be not less than twenty-four (24) inches in length, located near center of car, not less than thirty (30) nor more than sixty (60) inches above platform endsill.

Manner of application.—Same as specified for "Box and other house cars."

VERTICAL END HANDHOLDS

Same as specified for "Box and other house cars."

UNCOUPLING LEVERS

Same as specified for "Box and other house cars."

Safety Appliances for Passenger-Train Cars

Passenger-Train Cars with Wide Vestibules

HAND BRAKES

Number.—Each passenger-train car shall be equipped with an efficient hand brake, which shall operate in harmony with the power brake thereon.

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

SIDE HANDHOLDS

Number.—Eight (8).

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, metal.

Minimum clear length, sixteen (16) inches.

Minimum clearance, one and one-fourth (1¼), preferably one and one-half (1½) inches.

Location.—Vertical: One (1) on each vestibule door post.

Manner of application.—Side handholds shall be securely fastened with bolts, rivets or screws.

END HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, sixteen (16) inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Handholds shall be flush with or project not more than one (1) inch beyond vestibule face.

Location.—Horizontal: One (1) near each side on each end, projecting downward from face of vestibule end sill. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—End handholds shall be securely fastened with bolts or rivets.

When marker sockets or brackets are located so that they can not be conveniently reached from platforms, suitable steps and handholds shall be provided for men to reach such sockets or brackets.

UNCOUPLING LEVERS

Uncoupling attachments shall be applied so they can be operated by a person standing on the ground.

Minimum length of ground uncoupling attachment, forty-two (42) inches, measured from center line of end of car to handle of attachment.

On passenger-train cars used in freight or mixed train service, the uncoupling attachments shall be so applied that the coupler can be operated from left side of car.

Passenger-Train Cars with Open End Platforms

HAND BRAKES

Number.—Each passenger-train car shall be equipped with an efficient hand brake, which shall operate in harmony with the power brake thereon.

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

END HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clear length, sixteen (16) inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Handholds shall be flush with or project not more than one (1) inch beyond face of end sill.

Location.—Horizontal: One (1) near each side of each end on face of platform end sill, projecting downward. Clearance of outer end of handhold shall be not more than sixteen (16) inches from end of end sill.

Manner of application.—End handholds shall be securely fastened with bolts or rivets.

END PLATFORM HANDHOLDS

Number.—Four (4). [*Cars equipped with safety gates do not require end platform handholds.*]

Dimensions.—Minimum clearance, two (2), preferably two and one-half (2½), inches, metal.

Location.—Horizontal from or near door post to a point not more than twelve (12) inches from corner of car, then approximately vertical to a point not more than six (6) inches from top of platform. Horizontal portion shall be not less than twenty-four (24) inches in length nor more than forty (40) inches above platform.

Manner of application.—End-platform handholds shall be securely fastened with bolts, rivets or screws.

UNCOUPLING LEVERS

Uncoupling attachments shall be applied so they can be operated by a person standing on the ground.

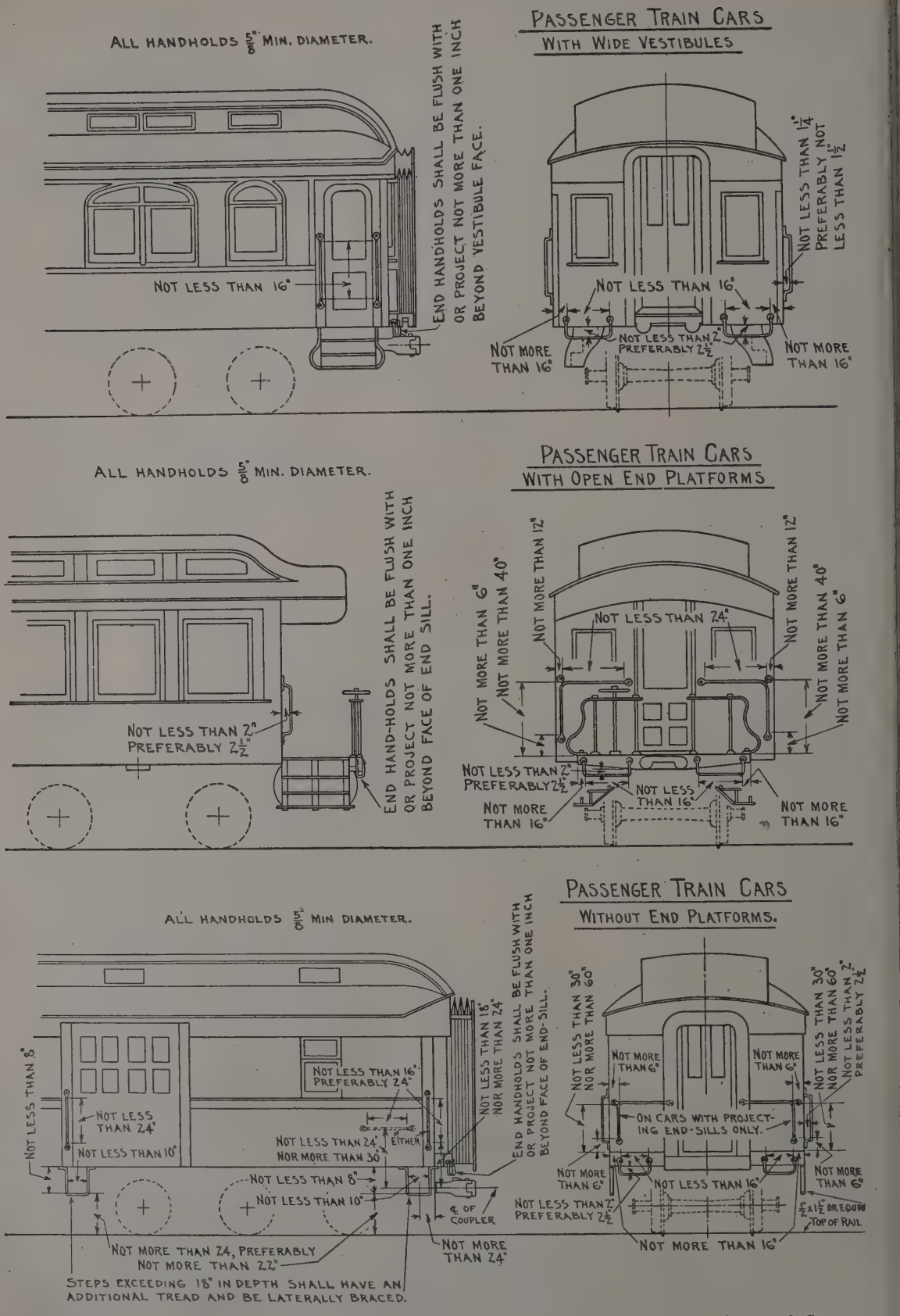

ALL HANDHOLDS 5/8" MIN. DIAMETER.
NOT LESS THAN 16"
END HANDHOLDS SHALL BE FLUSH WITH OR PROJECT NOT MORE THAN ONE INCH BEYOND VESTIBULE FACE.
PASSENGER TRAIN CARS
WITH WIDE VESTIBULES
NOT LESS THAN 1/4" PREFERABLY NOT LESS THAN 1 1/2"
NOT LESS THAN 16"
NOT LESS THAN 2" PREFERABLY 2 1/2"
NOT MORE THAN 16"
NOT MORE THAN 16"
ALL HANDHOLDS 5/8" MIN. DIAMETER.
END HAND-HOLDS SHALL BE FLUSH WITH OR PROJECT NOT MORE THAN ONE INCH BEYOND FACE OF END SILL.
NOT LESS THAN 2" PREFERABLY 2 1/2"
PASSENGER TRAIN CARS
WITH OPEN END PLATFORMS
NOT MORE THAN 6"
NOT MORE THAN 40"
NOT MORE THAN 12"
NOT LESS THAN 24"
NOT MORE THAN 12"
NOT MORE THAN 40"
NOT MORE THAN 6"
NOT LESS THAN 2" PREFERABLY 2 1/2"
NOT LESS THAN 16"
NOT MORE THAN 16"
NOT MORE THAN 16"
ALL HANDHOLDS 5/8" MIN DIAMETER.
END HANDHOLDS SHALL BE FLUSH WITH OR PROJECT NOT MORE THAN ONE INCH BEYOND FACE OF END SILL.
PASSENGER TRAIN CARS
WITHOUT END PLATFORMS.
NOT LESS THAN 8"
NOT LESS THAN 24"
NOT LESS THAN 10"
NOT LESS THAN 16" PREFERABLY 24"
NOT LESS THAN 24" NOR MORE THAN 30"
EITHER
NOT LESS THAN 8"
NOT LESS THAN 10"
NOT LESS THAN 18" NOR MORE THAN 24"
℄ OF COUPLER
NOT MORE THAN 24", PREFERABLY NOT MORE THAN 22"
NOT MORE THAN 24"
STEPS EXCEEDING 18" IN DEPTH SHALL HAVE AN ADDITIONAL TREAD AND BE LATERALLY BRACED.
NOT LESS THAN 30" NOR MORE THAN 60"
NOT MORE THAN 6"
NOT MORE THAN 6"
NOT LESS THAN 30" NOR MORE THAN 60"
NOT LESS THAN 2" PREFERABLY 2 1/2"
ON CARS WITH PROJECTING END-SILLS ONLY.
NOT MORE THAN 6"
NOT LESS THAN 16"
NOT MORE THAN 6"
NOT LESS THAN 2" PREFERABLY 2 1/2"
1/2" x 1 1/2" OR EQUIV. TOP OF RAIL
NOT MORE THAN 16"

FIG. 2763—APPLICATION OF SAFETY APPLIANCES TO PASSENGER TRAIN CARS. COURTESY OF GIBSON, PRIBBLE & COMPANY.

Minimum length of ground uncoupling attachment, forty-two (42) inches, measured from center of end of car to handle of attachment.

On passenger-train cars used in freight or mixed train service, the uncoupling attachments shall be so applied that the coupler can be operated from left side of car.

Passenger-Train Cars Without End Platforms

HAND BRAKES

Number.—Each passenger-train car shall be equipped with an efficient hand brake, which shall operate in harmony with the power brake thereon.

Location.—Each hand brake shall be so located that it can be safely operated while car is in motion.

SILL STEPS

Number.—Four (4).

Dimensions.—Minimum length of tread, ten (10), preferably twelve (12), inches.

Minimum cross-sectional area, one-half (½) by one and one-half (1½) inches or equivalent, wrought iron or steel.

Minimum clear depth, eight (8) inches.

Location.—One (1) near each end on each side, not more than twenty-four (24) inches from corner of car to center of tread of sill step.

Outside edge of tread of step shall be not more than two (2) inches inside of face of side of car.

Tread shall be not more than twenty-four (24), preferably not more than twenty-two (22), inches above the top of rail.

Steps exceeding eighteen (18) inches in depth shall have an additional tread and be laterally braced.

Manner of application.—Sill steps shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

SIDE HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five eighths (⅝) of an an inch, wrought iron or steel.

Minimum clear length, sixteen (16), preferably twenty-four (24), inches.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—Horizontal or vertical: One (1) near each end on each side of car over sill step.

If horizontal, not less than twenty-four (24) nor more than thirty (30) inches above center line of coupler.

If vertical, lower end not less than eighteen (18) nor more than twenty-four (24) inches above center line of coupler.

Manner of application.—Side handholds shall be securely fastened with bolts, rivets or screws.

END HANDHOLDS

Number.—Four (4).

Dimensions.—Minimum diameter, five-eigths (⅝) of an an inch, wrought iron or steel.

Minimum clear length, sixteen (16) inches.

Minimum clearance, two (2), preferably two and one one-half (2½) inches.

Location.—Horizontal: One (1) near each side on each end, projecting downward from face of end sill or sheathing. Clearance of outer end of handhold shall be not more than sixteen (16) inches from side of car.

Manner of application.—Handholds shall be flush with or project not more than one (1) inch beyond face of end sill.

End handholds shall be securely fastened with bolts or rivets.

When marker sockets or brackets are located so that they cannot be conveniently reached from platforms, suitable steps and handholds shall be provided for men to reach such sockets or brackets.

END HANDRAILS

Number.—Four (4). [*On cars with projecting end sills.*]

Dimensions.—Minimum diameter, five-eighths (⅝) of an inch, wrought iron or steel.

Minimum clearance, two (2), preferably two and one-half (2½), inches.

Location.—One (1) on each side of each end, extending horizontally from door post or vestibule frame to a point not more than six (6) inches from corner of car, then approximately vertical to a point not more than six (6) inches from top of platform end sill; horizontal portion shall be not less than thirty (30) nor more than sixty (60) inches above platform end sill.

Manner of application.—End handrails shall be securely fastened with bolts, rivets or screws.

SIDE-DOOR STEPS

Number.—One (1) under each door.

Dimensions.—Minimum length of tread, ten (10), preferably twelve (12), inches.

Minimum cross-sectional area, one-half (½) by one and one-half (1½) inches or equivalent, wrought iron or steel.

Minimum clear depth, eight (8) inches.

Location.—Outside edge of tread of step not more than two (2) inches inside of face of side of car.

Tread not more than twenty-four (24), preferably not more than twenty-two (22), inches above the top of rail.

Manner of application.—Steps exceeding eighteen (18) inches in depth shall have an additional tread and be laterally braced.

Side-door steps shall be securely fastened with not less than one-half (½) inch bolts with nuts outside (when possible) and riveted over, or with not less than one-half (½) inch rivets.

A vertical handhold not less than twenty-four (24) inches in clear length shall be applied above each side-door step on door post.

UNCOUPLING LEVERS

Uncoupling attachments shall be applied so they can be operated by a person standing on the ground.

Minimum length of ground uncoupling attachment, forty-two (42) inches, measured from center line of end of car to handle of attachment.

On passenger-train cars used in freight or mixed train service, the uncoupling attachment shall be so applied that the coupler can be operated from the left side of car.

Cars of construction not covered specifically in the foregoing sections, relative to handholds, sill steps, ladders, hand brakes and running boards, may be considered as of special construction, but shall have, as nearly as possible, the same complement of handholds, sill steps, ladders, hand brakes and running boards as are required for cars of the nearest approximate type.

"Right" or "left" refers to side of person when facing end or side of car from ground.

To provide for the usual inaccuracies of manufacturing and for wear, where sizes of metal are specified, a total variation of five (5) per cent below size given is permitted.

Lumber

DESPITE THE FACT that in recent years the trend in car building has been toward all-steel or part-steel—composite—construction, there is still a large amount of wood used in the construction of new cars and in the repair of existing wooden cars. Practically all of the cars now being built for use on American railroads have steel underframes and many of them steel body frames as well, consequently the percentage of heavy timber required has diminished but timbers are still used to a considerable extent for body framing, side sills and end sills. Wood is also used extensively for roofing, siding, lining, flooring, and other lighter parts of both freight and passenger cars There is also a large amount of wood used in the United States in the construction of cars for use in industrial operations and on the railroads of foreign countries.

Lumber varies with the species of trees from which it is obtained and a knowledge of the chief characteristics of the many kinds and grades of woods is essential to insure intelligent selection, inspection and use of them in car construction.

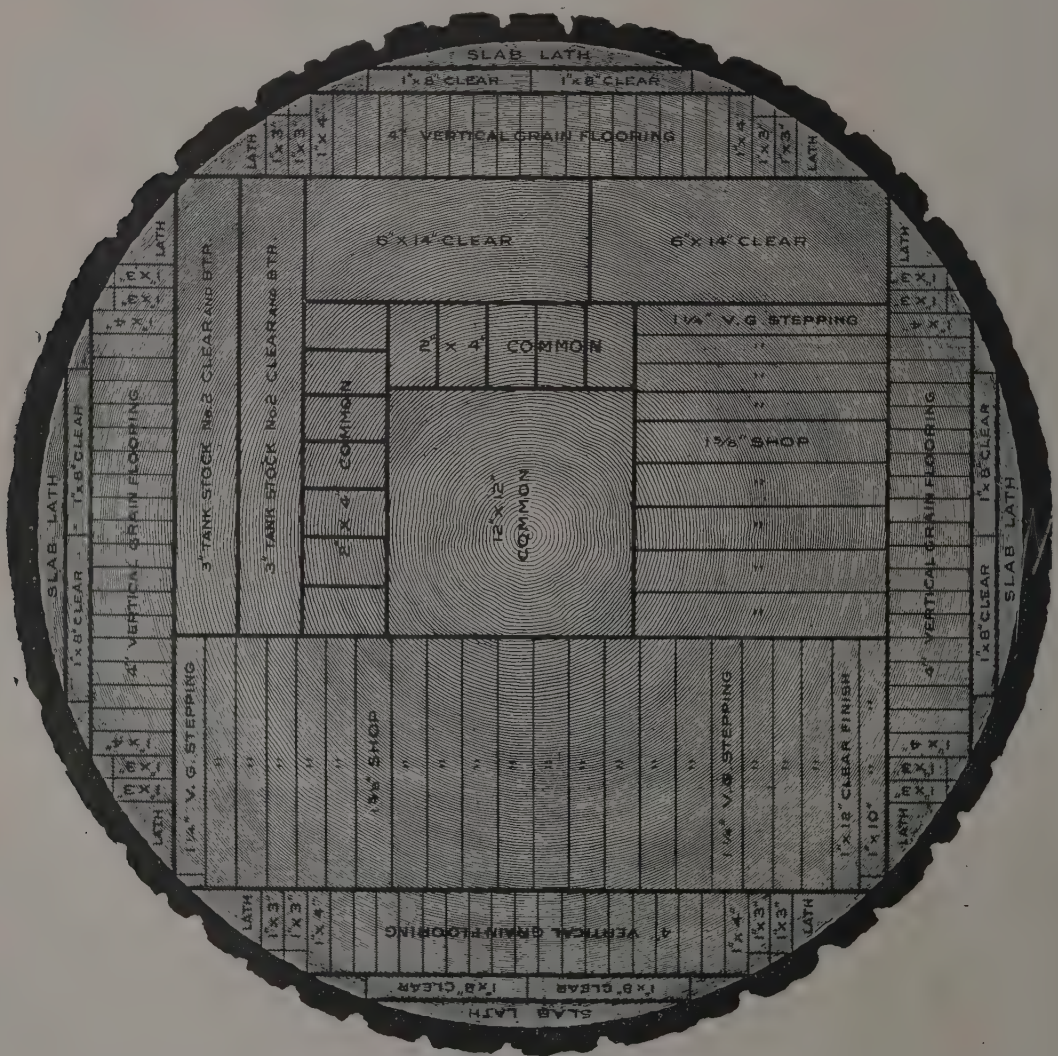


FIG. 2764—CROSS SECTION OF LOG SHOWING METHOD OF SAWING TO OBTAIN A MAXIMUM OF VERTICAL GRAIN.

The structure of the quickly grown sapling differs from that of the slowly matured tree. The butt cut—at the butt or base of the tree—differs from the top log—near the top of the tree. The manner in which the tree is cut, the log sawn and the lumber handled all have an influence on the quality of the material. Therefore the most satisfactory

results may be obtained by beginning the inspection in the forest, following the log to the mill and inspecting the lumber as it comes from the saw and then follow it to the service for which it is intended.

Good timber may be selected with considerable accuracy while it is still standing in the forest. Tall straight-grained trees of matured growth having a minimum of resinous matter and knots—limb growth—are preferable to very young or very old trees.

The rings which appear on the end surface of a log or piece of timber are thin, cylindrical layers of wood which are formed each year in the growing season. These annual rings indicate the age of a tree and when the entire log is available for inspection serve as a valuable means of selecting young vigorous timber. It is generally accepted as a fact that the slower the growth of a tree the more compact and strong the wood becomes. Therefore logs having the greatest number of annual rings per inch are likely to produce the best lumber.

Grain

When sawing a log the direction in which the saw passes through the annual rings produces lumber having either vertical grain—also called edge grain—or flat grain. Under certain conditions either vertical or flat grain may also contain cross grain.

Vertical grain is obtained when the saw cuts through the log so that the annual rings are severed at approximately a right angle to the layers of wood. This produces a piece having a succession of strips of wood which practically stand on edge or in a vertical position. The surface thus presents a series of narrow areas of interwoven fibres which renders the piece practically free from splintering. Lumber cut in this manner is especially desirable for use as flooring which is to be used without a covering of other material. It is also preferable to flat-grained material for siding or roofing where it may be exposed to severe weather conditions. An objection to vertical grained material is that it splits easily when being nailed.

Flat grain is obtained when the saw cuts in a direction parallel to the layers of annual growth. The piece thus produced has a succession of thin curved layers of wood and if not thoroughly protected by paint or other material the top layers are liable to loosen and splinter or "shell out" from the body of the piece. For this reason flat-grained material is not desirable for flooring unless well protected and is less suitable than vertical-grained material for siding or other parts exposed to the weather. It may, however, be used for such purposes as inside sheathing or lining, or for roofing which is to be covered with other material. One advantage of flat-grained material is that it may be nailed with very little danger of splitting.

Cross grain is a serious defect in lumber and usually is caused by the method of sawing but also is often due to the divergent fibres of limb growth. If the log is not placed on the saw carriage so that the plane of the saw is approximately parallel to the axis of the log the fibres of the piece cut will not be parallel to its surface and cross or diagonal grain results. Cross grain is very likely to occur when the log has considerable taper as in this case cross grain will be produced unless the saw is parallel to the annual growth rings instead of the axis of the log. Lumber with cross grain is weaker than straight-grained material, the defect being most serious when the piece is subjected to flexure. Therefore it is not desirable in timbers used for sills or framing in car construction.

Spiral grain is also very frequently found in lumber. It is caused by the growth of the wood fibres in a spiral direction about the axis of the tree instead of in a vertical direction. Usually it can not be detected by a casual inspection as it does not show in the visible grain of the wood which is a sectional view of the annual rings of growth cut longitudinally. Spiral grain has little if any effect on timber when used in the round but in sawed material the greater the pitch of the spiral the greater is the defect and, when excessive, the lumber is valueless where strength is required.

Other Defects

Knots, pitch pockets, pitch streaks, shakes, rind gall and season checks are defects which all have an effect on the appearance and quality of lumber and must be considered in the selection and use of the material. Other defects are: wane, sap, wormholes and bird pecks.

Knots are caused by the limb growth and are portions of branches included in the wood of the trunk or are small branches growing from a larger branch. The fibres of a branch grow approximately at right angles to that of the main stem and consequently produce a local cross-grain or a knot when the log is sawed. Knots materially affect the strength of timber and depreciate its value for structural purposes, where it is subjected to bending and tension, but have no appreciable effect on its strength when under compression. A knot on the upper side of a beam is compressed while one on the lower side is subject to tension therefore the extent to which knots affect the strength of a beam depends upon their position. The size and number of knots, their condition and the direction of the fibre all have an influence on the strength of a piece of lumber and the use to which it may be put.

Pitch pockets and streaks are defects caused by accumulations of resin in openings between adjacent layers of yearly growth. Their effect on lumber depends on their size and location.

Shakes are defects caused by the parting of the annual growth rings. Heart shake often occurs in overmature timber. It usually results from a shrinkage of the heart-wood and generally is more pronounced at the butt of the tree although it frequently extends the entire length. A single cleft is termed a simple heart shake; when it consists of several radial clefts it is termed a star shake. Cup or ring shake results from the pulling apart of one or more growth rings in a portion of the tree. It is a serious defect, probably caused chiefly by the swaying of the tree in a strong wind, and is more prevalent in old trees than in young growth.

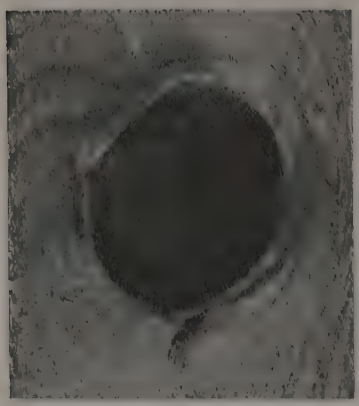
Rind gall is a defect which has an effect similar to that of a cup shake. It is caused when, due to abrasion, blazing, chipping, fire, or gnawing of animals, a portion of the growing wood is exposed by the removal of bark. Subsequent growth does not cohere with the wood previously formed and a weak spot in the timber results.

Season-check is a defect caused by the drying or seasoning of the timber. It consists of cracks or checks which open in the ends of the log or, in sawed lumber, may also occur on the other surfaces. Usually it is more pronounced in timber that has dried rapidly.

Many of these defects do not materially affect the value of lumber for certain uses and some defects are permissible in practically all grades of lumber used in car building. Therefore certain limitations within which they are allowable have been prescribed in lumber specifications approved and recommended by the American Railway Association.

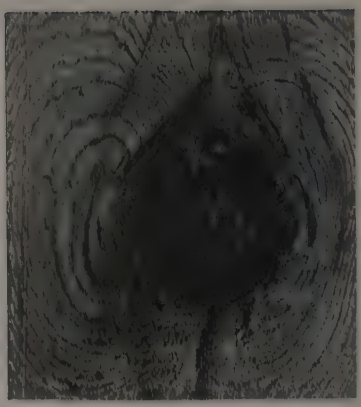
Varieties of Wood

The woods most commonly used in car construction are: Pine, Spruce, Oak, Douglas Fir, and Cypress. Other woods used to some extent are: Ash, Elm, Hemlock, Hickory, Basswood and Poplar. Each of these woods have specific

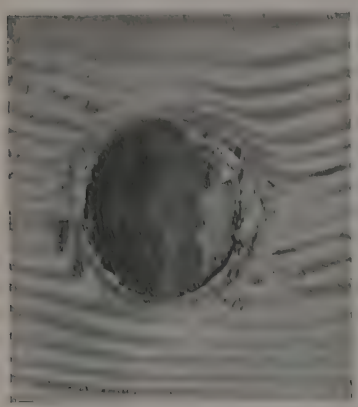


Cypress.
STANDARD SOUND KNOT.

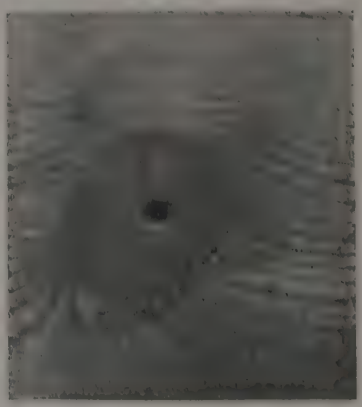
Southern Yellow Pine.
ENCASED KNOT.



Southern Yellow Pine.
ROTTEN KNOT.

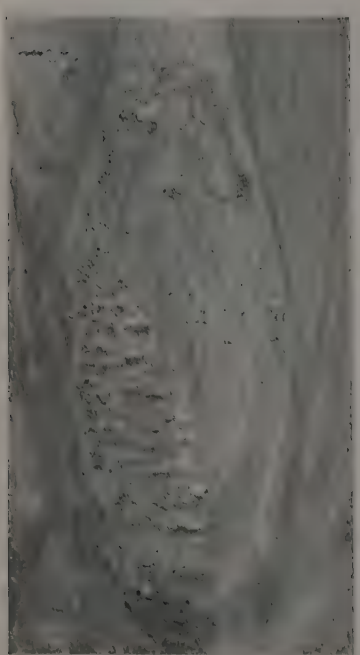


Douglas Fir.
LOOSE KNOT.

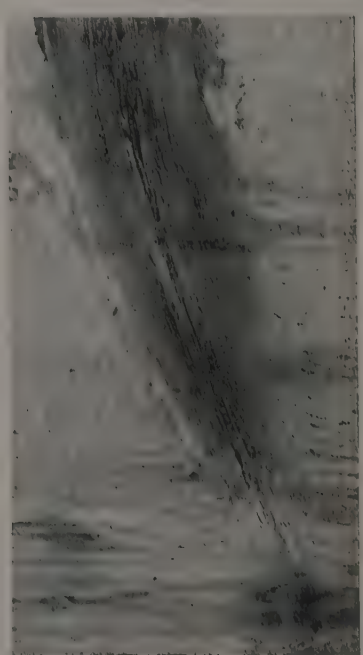


Southern Yellow Pine.
PITH KNOT.

Southern Yellow Pine.
PIN KNOT



Northern White Pine.
LARGE KNOT



Northern White Pine.
SPIKE KNOT.

Oak.
BURL KNOT.

FIG. 2705—TYPICAL ILLUSTRATIONS OF KNOT DEFECTS IN LUMBER.

qualities which determine the uses to which they are put in car construction.

Pine is used in car construction more extensively than any other wood. It is of a more or less resinous nature, has a moderately strong even texture, and generally is easily worked. It is divided into two main groups or classes: soft pine—white pine; and hard pine—yellow pine and red pine.

Soft Pine includes Common White Pine grown chiefly in the northern section of the east and in the middle-west; and Western Pine—also called Sugar Pine—found chiefly on the Pacific Slope. Pines of this class are white or yellowish-white in color, are slightly resinous and of medium weight and strength. They are used for car roofs—usually covered with other weather-resisting material; for running-boards; battens; fascias; etc.

Hard Pine includes Yellow or Southern Yellow Pine, Pine and Spruce of the north under a common name of Northern Pine.

Other hard pines having certain peculiarities which differentiate them from those already mentioned are: Bull Pine—a yellowish pine found in the Far West; Black Pine—Tamarack or Larch—a hard yellow pine found chiefly in the Far West but also in other parts of America; and Cuban Pine—very similar to Long-leaf—found in the coast states of the south.

Spruce is very similar in appearance to white pine. It is of whitish color, light in weight and is a moderately strong soft wood. It is used in car construction for roofing and for other purposes where White Pine is acceptable, being classed with White Pine and Norway Pine as Northern Pine. Spruce is found chiefly in the northern and northeastern sections of the United States and in Canada.

Oak is a heavy and hard wood, rather coarse of texture

	‡ Specific Gravity	† Modulus of Rupture	x Ratios of end Strength	++ Crushing Strength	†* Shearing Strength	xxx Modulus of Elasticity	xox Toughness	+++ Hardness
Pine, Longleaf	.53	8,630	163	4,280	1,006	1,662	8.1	512
Pine, Shortleaf	.48	7,710	161	3,570	708	1,395	5.1	...
Pine, White	.36	5,310	147	2,720	644	1,073	5.9	296
Pine, Norway	.44	6,430	146	3,080	776	1,384	5.8	342
Cypress	.45	7,110	158	3,960	818	1,378	5.1	354
Spruce, White	.32	4,200	163	1,940	592	968	6.6	...
Spruce, Red	.38	5,710	150	2,760	721	1,179	6.1	346
Douglas fir	.42	6,340	151	2,920	856	1,242	6.6	408
Oak, White	.60	8,160	136	3,510	1,251	1,214	11.4	1,063
Oak, Red	.57	8,000	140	3,370	1,146	1,330	11.3	982
Ash, Black	.47	6,000	128	2,300	860	1,033	12.2	548
Ash, White	.55	9,853	179	4,300	1,380	1,457	15.6	941
Hickory	.62	10,280	179	3,890	1,032	1,289	18.8	...
Hickory	.66	11,850	162	4,820	1,298	1,672	30.2	...
Elm, Soft	.43	6,950	162	2,810	873	1,040	11.3	511
Elm, Rock	.58	9,430	162	3,740	1,270	1,222	19.4	888
Hemlock, East	.38	6,180	162	3,270	876	1,123	6.7	406
Hemlock, West	.42	7,290	174	3,390	.....	1,428	...	...
Basswood	.34	4,860	143	2,140	607	995	5.3	242
Poplar (Aspen)	.35	5,850	167	2,720	813	1,185	6.1	366
Beech	.54	8,160	156	3,280	1,210	1,242	12.5	824
Birch, Yellow	.55	8,600	156	3,460	1,115	1,543	16.6	745
Birch, Sweet	.59	8,590	145	3,560	1,220	.....	15.6	894
Buckeye	.33	4,820	146	2,050	662	981	5.4	286
Butternut	.36	5,370	149	2,410	756	969	8.1	386
Cherry, Red	.36	5,040	140	2,170	678	1,042	6.2	386
Cherry, Black	.47	8,030	171	3,540	1,127	1,308	12.8	664
Gum (Red)	.43	6,450	150	2,690	.....	1,138	...	...
Larch	.46	7,250	158	3,700	.....	1,310	...	...
Maple, Soft	.44	5,820	132	2,490	1,053	943	11.0	592
Maple, Hard	.56	9,060	162	3,850	1,380	1,474	12.0	882
Pecan	See Hickory							
Redwood	.35	7,000	200	3,990	.....	1,062	...	...
Sycamore (Buttonwood)	...	6,300	140	2,790	1,001	964	7.1	580
Tamarack	.49	7,170	146	3,480	863	1,236	7.2	375
Tupelo	.48	7,380	154	3,550	1,031	1,045	7.8	700

‡ Test pieces over dry.
† Test pieces 2 in. sq., 28 in. span of green, clear wood.
x Modulus of Rupture ÷ Specific Gravity.
++ Pounds per sq. in.; pressure applied parallel to grain.
†* Pounds per sq. in.
xxx Wood tested in green condition; Modulus given Ms of Us in sq. in.
xox Inch-pounds per cu. in.
+++ Pressure in pounds required to indent specimen in depth of one-half diameter of a .444 inch of diameter steel ball.

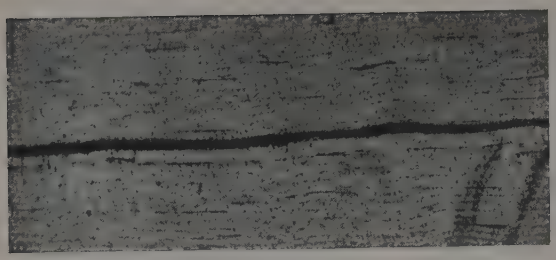
FIG. 2766—TABLE GIVING PROPERTIES OF VARIOUS WOODS USED IN CAR CONSTRUCTION.

found chiefly in the south, and Norway Pine, found in the northern middle-west states and in Canada.

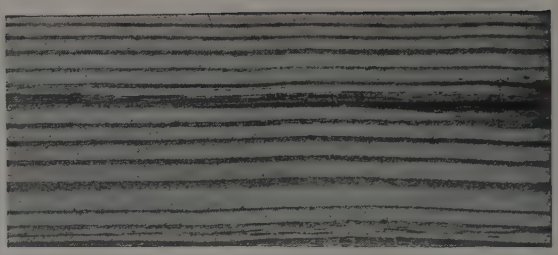
There are several varieties of yellow pine, the heaviest, hardest, and strongest variety being known as Long-leaf Pine—also called Pitch Pine and Georgia Pine. This class of pine is close-grained, highly resinous and is yellow or dark yellow in color. In car construction it is used chiefly as car timbers for framing and for other parts where strength and durability are required. Short-leaf Pine—also called Carolina Pine—is coarser-grained, less resinous, and is lighter and softer than the long-leaf variety. It is used for car roofing, siding, flooring, body framing and many other parts of wooden cars. A similar pine called Loblolly Pine is also largely used for the same purposes.

Norway Pine—also called Red Pine—is of a yellowish-red color and has approximately the same texture as short-leaf yellow pine but is somewhat less resinous and has slightly less strength. Much of the Norway Pine lumber produced in the northern states is classed with the White and usually very tough and strong. Both white and red oak are suitable for use in car construction and are used for sills, framing, heavy flooring and sometimes for decking and lining. The sapwood is white or very light brown in color and the heartwood is brown or reddish-brown. White oak is considerably tougher and stronger than red oak which is of somewhat coarser texture, more porous and often brittle, and therefore less durable than the white variety. Oak is found in practically all of the timber bearing sections of the United States.

Douglas Fir is usually quite coarse grained, contains very little resinous matter, is moderately hard and of medium weight and strength. It is sometimes referred to as Douglas Spruce and is found in both red and yellow varieties. The red fir is somewhat harder and stronger than the yellow variety which is considerably lighter in weight. Fir is used in car construction for many of the same purposes as yellow pine being suitable for framing, siding, roofing, lining and decking. It is obtained chiefly from the forests of



Large Open Pitch Pocket



Small Pitch Streak

Small Closed Pitch Pocket

Metal Rafting-Pin Hole

Bird Peck

Spot Worm Defects

Wooden Rafting-Pin Hole

Solid Pitch

Grub Worm Holes

Fig. 2767—Typical Illustrations of Pitch and Other Defects in Lumber.

the northern Rocky Mountain and Pacific Coast states.

Cypress is a moderately strong and heavy wood containing some resinous matter and usually is of a reddish color. It is very durable and is used in car construction chiefly for roofing, siding, and lining. It is found largely in the Southern states.

Ash is a straight-grained wood, quite heavy, hard and strong, and is rather coarse in texture. It is white, reddish-white, or slightly yellow in color.

Elm is heavy, hard and strong, is very tough but very often is cross-grained. The sapwood is of a whitish color and the heartwood brown, both having shades of red and gray.

Hemlock is of a medium weight, moderately stiff and strong but is often cross-grained and therefore is most suitable for use in comparatively large pieces not subject to great stress. The wood is free from resin and is usually of a reddish-gray color.

Hickory is a heavy strong and tough wood. It is coarse in texture and straight-grained. The sapwood is white in color and the heartwood a reddish nut-brown.

Basswood is a very light soft wood of fine texture but not very strong. The wood is white to light brown in color.

Poplar is a light soft wood of fine texture and not very strong. The wood is of a whitish or gray to yellow color.

The relative properties of the various classes of woods commonly used in car construction and of other woods sometimes used for special purposes in railway cars, are given in the table on the preceding page.

Lumber Specifications

Description of various woods used by railroad companies for car and locomotive lumber.

1. *Ash* .....To cover White, Black, Blue, Green and Red Ash.
2. *Basswood* .....To cover Linden, Linn, Lind or Lime-tree.
3. *Beech* .....To cover Red and White Beech.
4. *Birch* .....To cover Red, White, Yellow and Black Birch.
5. *Buckeye* .....To cover wood from Horse-chestnut tree.
6. *Butternut* .....To cover wood from tree of that name, also known as White Walnut.
7. *Cherry* .....To cover Sweet, Sour, Red, Black and Wild Cherry.
8. *Chestnut* ..... To cover wood from tree of that name.
9. *Cottonwood* ..... To cover wood from tree of that name. (Do not confuse with Popple or Poplar.)
10. *Cypress* .....To cover Red, Gulf, Yellow and East Coast Cypress, also known as Bald Cypress.
11. *Elm—soft* .....To cover White, Water, Gray, Red or Slippery and Winged Elm.
12. *Elm—rock* .....To cover Rock or Cork Elm.
13. *Douglas Fir* .....To cover Yellow, Red, Western, Washington, Oregon, Puget Sound Fir or Pine, Northwest and West Coast Fir.
14. *Gum* .....To cover Red Gum, Sweet Gum or Satin Walnut.
15. *Hemlock* .....To cover Southern and Eastern Hemlock; that is, Hemlock from all States east of and including Minnesota.
16. *Western Hemlock*..To cover Hemlock from the Pacific Coast.
17. *Hickory* .....To cover Shellbark, Kingnut, Mockernut, Pignut, Black, Shagbark and Bitternut.
18. *Western Larch*.....To cover the species of Larch or Tamarack from the Rocky Mountain and Pacific Coast regions.
19. *Maple—soft* .....To cover Soft and White Maple.
20. *Maple—hard* .....To cover Hard, Red, Rock and Sugar Maple.
21. *White Oak* .....To cover White, Burr or Mossy Cup, Rock, Post or Iron, Overcup, Swamp Post, Live, Chestnut or Tan Bark, Yellow or Chinquapin and Basket or Cow Oak.
22. *Red Oak* .....To cover Red, Pin, Black, Water, Willow, Spanish, Scarlet, Turkey, Black Jack or Barn and Shingle or Laurel Oak.
23. *Pecan* ..... To cover wood from tree of that name.
24. *Southern yellow Pine* ..... To cover Long-leaf and Short-leaf Yellow Pine grown in the Southern States.
25. *White Pine* .....To cover wood from tree of that name grown in Maine, Michigan, Wisconsin, Minnesota and Canada.
26. *Norway Pine* .....To cover Norway or Red Pine grown in Michigan, Minnesota, Wisconsin and Canada.
27. *Idaho White Pine*..To cover variety of White Pine grown in western Montana, northern Idaho and eastern Washington.
28. *Western Pine* .....To cover timber known as White Pine grown in Arizona, California, New Mexico, Colorado, Oregon and Washington; sometimes known as Western Yellow or Ponderosa Pine, or California White Pine or Western White Pine.
29. *Poplar* .....To cover wood from the Tulip Tree, otherwise known as Whitewood, Yellow Poplar and Canary Wood.
30. *Redwood* .....To cover wood from tree of that name.
31. *Spruce* .....To cover Eastern Spruce; that is, the Spruce timber coming from points east of and including Minnesota and Canada, covering White, Red and Black Spruce.
32. *Western Spruce* ...To cover the Spruce timber from the Pacific Coast.
33. *Sycamore* .....To cover wood from tree of that name, otherwise known as Buttonwood.
34. *Tamarack* .....To cover Tamarack or Eastern

Tamarack, grown in States east of and including Minnesota.

35. *Tupelo* .....To cover Tupelo Gum and Bay Poplar.

36. *Walnut* .....To cover Black Walnut (for White Walnut, see Butternut).

In 1916 the following schedule of lumber, indicating the kind and grade that should be used in each part, was adopted.

table of standard sizes, *except where otherwise expressly stipulated between buyer and seller.*

3. Recognized defects in Northern Pine are knots, knotholes, splits, shake, wane, wormholes, pitch pockets, torn grain, loosened grain, sap, sap stain, checks and rot.

KNOTS

4. Knots shall be classified as pin, small and large or coarse, as to size, and round or spike, as to form, and as sound, loose, encased, pith and rotten, as to quality.

EXHIBIT E—SCHEDULE OF LUMBER

Detail Part.	Kind of Lumber.	Grade. (A. R. A. Specifications.)
Battens, Door	White Pine, Yellow Pine	No. 1 Common.
Bolsters, Truck	Oak	Car Timber.
Bolsters, Body	Oak	Car Timber.
Beams, Bumper	Oak	Car Timber.
Beams, Needle	Oak, Longleaf Pine	Car Timber.
Belt Rail	Oak, Yellow Pine	Car Timber.
Braces	Yellow Pine	No. 1, Common Heart, New. No. 1, Common Heart, Repairs
	Oak	Car Timber.
	Poplar	
Boards: Card, Legend, Number	White Pine, Cypress	No. 1, Common. C. and Better.
Boards for Solid Coke Racks	Oak, Yellow Pine	Car Timber [Heart. No. 1, Common
Boards, Deck for Stock Cars	Oak, Yellow Pine	Car Timber [Heart. No. 1, Common
Carline	Oak, Yellow Pine	Timber [Heart. No. 1, Common
Decking or Flooring	Yellow pine and Oak (open cars). Yellow Pine (box cars)	All Heart and Heart Face, Car Timber. Heart Face and No. 1 Common.
	Yellow Fir	Edge Grain.
Door Header	Yellow Pine	No. 1, Common Heart.
	Oak, Yellow Fir	Car Timber.
Door, Grain	May be made of any kind of wood sufficiently sound to prevent leakage of Grain. Only 10 per cent in any shipment to be less than 6 in. wide	
Door, Side	Yellow Pine, Cypress, Yellow Fir	B. and Better, New. No. 1, Common, Repairs. C. and Better.
Draft Timbers	Oak	Car Timbers.
Dust Guards	Bass Wood	
Fascia	White Pine	B. & Better, New. C. & Better, New. No. 1, Common, Repair.
	Cypress	C. and Better.
	Fir	No. 2, Clear and Better, Flat Grain.
	Poplar	No. 2.

Detail Part.	Kind of Lumber.	Grade. (A.R.A. Specifications.)
Framing Car	Oak, Fir, Yellow Pine	No. 2, Clear and Better, Edge and Flat Grain.
Frame for Box Car Side Door	Oak	Car Timber
	Yellow Pine	No. 1, Com. Heart.
Lining: Refrigerator and Box Car without Siding	Yellow Pine	B. and Better. No. 1, Common.
	Fir	No. 2, Clear & Better, Flat Grain.
Lining: Refrigerator and Box Car with Siding	Cypress	C. and Better.
	Yellow Pine	No. 1, Common.
	Fir	No. 3, Clear.
	Cypress	Car Lining.
Lagging	White Pine	No. 1, Common.
Plank: Side	Yellow Pine	No. 1, Common Heart. Car Timber.
Plank: End	Oak, Yellow Pine	No. 1, Common Heart.
Plank: Spring	Oak	Car Timber.
Plank: Platform	Oak	Car Timber.
Plank: Truss	Oak	Car Timber.
Roofing: Single Board and outside Double Board	White Pine, Norway Pine, Eastern Spruce	No. 1, Common.
	Yellow Pine	B. and Better.
	Fir	No. 2 Clear & Better, Flat Grain.
	Cypress	C. and Better.
Roofing: Double Board Inside	White Pine, Norway Pine, Eastern Spruce	No. 3, Common.
	Yellow Pine	No. 1 Common.
	Fir	No. 3, Clear.
	Cypress	Car Lining.
Running Boards	Yellow Pine	No. 1 Common.
	White Pine	B. and Better.
Ridge Pole	Oak	Car Timber.
	Yellow Pine	No. 1, Common. Heart.
Rack, Slats for Coke	Oak, Yellow Pine	Car Timber.
Siding	Yellow Pine	B. and Better. No. 1, Common.
	Fir	No. 2, Clear and Better, Flat Grain.
	Cypress	C. and Better.
	Poplar	No. 2.
Sills: Center, Intermediate, Side, Nailing, Deck	Yellow Pine	Heart Face.
Sills: Center Filling	Fir	No. 2, Clear & Better, Edge Grain.
Stakes	Oak	Car Timber.
	Yellow Pine	No. 1.
Steps, Brake	Oak	Car Timber.

Classification, Grading and Dressing Rules for Northern Pine Car Material, Including White Pine Norway Pine and Eastern Spruce

1. *Norway Pine* to cover Norway or Red Pine grown in Michigan, Minnesota, Wisconsin and Canada.

White Pine to cover wood from tree of that name grown in Maine, Michigan, Wisconsin, Minnesota and Canada.

Spruce to cover Eastern Spruce; that is, the Spruce timber coming from points east of and including Minnesota and Canada, covering White, Red and Black Spruce.

2. *Northern Pine Lumber* shall be graded and classified according to the following rules and specifications as to quality, and dressed stock shall conform to the subjoined

5. A pin knot is sound and shall not exceed ½ inch in diameter.

6. A small knot is larger than a pin knot and shall not exceed 1½ inches in diameter.

7. A large or coarse knot is one of any size over 1½ inches in diameter.

8. A round knot is oval or circular in form.

9. A spike knot is one sawn in a lengthwise direction.

The mean or average diameter of knots shall be considered in applying and construing these rules.

10. A sound knot is one solid across its face; is as hard as the wood it is in and is so fixed by growth or position that it will retain its place in the piece.

11. A loose knot is not firmly set, but still retains its place in the piece.

12. A pith knot is a sound knot with a pith hole not more than ¼ inch in diameter.

13. An encased knot is one surrounded wholly by bark or pitch.

14. A rotten knot is one not as hard as the wood it is in.

PITCH

15. Pitch pockets are openings between the grain of the wood containing more or less pitch or bark, and shall be classified as small, standard and large pitch pockets.

16. A small pitch pocket is one not over ⅛ of an inch wide.

17. A standard pitch pocket is one not over ⅜ of an inch wide, or 3 inches in length.

18. A large pitch pocket is one over ⅜ of an inch wide or over 3 inches in length.

19. A pitch pocket showing open on both sides of the piece ⅛ of an inch or more in width shall be considered the same as a knothole.

WANE

20. Wane is bark, or the lack of wood, from any cause, on edge.

SAP

21. White or bright sap shall not be considered a defect in any of the grades provided for and described in these rules, except where stipulated.

MISCELLANEOUS

22. Defects in rough stock caused by improper manufacture and drying will reduce grade, unless they can be removed in dressing such stock to standard sizes.

23. All lumber for uses described in these rules shall be inspected on the face side to determine the grade, and the face side is the side showing the best quality or appearance.

24. Chipped grain consists in a part of the surface being chipped or broken out in small particles below the line of the cut, and as usually found should not be classed as torn grain, and shall not be considered a defect.

25. Torn grain consists in a part of the wood being torn out in the dressing. It occurs around knots and curly places, and is of four distinct characters; slight, medium, heavy and deep.

Slight torn grain shall not exceed 1/32 of an inch in depth, medium 1/16 of an inch, and heavy ⅛ of an inch. Any torn grain heavier than ⅛ of an inch shall be termed deep.

26. The grade of all regular stock shall be determined by the number, character and position of the defects visible in any piece. The enumerated defects herein described admissible in any grade are intended to be descriptive of the coarsest pieces *such grades may contain,* but the average quality of the grade shall be midway between the highest and lowest pieces allowed in the grade.

27. Lumber and timber sawed for specific purposes must be inspected with a view to its adaptability for the use intended.

28. *All dressed stock shall be measured strip count, viz.: full size of rough material necessarily used in its manufacture.*

29. Lumber must be accepted on grade in the form in which it was shipped. Any subsequent change in manufacture or mill work will prohibit an inspection for the adjustment of claims, except with the consent of all parties interested.

30. The foregoing general observations shall apply to and govern the application of the following rules. The rules referred to under Sections 31, 32, 33, 34 and 35 govern 4 or 6 inch strips, and are intended to cover strips used for car siding, car lining and car roofing.

31. *B and Better White Pine* shall be practically clear and free of all defects, except will admit of not exceeding four pin knots, and bright sap not to exceed 25 per cent of the face of the piece.

32. *C and Better Norway Pine.* Bright sap is no defect in this grade and stained sap will be admitted to the extent of not exceeding ⅕ the surface of the face of the piece, if not in combination with other defects. This grade shall be free from shake, rot and splits, but will admit of not exceeding four pin knots.

33. *No. 1 Common White Pine, Norway Pine and Eastern Spruce* admits of small sound knots, but shall be free from large or coarse knots, knotholes, should have practically no shake, wane or rot, but will admit of bright sap to any extent.

34. *No. 2 Common White Pine, Norway Pine and Eastern Spruce* is similar to No. 1, described above, except that it will admit of spike knots, bright or stained sap, slight shake, slight wane on reverse side, but not a serious combination of any of these defects.

35. *No. 3 Common White Pine, Norway Pine and Eastern Spruce,* in addition to the defects mentioned in No. 2, described above, will also admit of large or coarse knots, more shake, sap, wane on reverse side that does not affect the tongue or groove and torn or loosened grain, checks, pin wormholes and splits, but no loose knots or knotholes, nor a serious combination of the defects named.

36. *No. 1 Common Norway Pine Car Decking or Flooring* will admit of sound knots, any amount of sap, and shall be free from shake, wane, rot and large or coarse spike knots.

STANDARD LENGTHS

37. *Car Siding*—8, 9, 10 and 12 feet or multiples.
Car Roofing—5 feet or multiples.
Car Lining—8, 9, 10, 12, 14, 16, 18 and 20 feet or multiples.
Car Decking—9 and 10 feet or multiples.

All orders shall be shipped in standard lengths, unless otherwise specified, but no lengths of either car siding, lining or roofing shall be shipped except in the lengths specified or multiples thereof. Those who do not desire stock shipped in multiple lengths should so specify.

Classification, Grading and Dressing Rules for Southern Yellow Pine Car Material

1. *Southern Yellow Pine* to cover Long-leaf and Short-leaf Yellow Pine grown in the Southern States.

2. *Southern Yellow Pine Lumber* shall be graded and classified according to the following rules and specifications as to quality, and dressed stock shall conform to the subjoined table of standard sizes, *except where otherwise expressly stipulated between buyer and seller.*

3. Recognized defects in Southern Yellow Pine are knots, knotholes, splits (either from seasoning, ring hearts or rough handling), shake, wane, red heart, pith, rot, rotten streaks, dote, red heart, wormholes, pitch streaks, pitch pockets, torn grain, loosened grain, seasoning or kiln checks and sap, sap stains and imperfect manufacture.

KNOTS

4. Knots shall be classified as pin, standard and large, as to size; and round and spike, as to form; and as sound, loose, encased, pith and rotten, as to quality.

5. A pin knot is sound and not over ½ inch in diameter.

6. A standard knot is sound and not over 1½ inches in diameter.

7. A large knot is one any size over 1½ inches in diameter.

8. A round knot is oval or circular in form.

9. A spike knot is one sawn in a lengthwise direction.

The mean or average diameter of knots shall be considered in applying and construing these rules.

10. A sound knot is one solid across its face; is as hard as the wood it is in and is so fixed by growth or position that it will retain its place in the piece.

11. A loose knot is one not held firmly in place by growth or position.

12. A pith knot is a sound knot with a pithhole not more than ¼ inch in diameter.

13. An encased knot is one surrounded wholly or in part by bark or pitch. Where the encasement is less than ⅛ of an inch in width on both sides, not exceeding one-half the circumference of the knot, it shall be considered a sound knot. (See Sections 10 and 17.)

14. A rotten knot is one not as hard as the wood it is in.

PITCH

15. Pitch pockets are openings between the grain of the wood containing more or less pitch or bark, and shall be classified as small, standard and large pitch pockets.

16. A small pitch pocket is one not over ⅛ of an inch wide.

A standard pitch pocket is one not over ⅜ of an inch wide or 3 inches in length.

A large pitch pocket is one over ⅜ of an inch wide or over 3 inches in length.

17. A pitch pocket showing open on both sides of the piece ⅛ of an inch or more in width shall be considered the same as a knothole.

18. A pitch streak is a well-defined accumulation of pitch at one point in the piece, and when not sufficient to develop a well-defined streak, or where fibre between grains is not saturated with pitch, it shall not be considered a defect.

19. A small pitch streak shall be equivalent to not over one-twelfth the width and one-sixth the length of the piece it is in.

A standard pitch streak shall be equivalent to not over one-sixth the width and one-third of the length of the piece it is in.

WANE

20. Wane is bark, or the lack of wood, from any cause, on the edge.

SAP

21. Bright sap shall not be considered a defect in any of the grades provided for and described in these rules, except where stipulated.

SHAKE

22. Shakes are splits or checks in timbers which usually cause a separation of the wood between annual rings.

Through Shake: A shake which extends between two faces of a timber.

Ring Shake: An opening between the annual rings.

MISCELLANEOUS

23. Defects in rough stock caused by improper manufacture and drying will reduce grade, unless they can be removed in dressing such stock to standard sizes.

24. All stock except car sills and framing shall be inspected on the face side to determine the grade. Stock surfaced one side, the dressed surface shall be considered the face side. Stock rough or dressed two sides, the best side shall be considered the face, but the reverse side of all such stock shall not be more than one grade lower.

25. Pieces of siding, lining or roofing with 3/16 of an inch or more of tongue will be admitted in any grade, provided it does not run more than one-third the length of the piece.

26. In all grades lower than B and better, wane on the reverse side, not exceeding one-third the width and one-sixth the length of any piece is admissible; provided the wane does not extend into the tongue, or over one-half the thickness below the groove.

27. Chipped grain consists in a part of the surface being chipped or broken out in small particles below the line of the cut, and as usually found shall not be classed as torn grain and shall not be considered a defect.

28. Torn grain consists in a part of the wood being torn out in dressing. It occurs around knots and curly places, and is of four distinct characters—slight, medium, heavy and deep.

Slightly torn grain shall not exceed 1/32 of an inch in depth; medium, 1/16 of an inch; heavy, ⅛ of an inch; any torn grain heavier than ⅛ of an inch shall be termed deep.

29. Loosened grain consists in a point of one grain being torn loose from the next grain. It occurs on the heart side of the piece and is a serious defect, especially in flooring.

30. *Rot, Dote and Red Heart:* Any form of decay which may be evident either as a dark-red discoloration not found in the sound wood, or the presence of white or red rotten spots, shall be considered as a defect.

Firm red heart shall not be considered a defect in any of the grades of Common Lumber.

31. The grade of all regular stock shall be determined by the number, character and position of the defects visible in any piece. The enumerated defects herein described admissible in any grade are intended to be descriptive of the *coarsest pieces such grades may contain,* but the average quality of the grade shall be midway between the highest and lowest pieces allowed in the grade.

32. Lumber and timber sawed for specific purposes must be inspected with a view to its adaptability for the use intended.

33. *All dressed stock shall be measured strip count, viz.: Full size of rough material necessarily used in its manufacture.*

34. Equivalent means equal, and in construing and applying these rules, the defects, whether specified or not, are understood to be equivalent in damaging effect to those mentioned applying to stock under consideration.

35. Lumber must be accepted on grade in the form in which it was shipped. Any subsequent change in manufacture or millwork will prohibit an inspection for the adjustment of claims, except with the consent of the parties interested.

36. The foregoing general observations shall apply to and govern the application of the following rules:

37. *B and Better Car Siding, Lining and Roofing, Car Siding for Double-Sheathed Cars, Lining for Cabin and Refrigerator Cars, Lining for Box Cars with Outer Steel Posts, and Roofing such as old-style Winslow roof,* will admit any two of the following, or their equivalent of combined defects: Sap stain not to exceed five per cent; firm red heart not to exceed fifteen per cent of the face; three pin knots; one standard knot; three small pitch pockets; one standard pitch pocket; one standard pitch streak; slight torn grain, or small kiln or season checks. Where no other defects are contained, six small pin wormholes will be admitted.

38. *Select Car Siding* will admit of one standard pitch streak, one standard pitch pocket, or their equivalent; and in addition, will admit of not exceeding five pin knots and two standard knots, or their equivalent; ten per cent sap

stain; firm red heart; slight shake; heavy torn grain; defects in manufacture or seasoning checks. Pieces otherwise good enough for B, but containing a limited number of pin wormholes shall be graded *select*. This grade is intended to be accumulated from running B and Better stock, and will consist of all the droppings which do not contain defects in excess of those mentioned in this paragraph.

39. *Select Car Lining and Roofing* will admit of one standard pitch streak; one standard pitch pocket, or their equivalent, and, in addition, sound knots not over one-half the width of the piece in the rough; ten per cent sap stain; firm red heart; slight shakes; heavy torn grain; defects in manufacture, or seasoning checks. Pieces otherwise good enough for B but containing a limited number of pin wormholes shall be graded *select*. This grade is intended to be accumulated from running B and Better stock, and will consist of all the droppings which do not contain defects in excess of those mentioned in this paragraph.

40. *No. 1 Common Car Lining and Roofing* will admit of the following defects or their equivalent: Sound knots, not over one-half of cross section of the piece at any point throughout its length or width; three pin knots or their equivalent; wane ½ inch deep on edge not exceeding 1½ inches wide and one-half the length of the piece; torn grain; pitch pockets; pitch; sap stains; seasoning checks; slight shakes; firm red heart and a limited number of pin or small wormholes well scattered. This grade is intended to be worked from fencing stock, either kiln or air dried.

41. *No. 2 Common Car Siding, Lining and Roofing* will admit the following defects or their equivalent: Knots not necessarily sound, the mean or average diameter of any one knot shall not be more than one-half the cross section if located on the edge and shall not be more than two-thirds of the cross section if located away from the edge; one split one-fourth the length of the piece; wormholes; rotten streaks one-fourth the length of the piece, or the equivalent of unsound red heart; shake or wane, but must not cut to waste. Pieces of Siding, Lining, or Roofing with one-eighth of an inch or more of tongue will be admitted in this grade, provided it does not run more than one-third the length of the piece.

42. *Standard Patterns.* (Insert B/P reference, showing net sizes after working.

NOTE.—For material furnished in accordance with Sections 43 to 47, the following "Density Rule" may be applied where so specified by the purchaser:

(a) Dense southern yellow pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth and fifth inches on a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp, and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

(b) Sound southern yellow pine shall include pieces of southern pine without any ring or summer-wood requirement.

43. *All-heart Car Decking or Flooring* will admit sound knots not over one-third of the cross section of the piece at any point throughout its length, provided they are not in groups; pitch pockets; firm red heart; shake and seasoning checks which do not go through the piece; loose or heavy torn grain, or other machine defects, which will lay without waste or will not cause a leakage in cars when loaded with grain. Must be strictly *all heart* on both sides and both edges.

44. *Heart Face Car Decking or Flooring* will admit of sound knots not over one-third the cross section of the piece at any point throughout its length; provided they are not in groups; pitch pockets; firm red heart; shake and seasoning checks which do not go through the piece; loosened or heavy torn grain, or other machine defects, which will lay without waste, or will not cause a leakage in cars when loaded with grain. Will admit of any amount of sap provided all of the face side of the piece is strictly all heart.

45. *No. 1 Common Car Decking or Flooring* will admit of sound knots not over one-half the cross section of the piece at any point throughout its length, provided they are not in groups; pitch pockets; sap stain; firm red heart; shake and seasoning checks which do not go through the piece; a limited number of pin wormholes; loosened or heavy torn grain, or other machine defects, which lay without waste, or will not cause a leakage in cars when loaded with grain.

STANDARD LENGTHS

46. *Car Siding*—8, 9, 10 and 12 feet or multiples.
Car Lining—8, 9, 10, 12, 14, 16, 18 and 20 feet or multiples.
Car Roofing—5 feet or multiples.
Car Decking or Flooring—9 and 10 feet or multiples.

All orders shall be shipped in standard lengths, unless otherwise specified, but no lengths of either car siding, lining or roofing shall be shipped, except in the lengths specified or multiples thereof. Those who do not desire stock shipped in multiple lengths should so specify.

CAR SILLS AND FRAMING

47. *No. 1 Common Heart Car Sills and Framing* will admit of sound knots, provided they are not in groups, the mean or average diameter of which shall not exceed two (2) inches; pitch; pitch pockets; slight shake; seasoning checks or other defects which will not impair its strength more than the defects aforementioned. Must be sawed from sound timber, free from doty or rotten red heart and true to measurements, or at least the measurements at no point on the sill shall be less than the size required.

Measurement of the girth at any point throughout the length of the piece must show at least 75 per cent heartwood.

Cubical contents shall not be used as basis for obtaining percentage of heartwood under this rule.

48. *No. 1 Common Car Sills and Framing* will admit of sound knots, provided they are not in groups, the mean or average diameter of which shall not exceed two (2) inches; pitch; pitch pockets; slight shake; seasoning checks; sap; sap stain, or other defects which will not impair its strength more than the defects aforementioned. Must be sawed true to measurements and from sound timber free from doty or rotten red heart; must be square cornered, except that one (1) inch of wane on one corner or one-half (½) inch of wane on two corners is admissible.

49. *Sizes* up to 6 inches in width shall measure full when green, and not more than ⅛ inch scant when dry or part dry. Sizes 6 to 12 inches in width shall measure full when green and not more than ¼ inch scant when dry or part dry. Sizes 12 to 16 inches in width shall measure full when green and not more than ⅜ inch scant when dry or part dry. Unless otherwise specified, one-fourth inch shall be allowed for each side which is to be dressed. In pieces 3 by 6 inches and under when ordered in lengths exceeding 30 feet, sound knots shall not exceed one-quarter

the width of the face through which they project, and the grain shall not cross sufficiently to impair the strength.

Classification and Grading Rules for Locomotive, Freight and Passenger Car Oak

GENERAL INSTRUCTIONS

Those who are not familiar with the anatomy of the oak tree should, when reading over these rules, take into consideration that the rule describes the poorest piece that goes into the grade and that a large percentage is above the grade described.

DEFINITION OF OAK FOR CONSTRUCTION PURPOSES

The term "Construction Oak" means all such products of Oak in which the strength and durability of the timber is the controlling element in its selection and use. The following is a list of products which are recommended for consideration as "Construction Oak":

I. CONSTRUCTION OAK

(A) }
(B) } Cover Maintenance of Way Material.
(C) }

(D) *Locomotive Timbers:* Sills, End and Truck Timbers.

(E) *Car Timbers:* Car Framing, including Upper Framing, Car Sills, End and Truck Timbers, Car Decking, Inside Lining.

(F) }
(G) }
(H) }
(I) } Cover Maintenance of Way Material.
(J) }
(K) }
(L) }

II. STANDARD DEFECTS

Definition of "Defect."—Fault, Blemish, Mark of Imperfection that will materially injure the strength.

Measurements which refer to the diameter of knots or holes shall be considered as referring to the mean or average diameter.

II.—(A) KNOTS

(1) *Sound Knots.* A sound knot is one which is solid across its face, and which is as hard as the wood surrounding it; it may be any color and contain checks.

(2) *Loose Knot.* A loose knot is one not firmly held in place by growth or position.

(3) *Pith Knot.* A pith knot is a sound knot with a pith hole not more than ¼ inch in diameter in the center.

(4) *Rotten Knot.* A rotten knot is one that is not sound and not as hard as the wood surrounding it.

(5) *Pin Knot.* A pin knot is a sound knot not over ¾ inch in diameter.

(6) *Standard Knot.* A standard knot is a knot not over 2 inches in diameter.

(7) *Large Knot.* A large knot is a sound knot more than 2 inches in diameter.

(8) *Round Knot.* A round knot is one which is oval or circular in form.

(9) *Spike Knot.* A spike knot is one sawn in lengthwise direction. The mean or average width shall be considered in measuring this knot.

(10) *Bird Peck.* Bruises apparently caused by bird pecks during the growth process of the timber. Considered no defect.

II.—(B) WORM DEFECTS

(1) *Pin Wormholes.* Pin wormholes are very small holes caused by minute insects or worms. These holes usually are not over 1-16 inch in diameter, or smaller, and the wood surrounding them is sound and does not show any evidences of the wormhole having any effect on the wood other than the opening.

(2) *Spot Worm Defects.* (Also known as Flag Worm Defects.) Spot worm defects are caused, like pin wormholes, by minute insects or worms working on the timber during its growth. The size of the hole is about the same as pin wormholes, but the surrounding wood shows a colored spot as evidence of the defect. This spot is usually sound and does not affect the strength of the piece.

(3) *Grub Wormholes.* Grub wormholes are usually from about ⅛ to 3-16 inch in width and vary in length from about 3-16 inch to 1 inch, and are caused by grub worms working in the wood.

(4) *Wooden Rafting Pinholes.* This defect sometimes appears on river timber which has been rafted and holes bored in the solid wood for tying the timber, and a solid plug or pin driven in the hole filling it completely. These defects must be treated and considered the same as knot defects. Ordinary metal rafting pin or chain dog hole is considered no defect.

II.—(C) SAP

Definition of "Sap."—The alburnum of a tree—the exterior part of the wood next to the bark; sap wood not considered a defect.

Sound Heart. The term sound heart is used in these rules whenever heart of piece is split or opened and shows on outside of piece and its condition is sound and solid, not decayed. Openings between annual rings are checks not considered a defect.

II.—(D) WANE

Wane is bark or lack of wood from any cause on edges of timber.

II.—(E) SHAKES

Definition of "Shakes."—Shakes are splits or checks in timber which usually cause a separation of the wood between the annual rings.

(1) *Ring Shakes.* Ring shakes are openings between the annual rings usually showing only on the end of the timber.

(2) *Through Shakes.* Through shakes are shakes which extend between two faces of the timber.

(3) *Checks.* A small crack in the wood due to seasoning; not considered a defect.

II.—(F) GRAIN

Crooked or Cross Grain. Crooked or cross grain occurs where the grain crosses the piece within a section of 24 inches in running length of the piece. This is only considered a defect in certain smaller sizes of dimension for specific purposes.

II.—(G) ROT

Any form of decay which may be detected as giving the timber a doty or rotten texture is a rot defect, including what is commonly known as dry rot. Water stain, or what are sometimes called scalded or burned spots, usually caused by timber lying in the water under certain conditions before it is sawed, and burned spots where the timber is improperly piled green, not considered defects, as they do not affect the strength of the piece.

III.—STANDARD NAMES FOR CONSTRUCTION OAK

Standard names for Construction Oak timbers; White

Oak and Red Oak. Unless specially mentioned, these terms include the following:

White Oak.	*Red Oak*
White Oak	Red Oak
Burr or Mossy Cup Oak	Pin Oak
Rock Oak	Black Oak
Post or Iron Oak	Water Oak
Overcup	Willow Oak
Swamp Post Oak	Spanish Oak
Live Oak	Scarlet Oak
Chestnut or Tan Bark Oak	Turkey Oak
Basket or Cow Oak	Black Jack or Barn Oak
Yellow or Chinquapin Oak	Shingle or Laurel Oak

Mixed Oak means any kind of oak.

IV.—STANDARD SPECIFICATIONS FOR STRUCTURAL OAK TIMBERS

(1) *General Requirements.* Except as noted, all structural timbers shall be white oak, to be sound timber and sawed specified sizes; free from ring shakes, crooked grain, rotten knots, large knots in groups, rot, dote and wane in amounts greater than allowed in these specifications.

(2) *Boxed Hearts.* Boxed hearts are permitted in pieces 5 by 5 square and larger. The center of the heart shall be boxed as near the center of the piece as practical, and

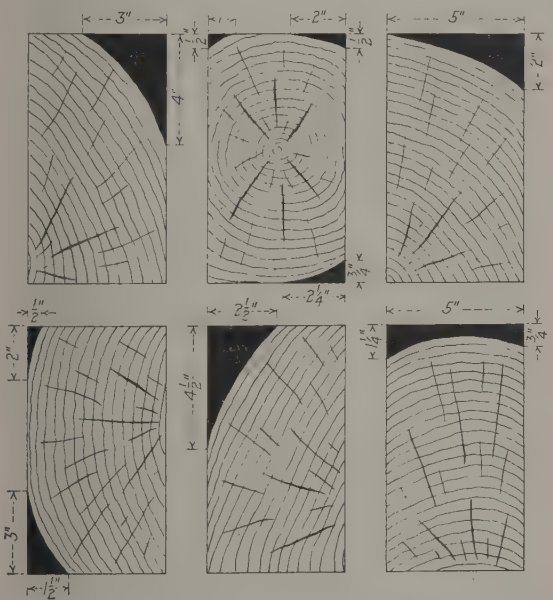


FIG. 2768—LUMBER SECTIONS—ALL SECTIONS 5" x 9", 75% HEART.

not to exceed 30 per cent of the pieces can have the center of the heart nearer than 1½ inches from any face; 20 per cent may show one heart face, corner or edge, not to exceed 75 per cent of the length of the piece.

IV.—(3) WANE

EXPLANATION

The term 20 per cent of number of pieces or amount shipped refers to each item and size of each car shipped.

(a) Pieces 5 by 5 to 8 by 8 square may show 1 inch wane, side measurement on any two corners or edges, and this wane not to exceed more than 25 per cent of the length of the piece singly, or 50 per cent in aggregate. In the absence of wane on all corners excepting one, the one corner may contain wane 50 per cent of the length of the piece as above described; not to exceed 20 per cent of number of pieces may have this defect.

(b) Pieces over 8 by 8, including 12 by 12, square may show 1½ inches wane, side measurement, edge of any two corners or edges, and this wane not to exceed more than 33⅓ per cent of the length of the piece singly, or 66⅔ per cent in aggregate. In the absence of wane on all corners excepting one, the one corner may contain wane 66⅔ per cent of the length of the piece as above described; not to exceed 20 per cent of number of pieces may have this defect.

(c) Pieces over 12 by 12 square may show 1¾ inches, side measurement, any two corners or edges, and this wane not to extend more than 40 per cent of the length of the piece singly, or 80 per cent in aggregate. In the absence of wane on all corners excepting one, the one corner may contain wane 80 per cent of the length of the piece as above described; not to exceed 20 per cent of number of pieces may have this defect.

(d) In event that pieces have two faces as wide as above described and two faces narrower, the proportion of the amount of wane is admissible.

(e) Pieces 1 inch to 5 inches thick, not exceeding 8 inches wide, are governed by defect specifications above mentioned, with the exception that they shall not contain wane, and not to exceed 20 per cent of pieces 2 inches and thicker may show sound heart on one face; pieces under 2 inches thick must be free of heart. Pieces 8 inches and wider may contain wane as per paragraphs b and d.

(f) Rough sizes of structural timber shall not vary more than ¼ inch scant of specified size. Dressed sizes may be ½ inch scant after dressing.

V.—(B) LOCOMOTIVE TIMBER OAK.

PASSENGER CAR DIMENSION OAK

REFRIGERATOR CAR DIMENSION OAK

Thickness cut to order, widths cut to order, lengths cut to order. Unless otherwise noted, must be cut from white oak. This stock, wherever practical, should be cut outside the heart and must be free of heart shake in pieces under 6 by 6 square. No attempt should be made to box the heart in pieces smaller than 5 by 7, unless heart is very small and tight. When heart is well boxed it must be firm and tight, and the center of the heart must not be nearer than 2 inches from any face. Must be sawed full to sizes with square edges, and cut from sound timber and free from wormholes, with the exception of a few small pin wormholes well scattered, and an occasional spot worm. None of these defects, however, to affect the serviceability of the piece for the purpose intended. Must be free from split, rot or dote, large, loose, rotten or unsound knots, or, in other words, free of all defects affecting the strength and durability of the piece. Sound standard knots well scattered not considered a defect.

V.—(C) FREIGHT CAR TIMBER

Freight car dimensions, including all cars other than refrigerator and passenger cars. Sizes cut to order. Unless otherwise ordered, must be sawed from good merchantable white or red oak timber. This stock must be free of rot, shakes and splits, large, loose, rotten or unsound knots, any of which will materially impair the strength and durability of the piece for the purpose intended. This stock is intended to work full size and length without waste for side posts, braces and end sills, end plates, drafting timbers, cross ties, etc., used in the construction of ordinary freight or stock cars. On pieces 3 by 4 inches or equivalent girth measurement and larger (nothing under 2 inches thick), heart check showing on one corner, admitted on twenty per cent of the pieces in each car shipment. Well-boxed, sound hearts admitted in this material in pieces 5 by 6 and larger.

On pieces 3 by 4 to 6 by 6, inclusive, or equivalent girth

measurement and larger (nothing under 2 inches thick), in absence of heart defects, wane on one corner, ¾ inch side measurement, admitted on not to exceed twenty per cent of the number of pieces in each car shipment.

Pieces over 6 by 6 square may contain 1 inch wane, side measurement, on one corner, with other conditions same as 3 by 4 to 6 by 6 sizes.

Classification and Grading Rules for Douglas Fir Car and Locomotive Material

1. The term "Douglas Fir" will cover the timber known likewise as Yellow, Red, Western, Washington, Oregon or Puget Sound Fir or Pine, Norwest and West Coast Fir.

2. *Douglas Fir Lumber* shall be graded and classified according to the following rules and specifications as to quality, and dressed stock shall conform to the subjoined table of standard sizes, *except where otherwise expressly stipulated between buyer and seller.*

3. Recognized defects in Douglas Fir are knots, knot-holes, splits, checks, wane, rot, rotten streaks, wormholes, dog or picaroon holes, pitch seams, shake, pitch pockets, chipped grain, torn grain, loose grain, solid pitch, stained heart, sap stain and imperfect manufacture.

KNOTS

4. Knots shall be classified as pin, small, standard and large, as to size; round and spike, as to form; and tight, loose and rotten, as to quality.

5. A pin knot is tight and not over ½ inch in diameter.

6. A small knot is tight and not over ¾ inch in diameter.

7. A standard knot is tight and not over 1½ inches in diameter.

8. A large knot is tight and any size over 1½ inches in diameter.

9. A round knot is oval or circular in form.

10. A spike knot is one sawn in a lengthwise direction. The mean or average diameter of knots shall be considered in applying and construing these rules.

11. A tight knot or sound knot is one solid across its face, is as hard as the wood it is in, and is so fixed by growth or position that it will retain its place in the piece.

12. A loose knot is one not held firmly in place by growth or position.

13. A rotten knot is one not as hard as the wood it is in.

PITCH

14. Pitch pockets are openings between the grain of the wood, containing more or less pitch and surrounded by sound grain wood; they shall be classified as small, standard and large pitch pockets.

15. A small pitch pocket is one not over ⅛ of an inch wide.

16. A standard pitch pocket is one not over ⅜ of an inch wide, or 3 inches in length.

17. A large pitch pocket is one over ⅜ of an inch wide or over 3 inches in length.

18. A pitch shake or seam is a clearly defined opening between the grain of the wood and may be either filled with granulated pitch or not, but in either case is considered a defect in any of the grades hereinafter described.

19. A pitch streak is a well-defined accumulation of pitch at one point in the piece, and when not sufficient to develop a well-defined streak, or where fiber between grains is not saturated with pitch it shall not be considered a defect.

20. A small pitch streak shall be equivalent to not over one-twelfth the width and one-sixth the length of the piece.

21. A standard pitch streak shall be equivalent to not over one-sixth the width and one-third of the length of the piece it is in.

WANE

22. Wane is bark, or the lack of wood, from any cause on edge.

SAP

23. Bright sap shall not be considered a defect in any of the grades provided for and described in these rules, except where stipulated.

24. Sap stain shall not be considered a defect, except as provided herein.

25. Discoloration of the heart of the wood, or stained heart, must not be confounded with rot or rotten streaks. The presence of rot is indicated by decided softness of the wood where it is discolored or by small white spots resembling pin wormholes.

MISCELLANEOUS

26. Defects in rough stock caused by improper manufacture and drying will reduce grade, unless they can be removed in dressing such stock to standard sizes.

27. All stock, except car sills and framing, shall be inspected on the face side to determine the grade. Stock surfaced one side, the dressed surface shall be considered the face side. Stock rough or dressed two sides, the best side shall be considered the face, but the reverse side of all such stock shall not be more than one grade lower.

28. Chipped grain consists in a part of the surface being chipped or broken out in small particles below the line of the cut, and as usually found, should not be classed as torn grain, and shall be considered a defect only when it unfits the piece for use intended.

29. Torn grain consists of a part of the wood being torn out in dressing. It occurs around knots and curly places, and is of four distinct characters—slight, medium, heavy and deep.

30. Slight torn grain shall not exceed 1-32 of an inch in depth; medium 1-16 of an inch, and heavy ⅛ of an inch. Any torn grain heavier than ⅛ of an inch shall be termed deep.

31. Loosened grain consists in a point of one grain being torn loose from the next grain. It occurs on the heart side of the piece, and is a serious defect, especially in flooring.

32. The grade of all regular stock shall be determined by the number, character and position of the defects visible in any piece. The enumerated defects herein described admissible in any grade are intended to be descriptive of the *coarsest piece such grades may contain,* but the average quality of the grade shall be midway between the highest and lowest pieces allowed in the grade.

33. Lumber and timber sawed for specific purposes must be inspected with a view to its adaptability for the use intended.

34. *All dressed stock shall be measured strip count, viz.: Full size of rough material necessarily used in its manufacture.*

35. Equivalent means equal, and in construing and applying these rules, the defects allowed, whether specified or not, are understood to be equivalent in damaging effect to those mentioned applying to stock under consideration.

36. Lumber must be accepted on grade in the form in which it was shipped. Any subsequent change in manufac-

ture or millwork will prohibit an inspection for the adjustment of claims, except with the consent of all parties.

37. The foregoing general observations shall apply to and govern the application of the following rules:

The rules referred to under Sections 38, 39 and 40 govern 4-inch or 6-inch strips, and are intended to cover strips used for car siding, car roofing and car lining.

The term "Edge Grain" is here used as synonymous with vertical grain, rift-sawn, or quarter-sawed. The term "Flat Grain" is synonymous with the term slash grain or plain sawed grain.

38. *No. 2 Clear and Better Edge Grain* shall be well manufactured, with angle of grain not less than forty-five degrees. This stock shall be kiln-dried and practically free from all defects, but will admit of bright sap on the face; not exceeding three small close pitch pockets not over 2 inches long, one pin knot, slight roughness in dressing, but not a serious combination of these defects.

39. *No. 2 Clear and Better Flat Grain* shall be well manufactured. The stock shall be kiln-dried and practically free from all defects, but will admit of bright sap on the face; not exceeding three small close pitch pockets not over 2 inches long, one pin knot, slight roughness in dressing, but not a serious combination of these defects.

40. *No. 3 Clear* shall be sound common lumber and will admit of roughness in dressing, bright sap, and also may contain five pin, three small and one standard knot and five pitch pockets in any continuous 5 feet of length of the piece; or any combination of tight knots or pitch pockets equivalent to those mentioned above. This grade particularly refers to stock used for inside lining of freight cars.

41. *Standard Car Decking or Flooring* shall be well manufactured from sound live timber and shall be free from splits, shakes, rot, bark or waney edges, and unsound knots, or pitch pockets, pitch seams or large knots which would weaken the piece for the use intended. This grade will admit of sound knots not to exceed one-third width of the piece, provided they are not in clusters, and sap.

42. *Common Car Sills and Framing* shall be well manufactured from sound live timber, sawed full size to sizes ordered and free from rot, unsound knots, cross grain, bark or waney edges or shakes, but will admit of sap and any number of sound knots, provided they are not in clusters, and do not exceed one-third width of piece; pitch pockets or pitch seams that would not weaken the piece for the purpose intended.

43. *Sizes* up to 6 inches in width shall measure full when green, and not more than ⅛ inch scant when dry or part dry. Sizes 6 to 12 inches in width shall measure full when green and not more than ¼ inch scant when dry or part dry. Sizes 12 to 16 inches in width shall measure full when green and not more than ⅜ inch scant when dry or part dry. Unless otherwise specified, ¼ inch shall be allowed for each side which is to be dressed. In pieces 3 by 6 inches and under when ordered in lengths exceeding 30 feet, sound knots shall not exceed one-quarter the width of the face through which they project, and the grain shall not cross sufficiently to impair the strength.

STANDARD LENGTHS

44. { *Car Siding*—8, 9, 10 and 12 feet or multiples.
Car Roofing—5 feet or multiples.
Car Lining—8, 9, 10, 12, 14, 16, 18 and 20 feet or multiples.
Car Decking—9 and 10 feet or multiples.

All orders shall be shipped in standard lengths, unless otherwise specified, but no lengths of either car siding, lining or roofing shall be shipped, except in the lengths specified or multiples thereof. Those who do not desire stock shipped in multiple lengths should so specify.

Classification and Grading Rules for Cypress Car Material

1. *Cypress* to cover Red, Gulf, Yellow and East Coast Cypress, also known as Bald Cypress.

2. *Cypress Lumber* shall be graded and classified according to the following rules and specifications as to quality, and dressed stock shall conform to the subjoined table of standard sizes, *except where otherwise expressly stipulated between buyer and seller.*

3. Recognized defects in Cypress are knots, knotholes, sap, wormholes, shake, season checks, splits and wane.

KNOTS

4. Knots shall be classified as standard and small, as to size, and sound or rotten, as to quality.

5. A standard knot is sound and not to exceed 1¼ inches in diameter.

6. A small knot is one not exceeding ¾ inch in diameter.

7. A sound knot is one solid across its face, is as hard as the wood it is in.

8. A rotten knot is one not as hard as the wood it is in.

SAP

9. Stained sap or bright sap shall not be considered a defect in the material specified in these rules.

SEASON CHECKS

10. Ordinary season checks are such as occur in lumber properly covered on yard or season checks of equal size in kiln-dried lumber.

WANE

11. Wane is bark or lack of wood on edge.

MISCELLANEOUS

12. The grade of all regular stock shall be determined by the number, character and position of the defects visible in any piece. The enumerated defects herein described admissible in any grade are intended to be descriptive of the *coarsest pieces such grade may contain,* but the average quality of the grade shall be better than the coarsest pieces allowed in the grade.

13. Lumber sawed for specific purposes must be inspected with a view to its adaptability for the use intended.

14. *All dressed stock shall be measured strip count, viz.: Full size of rough material used in its manufacture.*

15. Lumber must be accepted on grade in the form in which it was shipped. Any subsequent change in manufacture or millwork will prohibit an inspection for the adjustment of claims, except with the consent of all parties.

16. The foregoing general observations shall apply to and govern the application of the following rule. The rule referred to in the following section is intended to govern 4-inch or 6-inch strips and to cover strips used for car siding, car roofing and car lining.

CAR ROOFING AND SIDING

"C and Better" Grade.—This grade will admit sound knots, stained sap, pin wormholes, very slight shake and other defects, but none that will prevent the use of each piece in its full width and length for car roofing and car siding; may be random or specified lengths and may be worked to pattern specified and graded from pattern side or S2S and C. M. graded from the better side.

CAR LINING

Shall be specified widths and 8 to 20 inches in length. Will admit tight knots, stained sap, pin wormholes, slight shake and other defects, but none that will prevent the use of each piece in its full width and length for car-lining purposes.

Yellow Pine, Fir and Hardwoods

The W. R. Hickman Lumber Company is a wholesale distributor of yellow pine, fir and hardwoods. It specializes in high-grade car decking, siding, roofing, grain doors and other items of car construction.

This company has an intimate acquaintance

Fig. 2769—Lumber Delivered in Quantities for Storing

with daily mill and market conditions, which enables it to furnish accurate information as to the most suitable grades and the most available kinds of lumber best adapted to railroad requirements.

The importance of efficient lumber distributing agencies such as The W. R. Hickman Company will be fully appreciated when consideration is given to the great variety of hard and soft woods in use, which comprise over twenty different kinds of lumber, sub-divided into many species of each kind. When it is also considered that railway lumber is cut and prepared by numerous mills in different

Fig. 2770—All Kinds of Lumber for Wooden Car Construction

sections of the country, the necessity for centralized distributing organizations will be still more evident.

The W. R. Hickman Lumber Company has an expert knowledge of the various kinds of car lumber manufactured in all sections of the country and, because of its direct information covering the location of available stocks, at mills which take the most advantageous freight rates, it furnishes an important service in giving railroad companies the benefit of deliveries from such mills at lowest freight cost.

A further valuable service rendered to railroad corporations when they deal with the Hickman Company consists in the convenience and facility with which large or mixed orders for railroad lumber are filled, eliminating the necessity for extensive, time-wasting negotiations. The buying organization of this company has daily contact with numerous mills and sources of lumber supply; consequently it is in a position to sell an entire schedule calling for many sizes in different kinds and qualities of lumber not produced by any one manufacturer.

Inasmuch as the cost of lumber at consuming points varies on account of difference in distances from the mills and as many railroad consuming points can be served at lower rates from some producing sections than from others, the Hickman Company's expert knowledge of rates, traffic conditions, freight tariffs and other factors connected with

Fig. 2771—Carefully Graded Lumber Stock for Car Framing

shipment, is of great value to the railroads. The importance of these considerations is emphasized by the fact that from 30 to 40 per cent of the retail value of lumber is composed of transportation charges.

Ever since the building of the first freight car—a hundred years ago—wood has been an inseparable and indispensible part of car construction. On the basis of consumption previous to the war, 1¼ billion board feet were used for car construction annually, or about 3 per cent of the total annual production. This represents an average value of nearly $45,000,000 at normal prices. In view of these figures, it will be evident that efficient and economical methods of lumber distribution instituted

Fig. 2772—Complete Line of Lumber for Car Repairs

by the lumber dealers and the savings effected through their expert knowledge of this commodity are well worthy of earnest consideration on the part of railroad corporations.

For other products and branch offices, see classified and alphabetical indexes.

THE W. R. HICKMAN LUMBER CO., 1262 HANNA BLDG., CLEVELAND, O.

Southern Yellow Pine

The physical and mechanical properties of Southern Yellow Pine have secured for this material an important place in the construction of freight and passenger railroad cars. Of the 2,500,000 freight cars in the United States at the present time, almost all embody lumber in some form in their construction. Dense Southern Yellow Pine, because of its strength, stiffness, hardness and durability, has proved by experience to be one of the best woods for car-building purposes. Forest Service Bulletin No. 605 issued February 27, 1918, indicates that Southern Yellow Pine constitutes 54 per cent of the lumber used in the construction of railroad cars in the United States, both for freight and passenger purposes and, as few wooden passenger coaches have been constructed in recent years, practically all of this lumber finds its application in the manufacture of freight cars.

The forests of Southern Yellow Pine are found in the South Atlantic and Gulf States, stretching from Virginia to Texas, and comprising, according to the best available records—January, 1922—at least 260,000,000,000 feet of standing timber. At the present rate of cutting—10,000,000,000 to 12,000,000,000 feet a year—it will require more than twenty years to exhaust this supply, not including new growth, which has been estimated to exceed 5,000,000,000 feet a year. The original growth of Southern Yellow Pine will continue to be available for many years in large quantities of well-manufactured material in all standard sizes and grades.

Properly selected Southern Yellow Pine is especially valuable for use in exposed situations and by some authorities, is considered to cause less deterioration and destruction of lading than result from the use of steel construction. Southern Yellow Pine is easy to repair, stands excessive strains and shocks without sudden failure, possesses great resilience and undergoes considerable deformation before rupture. In exposed situations, subject to variations of temperature, it is more durable than most structural timbers. For floor timbers and framing, decking, siding and roofing, Southern Yellow Pine is produced in sufficient sizes and grades to meet all the car-builder's demands.

Complete information covering all uses of Southern Yellow Pine is contained in booklets published by the Southern Pine Association, which are furnished free upon request. Among other subjects these books include: "The Use of Southern Yellow Pine in Car Construction"; "Standard Specifications for Southern Yellow Pine Car Material"; and the "Southern Pine Manual of Standard Wood Construction." The Association also mantains a responsible inspection bureau at the service of railroads and car-builders, which insures proper selection of materials and uniformity of grades.

TABLE 1—WORKING STRESSES—STRUCTURAL SOUTHERN YELLOW PINE
(Pounds Per Square Inch.)

Grades	Weight Lb.Cu.Ft.	Extreme Fiber Stress: Parallel to Grain	Extreme Fiber Stress: Cross Grain	Fiber Stress at Elastic Limit Impact Bending	Compression: Short Cols.	Compression: Long Cols.	Compression: Cross Grain	Longitudinal shear: Beams: Conc.	Longitudinal shear: Beams: Unif. Load	Longitudinal shear: Beams: Details	Tension: Parallel to Grain	Tension: Cross Grain	Mod. of Elasticity: Individual	Mod. of Elasticity: Framed Struct.
Dense	45	1,600	50	10,000	1,200	1,200-20—$\frac{l}{d}$	250	225	175	300	1,600	50	1,600,000	1,000,000
Sound ...	40	1,300	40	9,000	1,000	1,000-20—$\frac{l}{d}$	225	200	150	250	1,300	40	1,400,000	800,000

TABLE II.—MECHANICAL PROPERTIES OF SOUTHERN PINE
(From Bulletin No. 556, United States Department of Agriculture, September 15, 1917)

Common and botanical name	Moisture content (percent)	Weight per cubic foot (lb.)	Shrinkage from green to oven-dry condition: In volume (percent of dimensions when green)	Shrinkage from green to oven-dry condition: Radial (percent of dimensions when green)	Shrinkage from green to oven-dry condition: Tangential (percent of dimensions when green)	Static bending: Fiber stress at elastic limit (lb. per sq. in.)	Static bending: Modulus of rupture (lb. per sq. in.)	Static bending: Modulus of elasticity (1,000 lb. per sq. in.)	Impact bending: Fiber stress at elastic limit (lb. per sq. in.)	Compression parallel to grain: Maximum crushing strength (lb. per sq. in.)	Compression perpendicular to grain—fiber stress at elastic limit (lb. per sq. in.)	Shearing strength parallel to grain (lb. per sq. in.)	Tension perpendicular to grain (lb. per sq. in.)	Hardness, load required to imbed a 0.444-in. ball to one-half its diameter: End (lb.)	Hardness, load required to imbed a 0.444-in. ball to one-half its diameter: Side (lb.)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Results of tests on four species of Southern Pine tested in a green condition in the form of small clear pieces															
Pine, longleaf (Pinus palustris)..	47	50	12.3	5.3	7.5	5,400	8,700	1,630	10,800	4,390	600	1,070	290	550	590
Pine, shortleaf (Pinus echinata)..	64	50	12.6	5.1	8.2	4,500	8,000	1,450	11,200	3,810	480	890	330	490	560
Pine, loblolly (Pinus tæda).....	70	54	12.6	5.5	7.5	4,400	7,500	1,380	9,500	3,580	550	900	280	400	450
Pine, Cuban (Pinus heterophylla).	47	53	12.7	5.9	7.5	5,600	8,800	1,630	11,300	4,470	590	1,030	290	570	630
Results of tests on four species of Southern Pine tested in an air-dry condition in the form of small clear pieces															
Pine, longleaf (Pinus palustris)..	9.2	42	...	..	..	11,800	16,700	2,200	16,400	10,880	1,670	1,640	420	1,140	1,020
Pine, shortleaf (Pinus echinata)..	11.0	38	...	..	..	9,200	13,900	1,970	16,600	8,660	1,310	1,390	410	940	880
Pine, loblolly (Pinus tæda).....	6.5	38	...	..	..	11,700	15,600	2,130	14,800	11,300	1,600	1,720	370	1,030	840
Pine, Cuban (Pinus heterophylla).	8.8	45	...	..	..	12,400	18,300	2,220	18,000	11,890	1,620	1,920	650	1,200	1,160

For other products and branch offices, see classified and alphabetical indexes.

SOUTHERN PINE ASSOCIATION, NEW ORLEANS, LA.

Paint

THE PAINTING OF RAILWAY CARS requires the use of many materials which are subject to variation in contents and therefore require proper mixing and application to insure satisfactory results. The materials used in paint mixtures as applied to railway cars include: white lead, red lead, raw and boiled linseed oils, turpentine, japan dryer, and oxide of iron paste. Recommended Practice for the composition of these materials is contained in specifications adopted by the American Railway Association and methods of application have been given study by committees appointed by the Association.

These recommendations deal chiefly with the painting of freight equipment. The painting of passenger equipment requires the use of varnish and other additional materials but these are not covered by A. R. A. specifications. Many of the largest railroads have painting departments in charge of experts and have developed specifications covering their requirements, but smaller roads are dependent on the guidance of the Recommended Practices and the assistance of paint manufacturers.

The methods which have been developed in the railroad shops have been discussed at various conventions of the Master Painters. The reports and discussions will be found in the Proceedings of the Master Painters' Association.

Freight Car Painting

The painting of freight car equipment is generally done on the outside of shops, weather conditions being favorable, and as convenient as possible to the place where the repairing is done. The longitudinal tracks are best adapted for this work and these tracks should be properly equipped with air lines, with plenty of space between tracks; care should be taken that such tracks be kept exclusively for painting purposes, for the reason that they must be kept clean of all rubbish or obstruction in order to facilitate the painting work.

Freight cars can be satisfactorily and efficiently painted outside of shops, but during a great part of the year work in the North can be properly done only within four walls and under a roof. For this reason a shop for painting freight cars is both economical and efficient and it is the opinion of many railroad men that when possible to do so it is best to paint freight equipment in properly constructed shops.

Painting Steel Freight Car Equipment

The painting of steel freight cars requires a somewhat different method than for wooden cars. A committee of the American Railway Association after an exhaustive study "recommends that new steel cars should have a coat of red lead applied to all lapped parts before assembling. Upon completion of construction the exterior should be thoroughly cleaned and prepared by sand blasting; a priming or first coat of paint, which should be a linseed oil mixture requiring twenty-four hours to dry, should immediately be applied both inside and outside."

"Carbon blacks are considered to be the best wearing and the most appropriate coating for this class of equipment, and perhaps but little less in wearing quality are the oxide of iron pigments. The preparation of these materials should be such as to insure an ideal binding and elastic film and great care should be taken to see that every part of the car is covered. For patch work or repainting the same method should be used as in new work; all scale and rust should be removed, the surface thoroughly cleaned, and two coats of paint applied."

"The recommendation of the committee is to use one coat of primer made from red lead and oil, followed by a coat of carbon black in oil. This procedure has not been generally carried out because of the first cost of raw material, red lead being high in price. As an alternative, the committee suggests the use of, preferably, iron oxide paste mixed in oil, or as a second recommendation the use of carbon black mixed in oil."

"Carbon paints are not desirable to use as contact coats on metal as they are conductors of electricity and also act as rust stimulants. However, they make good top coats. Graphite paints are not good inhibitors of rust because of the ease with which they conduct electricity; graphite has no action on oils except to retard drying. Asphaltum has practically no value as a protective coating. It generally contains no oil at all, has very little toughness, and its acidity tends to promote action of rust underneath the coating where it can not be seen until the paint has scaled off."

A report of a comittee on protective coatings for steel cars; the method of application and the results of the experiments will be found in the 1908 M. C. B. Proceedings, page 371.

Passenger Car Paint Shops

In passenger car painting it is necessary to have more desirable shop arrangements than for freight equipment and this subject has been given very careful study; in 1921 a committee of the American Railway Association, after an extensive investigation, made a report on the subject of painting as practiced in railroad shops which in part reads as follows:

"In a passenger car paint shop, light, heat, and ventilation are essential, therefore, the shop roof should be high and fitted with skylights and the windows should be many and large. Steam heat is used in most railroad paint shops but a system of hot air pipes along the roof trusses, with drops from which hot air is blown by fans into the shop has given very satisfactory results. The floors should be of cement or a similar hard substance, finished with a smooth surface and provided with good drainage and sewage facilities so that it may be easily washed and quickly drained in order to keep the shop in a dry condition to promote proper drying of the paint.

"A very effective method of drying and hardening paint on steel cars is provided by the use of paint bake-ovens, but this method can be used only on cars which are entirely of steel both on the interior and exterior. These

ovens cannot be used for cars having a steel exterior and a wood interior and would be of no value to most railroads."

"The paint mixing and stock room should be fireproof and conveniently located to the passenger car paint shop, if possible, in an annex to the shop so that the paint will be readily available."

The specifications for paint materials which have been adopted by the American Railway Association as Recommended Practice are as follows:

Black Paint

Recommended Practice—ADOPTED, 1917; REVISED, 1919

1. *Scope.*—These specifications cover carbon black semi-paste to be used as a protective paint for A. R. A. equipment cars.

I. CHEMICAL PROPERTIES AND TESTS.

2. *Chemical Composition.*— (a) Paste.—The paste shall conform to the following requirements:

Pigment .....43 to 47 per cent by weight.
Linseed oil .....53 to 57 per cent by weight.

(b) *Pigment.*—The pigment shall conform to the following requirements:

*Lampblack or carbon black..not less than 30 per cent
Red led .....not less than 8 per cent.
China clay or other approved
Inert pigment .....not more than 62 per cent.
Oxide of iron, if present....not over 15 per cent, and may be substituted for an equal amount of lampblack.

(c) In view of the great variety of inert materials available for use as constituents of paint pigments, some of which are undesirable, it has been deemed advisable to ask those desiring to use any other inert material in place of a part or the whole of the China clay called for in the formula to submit a sample of the material in dry form for examination. Such material shall be approved before using and shall not be changed after having been approved. Phosphates, barytes, sulphates of lime or gypsum, carbonate of lime or whiting, or any other carbonates or sulphates, will not be allowed as substitutes for China clay.

(d) The presence of caustic substances, such as caustic lime or any soaps or other emulsifying material, will not be permitted.

3. *Oil.*—The linseed oil shall conform to the A. R. A. Specifications for Linseed Oil.

II. PHYSICAL PROPERTIES AND TESTS.

4. *Shade.*—A sample of dry pigment showing the standard shade will be furnished, and shipments will be required to conform strictly to standard. The shade of paint being affected by the grinding, the railroad company's standard shade is that given by the dry samples furnished, mixed with the proper amount of oil and ground, or better, rubbed up in a small mortar with pestle until the paste will pass the railroad company's test for fineness. It is best to use fresh samples of the dry pigment for each day's testing. The comparison should always be made by putting a small hillock of the standard paste and that to be compared near each other on a glass, and then laying a thin piece of glass as a cover on the two hillocks, and pressing them together until the two samples unite. The line where the two samples unite is clearly marked if they are not the same shade. It is recommended to use for the cover the thin glass commonly used by microscopists, since the thin glass does not change the shade perceptibly.

5. *Fineness.*—The pigment shall be ground so fine that it will not show any appreciable settling in the barrel, and, when a sample of the paste is washed on a 350-mesh sieve with a suitable solvent, at least 97 per cent of the pigment shall pass through the sieve. There shall be no visibly coarse particles in the residue on the 350-mesh sieve and all shall pass through a 200-mesh sieve.

6. *Sampling.*—A sample of the paste shall be taken at random from any barrel, can or package in each shipment, at destination.

7. *Place of Making Tests.*—The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

III. PERMISSIBLE VARIATIONS.

8. *Weight.*—As quotations are made by the pound on the basis of the paint weighing not over 10.5 lb. per gallon, all paint received which weighs more than 10.5 lb. per gallon, but not over 11.5 lb. per gallon, will be accepted at the weight of 10.5 lb. per gallon, the excess weight being at the expense of the manufacturer.

IV. PACKING AND MARKING.

9. *Packing.*—Standard black paste shall be put up in moisture-proof barrels, cans or packages, according to the railroad company's requirements.

10. *Marking.*—The manufacturer shall mark the black paste packages according to the railroad company's requirements.

V. INSPECTION AND REJECTION.

11. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

12. *Rejection.*—Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

13. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

*The lampblack shall be of a good quality and of such a character as to produce the standard shade. Ground coal, etc., will not be considered.

White Lead for Lettering

Recommended Practice—ADOPTED, 1916.

1. *Scope.*—These specifications cover two kinds of white lead paste to be used as a base in stencil paint for freight equipment cars.

I. CHEMICAL PROPERTIES AND TESTS.

2. *Chemical Composition.*—(a) Paste. The paste shall conform to the following:

Pigment .....90-93 per cent by weight.
Oil ..... 7-10 per cent by weight.
Moisture, mechanical combined with pigment or oil.... not over 0.25 per cent by weight.

(b) *Pigment.*—The composition of the pigment shall conform to either of the following:

(1) Basic carbonate of lead:
Lead carbonate.....68-75 per cent by weight.
Lead hydrate.....25-32 per cent by weight.
Lead sulphate..not over 0.5 per cent by weight.
Acetates .....not any.

(2) Equal parts of basic carbonate and basic sulphate white lead:
Lead carbonate.....34.-37.5 per cent by weight.
Lead sulphate .....37.-42.5 per cent by weight.
Lead hydrate..... 12.5-16 per cent by weight.
Lead oxide..... 5. -10 per cent by weight.
Zinc oxide..... 2. - 4 per cent by weight.
Water soluble...not over 0.5 per cent by weight.
Lead acetate.....None.

(c) The pigment shall conform to the railroad company's standard sample as far as fineness, opacity and density are concerned, and shall not have a crystalline structure or any adulterants.

3. *Oil.*—The linseed oil shall conform to the A. R. A. Specifications for Linseed Oil.

4. *Fineness.*—(a) The pigment shall be so fine that after having been separated from the oil and freed from hygroscopic moisture and then thoroughly mixed again with pure linseed oil, which has also been freed from moisture in the proportion of one part oil to one part pigment by weight, it will stand the following:

(b) Place a small amount of the above mixture on one end of a strip of dry glass, set the strip vertical where the temperature is 70 deg. F. and allow to remain for 30 minutes.

(c) As the mixture runs down the glass the fineness will be acceptable if the oil and pigment do not separate in the first inch.

II. Packing and Marking.

5. *Packing.*—White lead paste shall be put up in moisture-proof barrels, cans or packages according to the railroad company's requirements.

6. *Marking.*—The manufacturer shall mark the white lead packages according to the railroad company's requirements.

III. Inspection and Rejection.

7. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

8. *Rejection.*—Material represented by samples which fail to satisfy the requirements of these specifications will be rejected.

9. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Red Lead

Recommended Practice—adopted, 1916.

1. *Scope.*—These specifications cover a high-grade commercial dry red lead, to be used in paint mixtures or as a priming coat. When used in priming coat it should be made up fresh from quick application to prevent setting. When less than 3 per cent of litharge is present it may be mixed up in paste form and held indefinitely.

2. *Composition.*—The dry pigment, which is probably a mixture of lead monoxide and lead dioxide, should contain at least 85 per cent of true red lead, Pb_3O_4, equivalent to 30.60 per cent of lead dioxide, and the remainder to be practically pure lead monoxide.

3. *Color.*—The pigment must be of bright color, free from organic coloring matter.

I. Methods of Analysis.

4. *Total Lead.*—(a) The total lead content will be obtained, after removal of insoluble matter, as sulphate.

(b) *Red Lead, Pb_3O_4.*—Weigh out 0.5 gram pigment as received into a dry 125-cc. Erlenmeyer flask. Into a dry 150-cc. beaker place in the following order: 15 grams crystallized sodium acetate, 1.2 grams potassium iodide, 5 cc. distilled water, and 5 cc. 50 per cent acetic acid. Mix thoroughlly until solution effected, pour into the Erlenmeyer flask containing the lead and rub with a glass rod until all the lead is dissolved; add 15 cc. of cold, distilled water and titrate with tenth-normal sodium thio-sulphate, using starch as indicator. A small amount of the lead may escape solution at first, but when the titration is nearly complete this may be dissolved by stirring. The reagents used to be analyzed chemicals and should be pulverized just before using. The titration should be started as soon as the greater part of the lead is in solution and should be carried to completion as soon as possible, as otherwise there is danger of loss of iodine. One cubic centimeter of tenth-normal sodium thio-sulphate corresponds to 0.011945 gram of lead dioxide or 0.034235 gram of red lead.

(c) *Lead Monoxide, PbO.*—Calculate the red lead found under (b) to sulphate, deduct this weight from the total weight of sulphate under (a) and calculate the difference to lead monoxide.

(d) *Moisture.*—One gram of the pigment as received will be dried at a temperature of 220 deg. F. for two hours, and the loss in weight calculated and expressed as per cent moisture.

(e) *Insoluble Impurities.*—Treat 1 gram of pigment with 20 cc. of concentrated hydrochloric acid, cover and heat on a steam bath for 15 minutes, add 100 cc. of hot water, boil, filter, wash with hot water, ignite and weigh the insoluble residue. The weight found should be expressed as per cent insoluble matter.

5. *Fineness.*—(a) The pigment shall be so fine that after having been separated from the oil and freed from hygroscopic moisture and then thoroughly mixed again with pure raw linseed oil, which has also been freed from moisture in the proportion of 1 part oil to 1 part pigment by weight, it will stand the following:

(b) Place a small amount of the above mixture on the

end of a strip of dry glass, set the strip vertical where the temperature is 70 deg. F. and allow to remain for 30 minutes.

(c) As the mixture runs down the glass the fineness will be acceptable if the oil and pigment do not separate in the first inch.

II. Inspection and Rejection.

6. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

7. *Rejection.*—The material will have failed and will be rejected if the tests herein required show the following:

(1) Less than 85 per cent true red lead, Pb_3O_4.

(2) Moisture in excess of 0.25 per cent.

(3) The presence of organic coloring matter.

8. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Linseed Oil—Boiled

Recommended Practice—adopted, 1916.

1. *Scope.*—These specifications apply to boiled linseed oil to be used in mixing paint for A. R. A. equipment cars.

I. Properties and Tests.

2. *Properties.*—Boiled linseed oil shall conform to the following requirements:

	MAX.	MIN.
Specific gravity at $\frac{15.5°}{15.5°}$ C.	0.945	0.937
Acid number	8	.....
Saponification number	195	189
Unsaponifiable matter, per cent	1.5	....
Refractive index at 25° C.	1.484	1.479
Iodine number (Hanus)	....	178
Ash, per cent	0.7	0.2
Manganese, per cent	...	0.03
Calcium, per cent	0.3	....
Lead, per cent	...	0.1
Flash point	...	260 C.

II. Methods of Testing.

3. *General.*—The sample should be thoroughly agitated before the removal of a portion for analysis.

4. *Specific Gravity.*—Use a pykometer, or Westphal balance, accurately standardized and having a capacity of at least 25 cc., or any other equally accurate method, making a test at 15.5° C., water being 1 at 15.5° C.

5. *Acid Number.*—Expressed in milligrams of KOH per gram of oil. Follow the method described in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, page 142.

6. *Saponification Number.*—Expressed as with acid number. Blanks should also be run to cover effect of alkali in glass. Follow method given in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, pages 137-138.

7. *Unsaponifiable Matter.*—Follow Boemers method taken from his Ubbelohde Handbuch der Ole u. Fette, pages 261-262. "To 100 g. of oil in a 1000 to 1500 cc. Erlenmeyer flask add 60 cc. of an aqueous solution of potassium hydroxide (200 g. KOH dissolved in water and made up to 300 cc.) and 140 cc. of 95 per cent alcohol. Connect with a reflux condenser and heat on the water bath, shaking at first until the liquid becomes clear. Then heat for one hour with occasional shaking. Transfer while yet warm to a 2000-cc. separatory funnel to which some water has been added, wash out the Erlenmeyer with water, using in all 600 cc. Cool, add 800 cc. of ether and shake vigorously one minute. In a few minutes the ether solution separates perfectly clear. Draw off the soap and filter the ether (to remove last traces of soap) into a large Erlenmeyer and distill off the ether, adding, if necessary, one or two pieces of pumice stone. Shake the soap solution three times with 400 cc. of ether, which add to the first ether extract. To the residue left after distilling the ether add 3 cc. of the above KOH solution, and 7 cc. of the 95 per cent alcohol, and heat under a reflux condenser for 10 minutes on the water bath. Transfer to a small separatory funnel, using 20 to 30 cc. of water, and after cooling shake out with two portions of 100 cc. of ether; wash the ether three times with 10 cc. of water. After drawing off the last of the water, filter the ethereal solution so as to remove the last drops of water, distill off the ether, dry residue in water oven and weigh."

Or, any accurate method involving the extraction of the dried soap may be used.

8. *Refractory Index.*—Use a properly standardized Abbe Refractometer at 25° C., or any other equally accurate instrument.

9. *Iodine Number (Hanus)*: Follow the Hanus method as described in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, page 136.

10. *Ash.*—The determination of the percentage of ash and the constituents thereof may be made by any method which gives accurate results.

Linseed Oil—Raw

Recommended Practice—adopted, 1916.

1. *Scope.*—These specifications apply to linseed oil to be used in mixing paint for A. R. A. equipment cars.

I. Properties and Tests.

2. *Properties.*—The material should be good, pure oil of a pale yellow color, made from No. 1 flaxseed, well clarified by settling and age, and unmixed with any foreign substance whatever. The raw linseed oil shall conform to the following requirements:

	MAX.	MIN.
Specific gravity at $\frac{15.5°}{15.5°}$ C.	0.936	0.932
or		
Specific gravity at $\frac{25°}{25°}$ C.	0.931	0.927
Acid number	6.00	....
Saponification number	195	189
Unsaponifiable matter, per cent	1.50	....
Refractive index at 25° C.	1.4805	1.4790
Iodine number (Hanus)	....	178
Flash point	....	260

II. Methods of Testing.

3. *General.*—All tests are to be made on oil which has been filtered at a temperature of between 60 and 80° F. through paper in the laboratory immediately before weighing out. The sample should be thoroughly agitated before the removal of a portion for filtration or analysis.

4. *Specific Gravity.*—Use a pyknometer, or Westphal balance accurately standardized and having a capacity of at least 25 cc. or any other equally accurate method, making a test at 15.5° C., water being at 15.5° C., or a test at 25° C., water being 1 at 25° C.

5. *Acid Number.*—Expressed in milligrams of KOH per gram of oil. Follow the method described in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, page 142.

6. *Saponification Number.*—Expressed as with acid number. Blanks should also be run to cover effect of alkali in glass. Follow method given in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, pages 137-138.

7. *Unsaponifiable Matter.*—Follow Boemers method taken from his Ubbelohde Handbuch der Ole u. Fette, pages 261-262. "To 100 g. of oil in a 1000 to 1500 cc. Erlenmeyer flask add 60 cc. of an aqueous solution of potassium hydroxide (200 g. KOH dissolved in water and made up to 300 cc.) and 140 cc. of 95 per cent alcohol. Connect with a reflux condenser and heat on the water bath, shaking at first until the liquid becomes clear. Then heat for one hour with occasional shaking. Transfer while yet warm to a 2000-cc. separatory funnel to which some water has been added, wash out the Erlenmeyer with water, using in all 600 cc. Cool, add 800 cc. of ether and shake vigorously one minute. In a few minutes the ether solution separates perfectly clear. Draw off the soap and filter the ether (to remove last traces of soap) into a large Erlenmeyer and distill off the ether, adding if necessary one or two pieces of pumice stone. Shake the soap solution three times with 400 cc. of ether, which add to the first ether extract. To the residue left after distilling the ether add 3 cc. of the above KOH solution, and .7 cc. of the 95 per cent alcohol, and heat under reflux condenser for 10 minutes on the water bath. Transfer to a small separatory funnel, using 20 to 30 cc. of water, and after cooling shake out with two portions of 100 cc. of ether; wash the ether three times with 10 cc. of water. After drawing off the last of the water, filter the ethereal solution so as to remove the last drops of water, distill off the ether, dry residue in water oven and weigh."

Or, any accurate method involving the extraction of the dried soap may be used.

8. *Refractive Index.*—Use a properly standardized Abbe Refractometer at 25° C. or any other equally accurate instrument.

9. *Iodine Number (Hanus)*: Follow the Hanus method as described in Bulletin No. 107, revised 1908, Department of Agriculture, Bureau of Chemistry, page 136.

Turpentine

Recommended Practice—Adopted, 1916.

1. *Scope.*—These specifications apply to both the turpentine that is distilled from pine oleoresins, and commonly known as "gum turpentine" or "spirits turpentine," and to the turpentine commonly known as "wood turpentine" that is obtained from resinous wood, whether by extraction with volatile solvents, steam or by destructive distillation, to be used in making paint for American Railway Association equipment cars.

2. *Appearance.*—The turpentine shall be clear and free from suspended matter and water.

3. *Color.*—The color shall be "Standard" or better.

4. *Specific Gravity.*—The specific gravity shall not be less than 0.862 nor more than 0.872 at 15.5° C.

5. *Refractive Index.*—The refractive index at 15.5° C. shall not be less than 1.468 nor more than 1.478.

6. *Initial Boiling Point.*—The initial boiling point shall not be less than 150 nor more than 160° C.

7. *Distillation.*—Ninety per cent of the turpentine shall distill below 170° C.

8. *Polymerization.*—The polymerization residue shall not exceed 2 per cent, and its refractive index at 15.5° C. shall not be less than 1.500.

9. *Odor.*—Shall not have an offensive or empyreumatic odor.

10. *Color.*—Fill a 200-mm., perfectly flat bottom colorimetric tube graduated in millimeters to a depth of from 40

Methods of Analysis.

to 50 mm. with the turpentine to be examined. Place the tube in a colorimeter and place on or under it a No. 2 yellow Lovibond glass. Over or under a second graduated tube in the colorimeter, place a No. 1 yellow Lovibond glass and run in the same turpentine until the color matches as nearly as possible the color in the first tube. Read the difference in depth of the turpentine in the two tubes. If this difference is 50 mm. or more, the turpentine is "Standard."

11. *Specific Gravity.*—Determine specific gravity at any convenient temperature with a plummet, the displacement of which has been accurately determined for that temperature, or by an equally accurate method, using the factor 0.00082 for each degree centigrade that the temperature of determination differs from 15.5° C.

12. *Refractive Index.*—Determine refractive index at any convenient temperature with an accurate instrument, and calculate the results to 15.5° C., using the factor 0.00045 for each degree that the temperature of determination differs from 15.5° C.

13. *Distillation.*—Use an ordinary Engler flask and condenser, and heat the flask by placing it in a glycerin or oil bath of the general type described in Bulletin No. 135,

Bureau of Chemistry. Fit the flask with a thermometer reading from 145 to 200° C. in such a way that the mercury bulb shall be opposite the side tube of the flask and the 175° mark below the cork. Place 100 cc. of the turpentine to be examined in the flask, connect with the condenser, insert stopper bearing thermometer, and heat until distillation of the turpentine begins. Conduct the distillation so that the distillate passes over at the rate of two drops per second. Note the initial distilling temperature and the percentage distilling below 170° C.

14. *Polymerization.*—Place 20 cc. of exactly 38/N (100.92 per cent) sulphuric acid in a graduated, narrow-neck Babcock flask, stoppered, and place in ice water and cool. Add slowly 5 cc. of the turpentine to be tested. Gradually mix the contents, cooling from time to time and not allowing the temperature to rise above about 60 deg. C. When the mixture no longer warms up on shaking, agitate thoroughly and place the bottle in a water bath and heat from 60 to 65 deg. C. for about 10 minutes, keeping the contents of the flask thoroughly mixed by vigorous shaking 5 or 6 times during the period. Do not stopper the flask after the turpentine has been added, as it may explode. Cool to room temperature, fill the flask with concentrated sulphuric acid until the unpolymerized oil rises into the graduated neck. Centrifuge about 1200 r.p.m. from four to five minutes, or allow to stand for 12 hours. Then read the unpolymerized residue, notice its consistency and color, and determine its refractive index.

Japan Dryer

Recommended Practice—ADOPTED, 1916.

1. *Scope.*—These specifications cover hardener and drier or japan to be used in making paint for American Railway Association freight equipment cars.

I. PHYSICAL PROPERTIES AND TESTS.

2. *Drying Test.*—(a) Turpentine. When equal parts by weight of the japan and of pure turpentine (A. R. A. Specifications for Turpentine) are thoroughly mixed and poured over a slab of glass, which is then placed nearly vertically at a temperature of 100 deg. F. with free access of air, but not exposed to draught, the coating shall be hard and dry, neither brittle, nor sticky, in a period of time not exceeding twelve minutes from the time it is poured on the glass.

(b) Linseed Oil. When 15 per cent of japan and 85 per cent of pure raw linseed oil (A. R. A. Specifications for Linseed Oil) by weight are thoroughly mixed and poured over a slab of glass which is then placed nearly vertical at a temperature of from 65 to 85 deg. F. with free access of air, but not exposed to draught, the coating shall dry throughout, neither brittle, nor sticky, within four hours.

3. *Curdling Test.*—When thoroughly mixed with pure raw linseed oil at the ordinary temperature in proportion of 5 per cent by weight of japan to 95 per cent by weight of raw linseed oil, no curdling shall result, nor shall any marked separation or settling of the material occur after standing a reasonable time.

4. *Residue Test.*—When five cubic centimeters of the japan are poured into 95 cubic centimeters of pure turpentine at the ordinary temperature and thoroughly shaken, a clear solution shall result, without residue, on standing one hour.

II. PACKING AND MARKING.

5. *Packing.*—Japan drier shall be put up in moisture-proof barrels, cans or packages, according to the railroad company's requirements.

6. *Marking.*—The manufacturer shall mark the japan drier packages according to the railroad requirements.

III. INSPECTION AND REJECTION.

7. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere at expense of purchaser.

8. *Rejection.*—Material represented by samples which fail to conform to the requirements of these specifications or contain more than 55 per cent volatile, or less than 25 per cent turpentine in volatile material, will be rejected.

9. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from the date of test report.

Oxide of Iron Paste

Recommended Practice—ADOPTED, 1916.

1. *Scope.*—These specifications cover oxide of iron paste to be used in painting freight equipment cars, and as a priming or subsequent coats on steel cars.

I. CHEMICAL PROPERTIES AND TESTS.

2. *Chemical Composition.*—(a) The paste shall conform to the following:

Pigment	70-75 per cent by weight.
Oil	24-29 per cent by weight.
Moisture	not over 1 per cent by weight.

(b) *Pigment.*—(1) The pigment shall conform to the following:

Sesquioxide of iron, not less than	25 per cent by weight.
Carbonate of lime	2-5 per cent by weight.
Inert material	Remainder.

(2) The pigment desired, if it contains sulphate of lime or gypsum, should have this fully hydrated. It should contain only such inert material as occurs with it in nature, with no addition of barytes, aniline colors, lakes or any other inorganic coloring matter. The inert material may contain sulphate of lime or gypsum, fully hydrated, silica, kaolin, soapstone, asbestine, or mixtures of any of these, sulphate of lime, and silica preferred.

3. *Oil.*—The linseed oil shall conform to the A. R. A. specifications for linseed oil.

II. PHYSICAL PROPERTIES AND TESTS.

4. *Fineness.*—(a) The pigment shall be so fine that after having been separated from the oil and freed from hygroscopic moisture and then thoroughly mixed again with

pure raw linseed oil, which has also been freed from moisture in the proportion of one part oil to one part pigment by weight, it will stand the following:

(b) Place a small amount of the above mixture on one end of a strip of dry glass, set the strip vertical where the temperature is 70° F. and allow to remain for thirty minutes.

(c) As the mixture runs down the glass, the fineness will be acceptable if the oil and pigment does not separate in the first inch.

5. *Drying.*—Mix thoroughly the paste received with sufficient pure raw linseed oil to properly thin it for use; when thinned in this way and without the use of drier, the mixture shall dry on a piece of glass within seventy-two hours at a temperature between 60 and 80° F.

6. *Shade.*—(a) Samples of standard pigment showing shade desired will be furnished and shipments shall conform to standard shade.

(b) The shade of paint being affected by grinding, the railroad company's standard shade is that given by the dry sample mixed with the proper amount of oil and ground, or better, rubbed up in a mortar until the paste will pass the railroad company's test for fineness. As the comparison should always be made with fresh samples, samples should be made up for each day's testing. After paint has become dry it shall not be used further.

(c) The comparison can best be made by putting a small amount of the Standard paste and that to be compared in hillocks near each other on glass, and then lay a thin piece of glass as a cover on the two hillocks and press them together until the two samples unite. It is recommended to use the microscopist's cover glass for the glass used as a cover, as thin glass does not change the shade perceptibly. The line where the two samples meet will be very clearly marked if they are not of the same shade.

7. *Samples.*—Sample of paste shall be taken from one barrel, can or package in each shipment for test purposes.

III. Permissible Variations.

8. *Weight.*—As quotations are made by the pound, on the basis of the paint weighing not over 15½ lb. per gallon, all paint received which weighs more than 15½ lb. per gallon, but not over 16½ lb. per gallon, will be accepted at the weight of 15½ lb. per gallon, the excess weight being at the expense of the manufacturer.

IV. Marking.

9. *Marking.*—Each barrel, can or package shall have such marking as shall be designated by the railroad company.

V. Inspection and Rejection.

10. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

11. *Rejection.*—Material which, subsequently to above tests at the factory or elsewhere and its acceptance, develops imperfections or fails to pass any one of the tests herein required, will be rejected and shall be replaced by the manufacturer at his own expense.

12. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Metal Materials

THE METAL MATERIALS USED IN CAR CONSTRUCTION include cast iron products in the form of gray iron castings and malleable iron castings; cast steel products; forgings; rolled sheets, plates and bars; rivets, chains, and pipes; and bolts and nuts including numerous forms of lock nuts and nut locks which are used in car construction.

The composition, manufacture and inspection of these materials are covered by standard and recommended specifications adopted by the American Railway Association as follows:

Foundry Pig Iron

Recommended Practice—ADOPTED, 1906; REVISED, 1916.

1. *Scope.*—These specifications apply to all foundry pig iron which should be bought according to the grades shown by Section 3.

I. MANUFACTURE.

2. *Process.*—The pig iron shall be made in accordance with the best modern practice and may be either sand or machine cast.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The pig iron shall conform to the following requirements as to chemical compositions:

	No. 1 Foundry Coke Iron.	No. 2 Low Silicon Coke Foundry Iron.	No. 3 High Manganese Coke Foundry Iron.
Silicon, per cent.....	2.50—3.25	1.00—1.50	1.00—1.50
Manganese, per cent.....	0.50—1.00	0.50—1.00	1.75—3.00
Phosphorus, per cent.....	0.50—0.90	0.20—0.70	0.20—0.70
Sulphur, per cent, not over	0.05	0.05	0.05

Foundry charcoal pig iron will be bought in grades according to the following limits:

Silicon, per cent, maximum variation, any grade	0.25
Manganese, per cent, maximum variation, any grade	0.40
Phosphorus, per cent, not over	0.50
Sulphur, per cent, not over	0.05

4. *Ladle Analyses.*—An analysis to determine the percentages of Silicon, Manganese, Phosphorus and Sulphur shall be made by the manufacturer from a test ingot taken during the pouring of each melt, a copy of which shall be given to the purchaser or his representative. This analysis shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—Analysis may be made by the purchaser from the pigs in accordance with Section 6. This analysis shall conform to the requirements specified in Section 3.

6. *Sampling.*—Ten pigs shall be taken at random from the various parts of each carload or less. These pigs shall be broken in half, and from one-half of each pig the same amount of drillings shall be taken at or near the center by boring parallel to the axis of the pigs. These drillings shall be well mixed and a sample for chemical analysis shall be taken from this mixture.

INSPECTION AND REJECTION.

7. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

8. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Malleable Iron Castings

Recommended Practice—ADOPTED, 1915; REVISED, 1919.

1. *Scope.*—These specifications cover all malleable iron castings for freight and passenger equipment cars.

I. MANUFACTURE.

2. *Process.*—The castings shall be made by either the air furnace, open-hearth, or electric furnace process.

II. PHYSICAL PROPERTIES AND TESTS.

3. *Tension Tests.*—The tension test specimens shall conform to the following minimum requirements as to tensile properties:

Tensile strength, lb. per sq. in.	45,000
Elongation in 2 in., per cent.	7.5

4. *Annealing Tests.*—(a) All castings, if of sufficient size, shall have cast thereon test lugs of a size proportional to the thickness of the casting, but not exceeding ⅝ by ¾ in. cross-section. On castings which are 24 in. or over in length, a test lug shall be cast near each end. These test lugs shall be attached to the casting at such a point that they will not interfere with the assembling of the castings, and may be broken off by the inspector.

(b) If the purchaser or his representative so desires, a casting may be tested to destruction. Such a casting shall show good, tough malleable iron.

5. *Test Specimens.*—(a) Tension test specimens shall

be of the form and dimensions shown in Fig. 2772. Specimens in which the mean diameter at the smallest section is less than 19/32 in. will not be accepted for test.

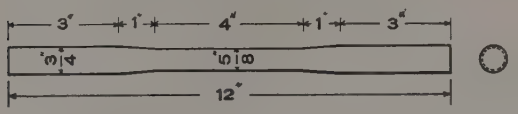


FIG. 2772—DIMENSIONS OF TEST SPECIMENS.

(b) A set of three tension test specimens shall be cast from each melt, without chills, using heavy risers of sufficient height to secure sound bars. The specimen shall be suitably marked for identification with the melt. Each set of specimens so cast shall be placed in an oven containing castings to be annealed.

6. *Number of Tests.*— (a) After annealing, three tension test specimens shall be selected by the inspector as representing castings in the oven from which these specimens are taken.

(b) If the first specimen conforms to the specified requirements, or if, in case of failure of the first specimen, the second and third specimens conform to the requirements, the castings in that oven shall be accepted, except that castings will not be accepted if the test lugs show that they have not been properly annealed. If either the second or third specimens fail to conform to requirements, the entire contents of that oven shall be rejected.

7. *Re-Annealing.*—Any castings that have shown insufficient annealing may be re-annealed, but not more than once. If the remaining test lugs, or castings broken as specimens, show the castings to be thoroughly annealed, they shall be accepted; if not, they shall be finally rejected.

III. WORKMANSHIP AND FINISH.

8. *Workmanship.*—The castings shall conform substantially to the patterns or drawings furnished by the purchaser, and also to gages which may be specified in any individual cases. The castings shall be made in a workmanlike manner. A variation of ⅛ in. per ft. will be permitted.

9. *Finish.*—The castings shall be free from injurious defects.

IV. MARKING.

10. *Marking.*—The manufacturer's identification mark and the pattern numbers assigned by the purchaser shall be cast on all castings of sufficient size. Markings shall be applied at such point that they will not interfere with the service of the castings.

V. INSPECTION AND REJECTION.

11. *Inspection.*— (a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of castings ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

(b) The purchaser may make the tests to govern the acceptance or rejection of the castings in his own laboratory or elsewhere. Such tests shall be made at the expense of the purchaser.

12. *Rejection.*— (a) Unless otherwise specified, any rejection based on tests made in accordance with Section II (b) shall be reported within 5 working days from the receipt of samples.

(b) Castings which show injurious defects subsequent to tests and acceptance at the manufacturer's works will be rejected and the manufacturer shall be notified.

13. *Rehearing.*—Samples tested in accordance with Section II (b), which represent rejected castings, shall be preserved for fourteen days from date of test report.

Annealed Carbon Steel Castings for Passenger and Freight Equipment Cars

Recommended Practice—ADOPTED, 1915; REVISED, 1919.

1. *Scope.*—These specifications cover all steel castings for passenger and freight equipment cars, including couplers, truck bolsters, truck side frames, yokes and miscellaneous castings.

I. MANUFACTURE.

2. *Process.*—The steel may be made by the open-hearth, crucible or electric process.

3. *Heat Treatment.*—Castings shall be allowed to become cold. They shall then be uniformly reheated to the proper temperature to refine the grain and allowed to cool uniformly and slowly. If, in the opinion of the purchaser or his representative, a casting is not properly annealed, he may at his option require the casting to be re-annealed.

II. CHEMICAL PROPERTIES AND TESTS.

4. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon	0.20-0.37	per cent.
Manganese	not over 0.75	per cent.
Phosphorus	not over 0.05	per cent.
Sulphur	not over 0.05	per cent.

5. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 4.

6. *Check Analyses.*—A check analysis may be made by the purchaser from the broken tension test specimen or from a finished casting representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 4. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the casting.

III. PHYSICAL PROPERTIES AND TESTS.

7. *Tension Tests.*—(a) The steel shall conform to the following minimum requirements as to tensile properties:

Tensile strength, lb. per sq. in.	65,000
Elastic limit, lb. per sq. in.	0.4 Tens. Str.
Yield point, lb. per sq. in.	0.45 Tens. Str.
Elongation in 2 in., per cent	$\frac{1{,}600{,}000}{\text{Tens. Str.}}$ Not under 22 per cent
Reduction of area, per cent	35

(b) Either the elastic limit or the yield point, but not both, shall be determined. The elastic limit shall be determined by an extensometer and the yield point by the drop of the beam of the testing machine.

(c) The yield point, or the elastic limit, shall be determined at a cross-head speed not to exceed ⅛ in. per

minute, and tensile strength at a speed not exceeding 1½ in. per minute.

8. *Alternative Tests to Destruction.*—In the case of orders including only castings not exceeding 150 lb. in weight, a test to destruction on one casting for each 100 castings or smaller lot may be substituted for the tension tests. This test shall show the material to be ductile, free from injurious defects, and suitable for the purpose intended.

9. *Test Specimens.*—(a) Tension test specimens shall conform to the dimensions shown in Fig. 2773. The ends shall not be less than ⅞ in. in diameter and of a strength and form to fit the holders of the test machine in such a manner that the load will be axial.

(b) An adequate number of test coupons shall be cast with and attached to castings, weighing over 150 lb., from each melt when presented for inspection. If the design of the casting is such that the test coupons can not be attached, the test bars shall be cast in runners outside of the casting, but attached to it to represent each melt. The location of the test coupons or bars, as well as the method of casting such coupons or bars, shall be subject to mutual agreement by the inspector and manufacturer. In the case of any orders for castings weighing under 150 lbs., the physical

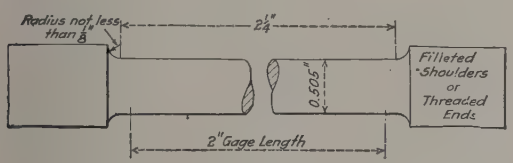


Fig. 2773—Dimensions of Test Specimens.

properties as required in Section 7 may be determined from an extra or spare test bar cast with and attached to some other casting from the same melt.

(c) When sufficient coupons have not been cast, a test specimen may be cut from a finished casting at a location mutually agreed upon by the inspector and manufacturer.

10. *Annealing Lugs.*—For the purpose of determining the quality of annealing, at least two and not more than four annealing lugs shall be cast on all castings 150 lb. and over, and on such castings less than 150 lb. as required by the purchaser. The location of the annealing lugs shall be agreed on by the inspector and the manufacturer. The standard annealing lug shall be 1 in. in height and 1 in. in width by ⅝ in. in thickness where it joins the casting. The inspector may remove one-half and the manufacturer one-half of the number of annealing lugs.

11. *Grouping Melts.*—(a) After 15 consecutive melts, which may contain any or all classes of castings covered by these specifications on one or more orders, have been tested and accepted, the manufacturer may group the succeeding melts in lots of five melts each, but each lot not to exceed 40 tons; the entire group to be accepted if the test specimen selected from the lot fulfills the chemical and physical requirements herein specified. If this test fails, a rehearing will be granted on the melt that the failed bar represents, and the other four melts of the group shall be tested individually.

(b) In case of small orders for bolsters, truck sides, draft arms, yokes or castings weighing over 150 lb., where the size of the order and the available pattern and foundry equipment are such that not more than five castings can be cast in any one melt, the physical properties as required in Section 7 may be determined from an extra or spare test coupon cast with and attached to some other casting from the same melt.

(c) If there is a period of more than 6 months between shipments of the class of castings covered by these specifications, then each melt shall be tested individually until 15 consecutive melts have been accepted, after which the melts may again be grouped as in paragraph (a).

(d) If one or more melts are rejected each succeeding melt shall be tested individually until 15 consecutive melts have been accepted, after which melts may again be grouped as in paragraph (a).

12. *Number of Tests.*—(a) One tension test shall be made from each melt, except as provided in Section II (a).

(b) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 7 (a) and any part of the fracture is more than ¾ in. from the center of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. Permissible Variations.

13. *Dimensions.*—The dimensions shall conform to the permissible variations shown on the drawings.

14. *Weight.*—The normal weight of the castings of any one design shall be determined from the actual weight of at least 50 castings weighed at one time. The weight of individual castings shall not vary more than 5 per cent over or 3 per cent under normal average weight so obtained. The gross weight of the entire order of castings to be not more than 2½ per cent over the normal average weight multiplied by the number of castings in the order. The gross weight as specified herein shall apply only on large orders of castings from machine patterns.

V. Workmanship and Finish.

15. *Workmanship.*—All castings shall substantially conform to the size and shape shown on standard drawings, and shall be made in a workmanlike manner.

16. *Patterns.*—When patterns are furnished by the purchaser, the manufacturer shall make sure that the allowance for shrinkage in these patterns agrees with his own practice, and castings shall be rejected which do not conform closely to dimensions on prints, or if distorted by improperly matched flasks, undue rapping or any other defect caused by molding. Special attention should be given to properly rounding all fillets and corners shown on drawings. Where surfaces are to be machined, the castings shall have the proper allowance for finish. Under no circumstances shall manufacturer change purchaser's patterns, without written permission from the purchaser.

17. *Finish.*—(a) The castings shall be free from all injurious defects. Castings shall not be painted before inspection. Castings rusted to any extent, or covered with any material to hide defects, shall be rejected.

(b) Any casting found with blow holes, cracks, low spots or thin sections filled with cement or like material will be rejected and shall not be further considered. Welding will not be permitted unless authorized by the inspector and then only when the defects are cleaned to solid metal and only at locations where the defects will not in any way be detrimental to the strength of the casting.

VI. Marking.

18. *Marking.*—The manufacturer's name or identification mark and the specified pattern number shall be cast on all castings. In addition, the month and year when made shall be cast on all bolsters, truck sides and similar castings. The location and size of numbers shall be agreed upon by the manufacturer and the inspector. In accordance with the standard practice of the individual foundry, to identify individual castings, a serial number

may be cast or the melt numbered may be stamped on bolsters, truck sides and similar castings as agreed upon by the manufacturer and the inspector.

VII. Inspection and Rejection.

19. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of castings ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

20. *Rejection.*—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 6 shall be reported within five working days from receipt of samples.

(b) Castings which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

21. *Rehearing.*—Samples tested in accordance with Section 6, which represent rejected castings, shall be preserved for two weeks from the date of test report.

Carbon Steel Castings

Tentative—adopted, 1921.

1. *Scope.*—(a) These specifications cover annealed and unannealed carbon steel castings for locomotive and car equipment, and for miscellaneous use.

(b) The purposes for which the two grades are generally used are:

Grade A, for castings designed for a low stress.

Grade B, for castings designed for unit stresses of 12,500 to 16,000 lb. per square inch, such as truck side frames, bolsters, couplers and coupler parts, locomotive frames, locomotive driving and trailer wheel centers.

I. Manufacture.

2. *Process.*—The steel may be made by the open-hearth or any other process approved by the purchaser.

3. *Annealing.*—(a) Grade A steel shall be annealed if the carbon content exceeds 0.30 per cent, or if the manganese content exceeds 0.75 per cent. Grade B steel shall be annealed if the carbon content exceeds 0.22 per cent, or if the manganese content exceeds 0.65 per cent.

(b) Castings of both Grades "A" and "B" of irregular section, and of less carbon or manganese content than specified in paragraph (a), where shrinkage or other internal stresses may be expected, should be annealed.

(c) Castings that require annealing shall be allowed to become cold. They shall then be uniformly heated to the proper temperature to refine the grain and allowed to cool uniformly.

(d) *Annealing Lugs.*—For the purpose of determining the quality of annealing, at least two and not more than four annealing lugs shall be cast on all castings 150 lb. and over, and on such castings less than 150 lb. as required by the purchaser. The locating of the annealing lugs shall be agreed upon by the inspector and the manufacturer. The standard annealing lug shall be 1 in. in height and 1 in. in width and ⅝ in. in thickness where it joins the casting. The inspector may remove one-half and the manufacturer one-half of the number of annealing lugs.

Note—The present Specifications for Steel Castings for Cars and Locomotives is retained as Recommended Practice of the Division and these Specifications are printed as Tentative Specifications until further action is justified by the experience of the members in working to them.

(e) If, in the opinion of the purchaser or his representative, a casting is not properly annealed, he may at his option require the casting to be re-annealed.

II. Chemical Properties and Tests.

4. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Phosphorus, not over.....0.05 per cent
Sulphur, not over.....0.05 per cent

5. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, silicon, phosphorus and sulphur. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, when requested, and shall conform to the requirements specified in Section 4.

6. *Check Analyses.*—A check analysis may be made by the purchaser from the broken tension test specimen or from a casting representing each melt. The phosphorus and sulphur thus determined shall conform to the requirements specified in Section 4. Determination of carbon and manganese should be made as information to ascertain whether the annealing was in accordance with Section 3 (a). Drillings for analysis shall be taken not less than ¼ in. beneath the surface, and if from a casting shall be taken in such a manner as not to impair its usefulness.

III. Physical Properties and Tests.

7. *Tension Tests.*—(a) The steel shall conform to the following minimum requirements as to tensile properties:

	Grade A.	Grade B.
Elastic limit, lb. per sq. in..	26,000	32,000
Yield point, lb. per sq. in...	29,250	36,000
Product of elastic limit and per cent elongation in 2 in.	700,000 (not less than 22%)	850,000 (not less than 18%)
Product of yield point and per cent elongation in 2 in.	788,000 (not less tran 22%)	956,000 (not less than 18%)
Produce of elastic limit and per cent reduction of area	975,000 (not less than 33%)	1,200,000 (not less than 27%)
Product of yield point and per cent reduction of area	1,100,000 (not less than 33%)	1,350,000 (not less than 27%)

(b) The ultimate tensile strength shall be reported as information.

(c) Either the elastic limit or the yield point, but not both, shall be determined. The elastic limit called for by these specifications shall be determined by an extensometer reading to at least 0.0002 in. The extensometer shall be attached to the specimen at the gage marks and not to the shoulders of the specimen nor to any part of the testing machine. When the specimen is in place and the extensometer attached, the testing machine shall be operated so as to increase the load on the specimen at a uniform rate. The observer shall watch the elongation of the specimen as shown by the extensometer and shall note for this determination the load at which the rate of elongation shows a sudden increase. The extensometer shall then be removed from the specimen, and the test continued to determine the tensile strength.

(d) The yield point, or the elastic limit, shall be determined at a crosshead speed not to exceed ⅛ in. per minute and tensile strength at a speed not to exceed 1½ in. per

minute. The yield point shall be determined by the drop of the beam of the testing machine.

8. *Alternative Tests to Destruction.*—In the case of orders including only castings not exceeding 150 lb. in weight, a test to destruction on one casting for each 100 castings or smaller lot may, at the option of the purchaser, be substituted for the tension tests. This test shall show the material to be ductile, free from injurious defects, and suitable for the purpose intended. Castings of minor importance may be accepted on surface inspection.

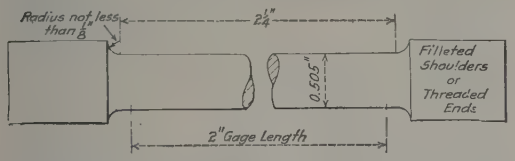


FIG. 2774—DIMENSIONS OF TEST SPECIMENS.

9. *Test Specimens.*—(a) Tension test specimens shall conform to the dimensions shown in Fig. 2774. The ends shall not be less than ⅞ in. in diameter and of a length and form to fit the holders of the test machine in such a manner that the load will be axial.

(b) An adequate number of test coupons shall be cast with and attached for castings weighing over 150 lb. from each melt when presented for inspection; coupons shall be cast attached to each end of each locomotive frame, to each locomotive cylinder and to each wheel center. If the design of the casting is such that the test coupons cannot be attached, the test bars shall be cast in runners outside of the casting, but attached to it to represent each melt. The location of the test coupons or bars, as well as the method of casting such coupons or bars, shall be subject to mutual agreement by the inspector and manufacturer. In the case of any orders for castings weighing under 150 lb., the physical properties as required in Section 7 may be determined from an extra or spare test bar cast with and attached to some other casting from the same melt.

(c) When sufficient coupons have not been cast, a test specimen may be cut from a finished casting at a location mutually agreed upon by the inspector and manufacturer.

10. *Grouping Melts.*—(a) After 15 consecutive melts, which may contain any or all kinds of castings (except frames, wheel centers and cylinders) covered by these specifications on one or more orders, have been tested and accepted, the manufacturer may group the succeeding melts in lots of five melts each, but each lot not to exceed 40 tons; the entire group to be accepted if the test specimen selected from the lot fulfills the chemical and physical requirements herein specified. If this test fails, a rehearing will be granted on the melt that the failed bar represents, and the other four melts of the group shall be tested individually.

(b) In case of small orders for bolsters, truck sides, draft arms, yokes or castings weighing over 150 lb., where the size of the order and the available pattern and foundry equipment are such that not more than five castings can be cast in any one melt, the physical properties as required in Section 7 may be determined from an extra or spare test coupon cast with and attached to some other casting from the same melt.

(c) If there is a period of more than six months between shipments of the class of castings covered by these specifications then each melt shall be tested individually until 15 consecutive melts have been accepted, after which the melts may again be grouped as in paragraph (a).

(d) If one or more melts are rejected, each succeeding melt shall be tested individually until 15 consecutive melts have been accepted, after which melts may again be grouped as in paragraph (a).

11. *Number of Tests.*—(a) One tension test shall be made from each locomotive frame. One tension test may be made from each wheel center and each locomotive cylinder casting, but at least one of each kind of such castings in each melt shall be tested. For miscellaneous castings from melts which do not include frames, wheel centers or cylinders, one tension test shall be made from each melt except as provided in Section 10 (a).

(b) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 7 (a) and any part of the fracture is more than ¾ in. from the center of the gage length as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

(d) If the results of physical tests do not conform to the requirements specified, the manufacturer may reanneal the castings but not more than twice. A retest shall be made as specified in Section 7.

(e) No part of these specifications shall operate to cause any one tension test to apply to more than 40 tons of castings that are offered for inspection.

IV. WORKMANSHIP AND FINISH.

12. *Workmanship.*—All castings shall substantially conform to the size and shape shown on standard drawings, and shall be made in a workmanlike manner.

13. *Finish.*—(a) The castings shall be free from all injurious defects. Castings shall not be painted before inspection. Castings rusted to any extent, or covered with any material to hide defects, shall be rejected.

(b) Any casting found with blow holes, cracks, low spots or thin sections filled with cement or like material will be rejected and shall not be further considered. Welding will not be permitted unless authorized by the inspector and then only when defects are cleaned to solid metal and only at locations where the defects will not in any way be detrimental to the strength of the casting.

V. MARKING.

14. *Marking.*—The manufacturer's name or identification mark and the specified pattern number shall be cast on all castings. In addition, the month and year when made shall be cast on all bolsters, truck sides and similar castings. The location and size of numbers shall be agreed upon by the manufacturer and the inspector. In accordance with the standard practice of the individual foundry, to identify individual castings, a serial number may be cast or the melt number may be stamped on bolsters, truck sides and similar castings as agreed upon by the manufacturer and the inspector. The melt number shall be legibly stamped on all other castings weighing over 150 lb.

VI. INSPECTION AND REJECTION.

15. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of castings ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

16. *Rejection.*—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 6

Steel Castings and Forgings

The Standard Steel Works Company has developed extensive facilities for the manufacture of steel castings and forgings, which have been in operation for several years.

The capacity of the Steel Foundry which was established in 1897 has been increased from time to time to keep pace with the increased demand for steel castings of high quality for railway service; the Standard Steel Works Company has specialized in the production of high grade castings for railway equipment of a special nature where quality and accuracy are important.

The Forge Shop was established in 1898 and has been enlarged on several occasions until now it is possible to manufacture forgings weighing up to 40 tons.

Carbon and alloy steel forgings are manufactured from ingots produced in the plant of the Standard Steel Works Company or from purchased rolled steel blooms. The use of ingots produced by the company is advantageous as it gives complete control of the processes of manufacture from the raw stock to the finished forging.

The Forge Shop equipment includes steam-hydraulic forging presses of 600 to 2,500 tons and steam hammers of 8,000 lb. capacity. Furnaces up to 25 ft. in length are available for heating forgings which are to be quenched and up to 45 ft. long for forgings that are to be annealed.

The process of forging leaves the steel with internal strains and an irregular grain structure; to put the steel into a satisfactory condition for railway service the grain structure must be refined and the internal strains relieved by annealing, or by quenching and tempering. For either annealing or for quenching and tempering the forging is heated to a temperature sufficiently high to refine the grain. For annealing the forging is allowed to cool relatively slowly either in the air or in the furnace. For quenching and tempering the forging is rapidly cooled by quenching in oil or water and is tempered by being reheated to a lower temperature and then allowed to cool uniformly. To secure uniform and satisfactory results the annealing and heat treating should be carried out in furnaces with accurate pyrometer control.

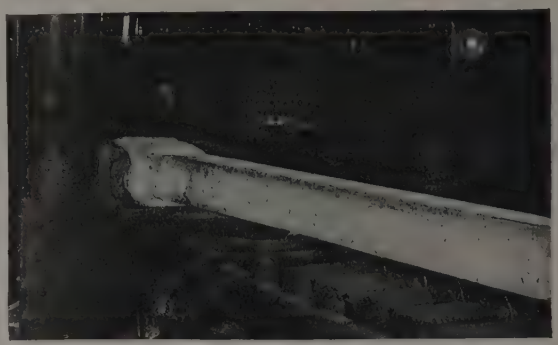


Fig. 2776—A "Standard" Forging Under the Hydraulic Press

The Heat Treating Plant, in which these operations are carried out, is fully equipped with furnaces capable of accurate temperature control, the temperature measurement being carried out by an elaborate installation of pyrometers. Oil and water tanks are available for quenching in either the horizontal or vertical position.

Alloy steels, such as chrome-vanadium or chrome-nickel steels, may be used when castings or forgings of greater strength than is given by quenched and tempered carbon steel are required. In the production of these alloy steel forgings and castings greater care is required and is given in the heat treatment than with the carbon steels.

The Standard Steel Works Company also manufactures semi-finished blooms and open-hearth ingots of their own manufacture.

Fig. 2775—Miscellaneous Steel Castings Made by the Standard Steel Works Company

For other products and branch offices, see classified and alphabetical indexes.

STANDARD STEEL WORKS COMPANY, PHILADELPHIA, PA.

shall be reported within five working days from receipt of samples.

(b) Castings which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

17. *Rehearing.*—Samples tested in accordance with Section 6, which represent rejected castings, shall be preserved for two weeks from the date of test report. In case of dissatisfaction with the results of tests, the manufacturer may make claim for rehearing within that time.

Galvanized Sheets

Standard—ADOPTED, 1917; REVISED, 1919.

1. *Scope.*—These specifications cover all galvanized steel and iron sheets.

I. MANUFACTURE.

2. *Process.*—(a) The sheet material may be either open-hearth mild steel, or puddled iron made wholly from pig iron.

(b) All sheets shall be thoroughly cleaned and then galvanized with a coating of not less than 1.5 oz. of zinc per sq. ft.

II. PHYSICAL PROPERTIES AND TESTS.

3. *Bend Tests.*—(a) A test specimen shall stand bending double on itself around a mandrel, the diameter of which is equal to four times the thickness of the specimen, without cracking or flaking of the coating on either side of the specimen.

(b) A test specimen shall bend twice in the same direction, first around a mandrel the diameter of which is equal to fifteen times the thickness of the specimen, and straighten, and then bend flat on itself and straighten, without cracking of the base material.

TABLE 1.

WEIGHT OF GALVANIZED SHEETS.

United States Standard Gage Number.	Weight Per Sq. Ft. Oz.	United States Standard Gage Number.	Weight Per Sq. Ft. Oz.
16	42.5	24	18.5
17	38.5	25	16.5
18	34.5	26	14.5
19	30.5	27	13.5
20	26.5	28	12.5
21	24.5	29	11.5
22	22.5	30	10.5
23	20.5		

(c) Sheets of Gage No. 26 and less in thickness shall double-lock-seam without cracking of the sheet or coating.

4. *Test Specimen.*—Specimens 8 in. in length by 2 in. in width shall be cut from the center of a sheet selected at random from each lot of 1,000 sheets or fraction thereof, for test purposes.

III. PERMISSIBLE VARIATIONS IN WEIGHT.

5. *Permissible Variations.*—The weight of the finished sheets shall not vary more than 2½ per cent either way from that shown in Table 1.

IV. WORKMANSHIP AND FINISH.

6. *Workmanship.*—The sheets shall conform to the gage and size ordered.

7. *Finish.*—The finished sheets shall be properly galvanized, be free from blackened and acid spots and surface defects.

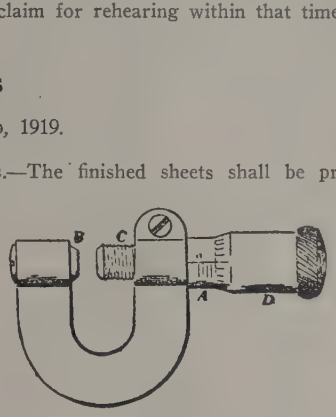


FIG. 2777—STANDARD SHEET METAL GAGE.

V. MARKING.

8. *Marking.*—The finished sheets shall, when ready for shipment, be properly marked with the name or brand of the manufacturer and a lot number for identification.

VI. INSPECTION AND REJECTION.

9. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

10. *Rejection.*—(a) Sheets represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Sheets which, subsequent to tests and inspection at the mills or elsewhere and their acceptance, show black spots, inferior galvanizing, improper trimming or other defects will be rejected and shall be replaced by the manufacturer.

11. *Rehearing.*—Samples tested in accordance with Section 9 (b), which represent rejected material, shall be preserved for two weeks from the date of the test report.

Structural Steel Plates and Sheets for Freight Equipment Cars

Standard—ADOPTED, 1917; REVISED, 1918.

1. *Scope.*—These specifications apply to all shapes, plates and sheets.

I. MANUFACTURE.

2. *Process.*—The steel shall be made by the open-hearth process.

II. CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon, not over	0.25 per cent.
Manganese	Optional per cent.
Phosphorus, not over	0.05 per cent.
Sulphur, not over	0.06 per cent.

4. *Ladle Analyses.*—An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus and sulphur. Drillings for analysis shall

be taken not less than ¼ in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative. This analysis shall conform to the requirements specified in Section 2.

5. *Check Analyses.*—Check analysis may be made from the finished material representing each melt, if so desired by the purchaser or his representative, and shall meet the requirements specified in Section 2.

III. Physical Properties and Tests.

6. *Bend Tests.*—(a) The test specimen for structural steel shall bend cold through 180 deg. without fracture on the outside of the bent portion as follows: For material ¾ in. in thickness and under, flat on itself; for material over ¾ in. to and including 1¼ in. in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for thicknesses over 1¼ in. around a pin the diameter of which is equal to twice the thickness of the specimen.

(b) Angles ¾ in. or under in thickness shall open flat and angles ½ in. or under in thickness shall bend shut, cold, without fracture.

(c) Bend test specimens shall be 1½ in. or over in width by the thickness of the material with planed or milled edges.

Note.—The above tests may be made either by pressure or by blows.

7. *Number of Tests.*—At least one bend test for structural steel shall be made for each thickness from each melt, and shall be taken from the finished product.

IV. Permissible Variations in Weight and Gage.

8. *Permissible Variations.*—(a) The cross section, or weight per lineal foot of shapes shall not vary more than 2.5 per cent from that specified.

(b) *When Ordered to Weight per Square Foot.*—The weight of each lot of sheets in each shipment shall not vary from the weight ordered more than the amount given in Table I. One cu. in. of steel is assumed to weigh 0.2833 lb.

(c) *When Ordered to Thickness.*—The thickness of each sheet shall not be more than 0.01 in. under that ordered. The overweight of each lot of sheets in each shipment shall not exceed the amount given in Table II.

(d) A variation from the length ordered of ⅛ in. under and ¼ in. over will be permitted for sheets or shapes under 12 ft. in length, and a variation of ¼ in. under and ½ in. over will be permitted for sheets or shapes 12 ft. and over in length.

V. Finish.

9. *Finish.*—The finished material shall be free from injurious seams, slivers, flaws and other defects, and shall have a workmanlike finish.

VI. Marking.

10. *Marking.*—The name of the manufacturer and the melt number shall be legibly stamped or rolled on all finished material, but small pieces may be shipped in securely

TABLE I.—PERMISSIBLE VARIATIONS OF PLATES ORDERED TO WEIGHT

Permissible Variations in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Ordered Weights.

Ordered Weight, Lb. per Sq. Ft.	Under 48 In.		48 to 60 In., Excl.		60 to 72 In., Excl.		72 to 84 In., Excl.		84 to 96 In., Excl.		96 to 108 In., Excl.		108 to 120 In., Excl.		120 to 132 In., Excl.		132 In. or Over.		Ordered Weight, Lb. per Sq. Ft.
	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	Over.	Under.	
Under 5	5	3	5.5	3	6	3	7	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Under 5.
5 to 7.5, excl.	4.5	3	5	3	5.5	3	6	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5 to 7.5, excl.
7.5 to 10, excl.	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	.....	.....	.....	.....	7.5 to 10, excl.
10 to 12.5, excl.	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3	10 to 12.5, excl.
12.5 to 15, excl.	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	12.5 to 15, excl.
15 to 17.5, excl.	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	15 to 17.5, excl.
17.5 to 20, excl.	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	17.5 to 20, excl.
20 to 25, excl.	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	20 to 25, excl.
25 to 30, excl.	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3	25 to 30, excl.
30 to 40, excl.	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	30 to 40, excl.
40 or over	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	40 or over.

Note.—The weight per square foot of individual plates shall not vary from the ordered weight by more than 1½ times the amount given in this table.

1 The term "lot" applied to Table I means all of the plates of each group width and group weight.

2 The term "lot" applied to Table II means all of the plates of each group width and group thickness.

TABLE II—PERMISSIBLE OVERWEIGHTS OF PLATES ORDERED TO THICKNESS.

Permissible Excess in Average Weights per Square foot of Plates for Widths Given, Expressed in Percentages of Nominal Weights.

Ordered Thickness, In.	Under 48 In.	48 to 60 In., Excl.	60 to 72 In., Excl.	72 to 84 In., Excl.	84 to 96 In., Excl.	96 to 108 In., Excl.	108 to 120 In., Excl.	120 to 132 In., Excl.	132 In. or Over.	Ordered Thickness, In.
Under ⅛	9	10	12	14	.....	.....	.....	.....	.....	Under ⅛
⅛ to 3/16, excl.	8	9	10	12	.....	.....	.....	.....	.....	⅛ to 3/16, excl.
3/16 to ¼, excl.	7	8	9	10	12	.....	.....	.....	.....	3/16 to ¼, excl.
¼ to 5/16, excl.	6	7	8	9	10	12	14	16	19	¼ to 5/16, excl.
5/16 to ⅜, excl.	5	6	7	8	9	10	12	14	17	5/16 to ⅜, excl.
⅜ to 7/16, excl.	4.5	5	6	7	8	9	10	12	15	⅜ to 7/16, excl.
7/16 to ½, excl.	4	4.5	5	6	7	8	9	10	13	7/16 to ½, excl.
½ to 5/8, excl.	3.5	4	4.5	5	6	7	8	9	11	½ to 5/8, excl.
5/8 to ¾, excl.	3	3.5	4	4.5	5	6	7	8	9	5/8 to ¾, excl.
¾ to 1, excl.	2.5	3	3.5	4	4.5	5	6	7	8	¾ to 1, excl.
1 or over	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over.

fastened bundles, with the above marks legibly stamped on an attached metal tag.

VII. Inspection and Rejection.

11. *Inspection.*—(a) The inspector representing the purchaser shall have free entry at all times, while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

12. *Rejections.*—Material which, subsequently to above tests at the mills or elsewhere and its acceptance, develops weak spots, brittleness, cracks or other imperfections, or fails to pass any one of the tests herein required, will be rejected, and shall be replaced by the manufacturer at his own expense.

13. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Rivet Steel and Rivets for Passenger and Freight Equipment Cars

Standard—adopted, 1917; revised, 1919.

1. *Scope.*—These specifications cover steel bars for the manufacture of rivets and finished steel rivets for locomotive tanks and underframes, passenger and freight equipment cars.

I. Manufacture.

2. *Process.*—The steel shall be made by the open-hearth process.

II. Chemical Properties and Tests.

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon .....percentage optional.
Manganese .....percentage optional.
Phosphorus .....not over 0.04 per cent.
Sulphur .....not over 0.05 per cent.

4. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—An analysis may be made by the purchaser from finished bars or rivets representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 3.

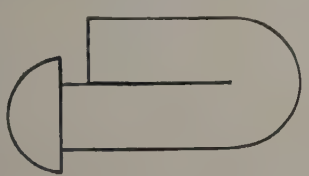


Fig. 2778—Bend Test.

III. Physical Properties and Tests.

A.—Requirements for Bars.

6. *Tension Tests.*—The bars shall conform to the following requirements as to tensile properties:

Tensile strength, lb. per sq. in..... 45,000-60,000

Elongation in 8 in., min. per cent.... $\frac{1{,}500{,}000}{\text{Tens. Str.}}$

but need not exceed 30 per cent.

7. *Bend Test.*—The test specimen shall bend cold through 180 deg. flat on itself without cracking on the outside of the bent portion.

B.—Requirements for Rivets.

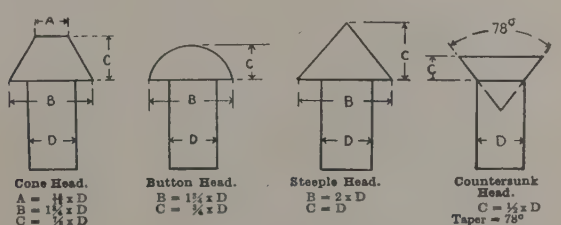
8. *Bend Tests.*—The rivet shank shall bend cold through 180 deg. flat on itself, as shown in Fig. 2778, without cracking on the outside of the bent portion.

9. *Flattening Test.*—Rivet heads shall be flattened sideways, when cold, to a thickness of one-third, and when at a driving heat to a thickness of one-fourth the original diameter of the shank, without splitting.

TABLE NO. 1

Dimensions for Rivets

Diam. of Rivet	Cone Head			Button Head		Steeple Head		Countersunk Head
D	A	B	C	B	C	B	C	C
¼	15/64	7/16	7/32	7/16	3/16	½	¼	1/16
5/16	19/64	35/64	9/32	35/64	15/64	5/8	5/16	1/8
3/8	23/64	21/32	21/64	21/32	9/32	¾	3/8	5/16
7/16	27/64	49/64	25/64	49/64	21/64	7/8	7/16	11/32
½	15/32	7/8	7/16	7/8	3/8	1	½	¼
9/16	17/32	63/64	1/2	63/64	27/64	1 1/8	9/16	9/32
5/8	19/32	1 3/32	35/64	1 3/32	15/32	1¼	5/8	5/16
11/16	41/64	1 13/64	39/64	1 13/64	33/64	1 3/16	11/16	11/32
¾	45/64	1 5/16	21/32	1 5/16	9/16	1½	¾	3/8
13/16	49/64	1 27/64	23/32	1 27/64	39/64	1 5/16	13/16	13/32
7/8	53/64	1 17/32	49/64	1 17/32	21/32	1¾	7/8	7/16
15/16	7/8	1 41/64	53/64	1 41/64	45/64	1 7/8	15/16	15/32
1	15/16	1 3/4	7/8	1 3/4	3/4	2	1	½
1 1/16	1	1 55/64	15/16	1 55/64	51/64	2 1/16	1 1/16	17/32
1⅛	1 1/16	1 31/32	63/64	1 31/32	27/32	2¼	1⅛	9/16
1 3/16	1 1/8	2 5/64	1 3/64	2 5/64	57/64	2 3/16	1 3/16	19/32
1¼	1 11/64	2 3/16	1 3/32	2 3/16	15/16	2½	1¼	5/8
1 5/16	1 9/32	2 13/32	1 13/64	2 13/32	1 1/32	2¾	1 5/16	21/32
1⅜	1 13/32	2 5/8	1 5/16	2 5/8	1 1/8	3	1⅜	¾
1¾	1 41/64	3 1/16	1 17/32	3 1/16	1 5/16	3½	1¾	7/8
2	1 7/8	3 1/2	1 3/4	3 1/2	1 1/2	4	2	1



Cone Head. A = H x D; B = 1¼ x D; C = ¼ x D

Button Head. B = 1¼ x D; C = ¾ x D

Steeple Head. B = 2 x D; C = D

Countersunk Head. C = ½ x D; Taper = 78°

10. *Test Specimens.*—(a) Bars.—Tension and bend test specimens shall be of the full section of bars as rolled.

(b) Rivets.—Bend and flattening test specimens shall be of the full section of rivets as manufactured.

(c) When accurate account of the material has been kept and the melts can be identified, only one set of specimens for each diameter in each melt shall be taken from either bars or the finished rivets.

11. *Number of Tests.*—(a) Bars.—One tension and one bend test shall be made from each lot of 200 bars, or from

each diameter in any one melt, each of which shall conform to the requirements specified.

(b) RIVETS.—One bend and one flattening test shall be made from each lot of 50 kegs of each diameter or from each diameter in any one melt, each of which shall conform to the requirements specified.

(c) If any test specimen from the bar or rivets originally selected to represent a lot of bars or rivets contain surface defects not visible before testing, but visible after testing, or if a tension test specimen breaks outside the middle third of the gage length, one retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN GAGE.

12. *Permissible Variations.*—The bars shall conform to the A. R. A. standard limit gages.

13. *Dimensions of Rivet Heads.*—Rivet heads shall conform to the dimensions shown on the purchaser's standard drawings when so specified, otherwise the heads shall conform within 5 per cent above or below, to the dimensions shown in Table 1.

V. WORKMANSHIP AND FINISH.

14. *Workmanship.*—The finished base shall be circular within 0.01 in., and the rivets shall be concentric, true to form and shall be made in a workmanlike manner.

15. *Finish.*—The finished bars and rivets shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING.

16. *Marking.*—(a) BARS.—Rivet bars shall, when ready for shipment, be properly separated and marked with the name or brand of the manufacturer and the melt or lot number for identification.

(b) RIVETS.—Kegs of finished rivets shall, when ready for shipment, be properly marked with the name or brand of the manufacturer, diameter of rivets and the melt or lot number for identification.

(c) SAMPLES.—The melt or lot number shall be legibly stamped on each test specimen representing a lot of bars. Samples representing a lot of rivets shall be marked in a manner that will not impair their value for test purposes.

VII. INSPECTION AND REJECTION.

17. *Inspection.*—The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the bars or rivets ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the bars or rivets are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

18. *Rejection.*— (a) Unless otherwise specified, any rejection based on tests made in accordance with Section 5 shall be reported within 5 working days from the receipt of samples.

(b) Bars, or rivets which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

19. *Rehearing.*—Samples tested in accordance with Section 5, which represent rejected bars or rivets, shall be preserved for two weeks from the date of the test report.

Shearing Values of Structural, Rivet and Mild Steel

Recommended Practice—ADOPTED, 1915.

The allowable stress per sq. in. for iron or steel, subject to shear in a plane perpendicular to the direction of rolling, shall not exceed 80 per cent of the allowable stress per sq. in. for tension, in the direction of rolling.

Refined Wrought Iron Bars

Recommended Practice—ADOPTED, 1914.

I. MANUFACTURE.

1. *Process.*—The finished product shall consist either of new muck-bar iron or a mixture of muck-bar iron and scrap, but shall be free from any admixture of steel. Muck bars shall be made wholly from puddled iron.

II. PHYSICAL PROPERTIES AND TESTS.

2. *Tension Tests.*—Unless otherwise specified, the iron shall conform to the following requirements as to tensile properties:

Tensile strength, lb. per sq. in.....47,000—53,000
Elongation in 8 in., minimum per cent.....22

3. *Permissible Variations in Physical Properties.*—(a) Tensile Strength.—Large sections reduced of flats and rounds of ½ in. or under may show a tensile strength of 45,000-52,000 lb. per sq. in.

(b) Elongation.—Twenty per cent of the test specimens representing one size may show the following percentage of elongation in 8 in.:

½ in. or over, tested as rolled.....20 per cent.
Under ½ in. tested as rolled.....16 per cent.
Reduced by machining.....18 per cent.

FLAT BARS:

⅜ in. or over, tested as rolled.....18 per cent.
Under ⅜ in., tested as rolled.....16 per cent.
Reduced by machining.....16 per cent.

4. *Bend Tests.*—(a) Cold-bend Test.—For round, square and hexagon bars under 2 sq. in. in section, and for flats less than ¾ in. thick, shall bend cold around a pin the diameter of which is equal to the diameter or thickness of the specimen, without fracture on the outside of the bent portion. For rounds, flats and hexagon bars 2 sq. in. or over in section, and for all flat bars over ¾ in. in thickness, around a pin the diameter of which is equal to twice the diameter or thickness of the specimen.

(b) Hot-bend Test.—The test specimen, when heated to a temperature between 1700 and 1800 deg. F. (light cherry red), shall bend through 180 deg. without fracture on the outside of the bent portion, as follows: For round, flat and hexagon bars under 2 sq. in. in section, flat on itself; for round, flat and hexagon bars 2 sq. in. nad over in section, around a pin the diameter of which is equal to the diameter or thickness of the specimen.

(c) Nick-bend Test.—The test specimen, when nicked 25 per cent around the round bar, and along one side for flat bars, with a tool having a 60-deg. cutting edge, to a depth of not less than 8 or more than 16 per cent of the diameter or thickness of the specimen, and broken, shall not show more than 10 per cent of the fractured surface to be crystalline.

5. *Test Specimen.*—Tension and bend test specimens shall be of the full section of material as rolled, if possible, otherwise the specimens shall be machined from the material as rolled; the axis of the machined specimen shall be located at any point one-half the distance from the center to the surface of round bars, or from the center to the edge of flat bars, and shall be parallel to the axis of the bar.

6. *Number of Tests.*—(a) All bars of one size shall be

piled separately. One bar from each 200 or less shall be selected at random and tested as specified.

(b) If any test specimen from the bar originally selected to represent a lot of material contains surface defects not visible before testing, but visible after testing, or if a tension-test specimen breaks outside the middle third of the gage length, one retest from a different bar will be allowed.

III. Permissible Variations in Gage.

7. *Permissible Variations.*—(a) Round bars shall conform to the standard A. R. A. limit gages.

(b) Flat bars.—The width and thickness of flat bars shall not vary more than 2 per cent from that specified.

(1) Sizes under 3 in. wide shall not be more than 1/32 in. under or over size in width.

(2) Sizes 3 in. and over shall not be under size or more than 1/16 in. wider than ordered.

IV. Finish.

8. *Finish.*—The bars shall be smoothly rolled and free from slivers, depressions, seams, crop ends, and evidences of being burned.

V. Inspection and Rejection.

9. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

10. *Rejection.*—Material which, subsequently to the above tests at the mills or elsewhere, and its acceptance, develops weak spots, cracks or imperfections, or is found to have injurious defects, shall be rejected and shall be replaced by the manufacturer at his own expense.

11. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Mild Steel Bars

Standard—adopted, 1917.

1. *Scope.*—This grade of material will be used for miscellaneous parts, such as arch bars, bolts, hand holds, steps and for general threading and welding material.

I. Manufacture.

2. *Process.*—The steel shall be made by the open-hearth process.

II. Chemical Properties and Tests.

3. *Chemical Composition.*—The Steel shall conform to the following requirements as to chemical composition:

Carbon	Optional	per cent.
Manganese	Optional	per cent.
Phosphorus	not over 0.05	per cent.
Sulphur	not over 0.05	per cent.

4. *Ladle Analyses.*—Analysis shall be made by the manufacturer from a test ingot taken from the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus and sulphur. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative. This analysis shall conform to the requirements specified in Section 2.

5. *Check Analyses.*—A check analysis shall be made from the finished material representing each melt, if so desired by the purchaser or his representative, and shall meet the requirements specified in Section 2.

III. Physical Properties and Tests.

6. *Tension Tests.*—The steel shall conform to the following requirements as to tensile properties:

Tensile strength, lb. per sq. in...50,000-65,000 for sizes smaller than 1 in. flats and 2 in. rounds.

Tensile strength, lb. per sq. in...50,000-60,000 for larger sizes.

Elongation in 8 in., per cent...1,500,000 tensile strength.

7. *Yield Point.*—The yield point as determined by the drop of the beam of the testing machine shall be one-half the ultimate tensile strength.

8. *Bend Test.*—The test specimen shall bend cold through 180 deg. without cracking on the outside of the bent portion, as follows: For material ¾ in. or under in thickness, flat on itself; for material over ¾ in. to and including 1¼ in. in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for material over 1¼ in. in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

9. *Test Specimen.*—Tension and bend-test specimens shall be of the full section of material as rolled, if possible; otherwise the specimen shall be machined from the material as rolled. The axis of the specimen shall be located at any point one-half the distance from the center to the surface of round bars, or from the center to the edge of flat bars, and shall be parallel to the axis of the bar.

10. *Number of Tests.*—(a) One tension and one bend test shall be made from each melt; except if material from one melt differs ⅜ in. or more in thickness or diameter, one tension and one bend test shall be made from both the thickest and the thinnest material rolled. When the material from separate melts can not be identified, one sample shall be taken from each lot of 30,000 lb. or fraction thereof. When the bars in any lot are not all of the same diameter or thickness samples shall be taken so as to represent each size differing in diameter or thickness by ⅜ in., and in all cases the thickest and the thinnest sections shall be represented.

(b) If any test specimen from the bar originally selected to represent a lot of material contains surface defects not visible before testing, but visible after testing, or if a tension-test specimen breaks outside the middle third of the gage length, one retest from a bar will be allowed.

IV. Permissible Variations in Gage.

11. *Permissible Variations.*—All bars shall conform to the limits as given in the table on the following page.

V. Finish.

12. *Finish.*—The finish material shall be smoothly rolled and free from injurious seams, slivers, flaws and other defects, and shall have a workmanlike finish.

VI. Inspection and Rejection.

13. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the

manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

14. *Rejection.*—Material which, subsequently to above tests at mills or elsewhere and its acceptance, develops weak spots or imperfections, or fails to pass any one of the tests herein required, will be rejected, and shall be replaced by the manufacturer entirely at his own expense.

15. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

ROUNDS, SQUARES, HEXAGONS

Size	Variations in Size: Under	Variations in Size: Over
Up to and including ½ in.	.007 in.	.007 in.
Over ½ in. and including 1 in.	.010 in.	.010 in.
Over 1 in. and including 2 in.	1/64 in.	1/32 in.
Over 2 in. and including 3 in.	1/32 in.	3/64 in.
Over 3 in. and including 5 in.	1/32 in.	3/32 in.
Over 5 in. and including 8 in.	1/16 in.	⅛ in.

FLATS

Width of Flats	Variation in Width: Under	Variation in Width: Over	Thickness in Flats. Variation in Thickness, Under and Over: 3/16 In. and Under	Over 3/16 In. Up to ½ In.	Over ½ In. Up to 1 In.	Over 1 In. Up to 2 In.
Up to and including 1 in.	1/64 in.	1/32 in.	.006 in.	.008 in.	.010 in.	.....
Over 1 in. up to and including 2 in.	1/32 in.	3/64 in.	.008 in.	.012 in.	.015 in.	1/32 in.
Over 2 in. up to and including 4 in.	3/64 in.	1/16 in.	.010 in.	.015 in.	.020 in.	1/32 in.
Over 4 in. up to and including 6 in.	1/16 in.	3/32 in.	.010 in.	.015 in.	.020 in.	1/32 in.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

Limit Gages for Round Iron

Recommended Practice—ADOPTED, 1893; MODIFIED, 1911.

Limit gages such as shown herewith for 1¼-in. iron are recommended for use in procuring round iron to take the Sellers' standard screw threads; round iron used to be of such size as will enter the large or + end of the gage intended for that size, in any way, and also of such size as will not enter the small or — end in any way.

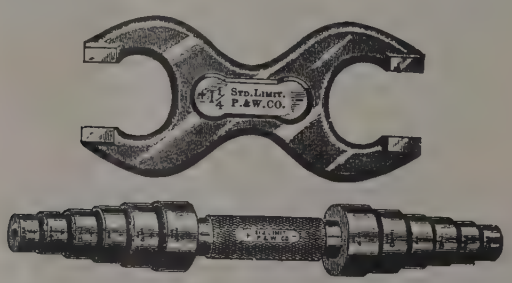


FIG. 2779

The limiting diameters for certain nominal sizes of iron together with the maximum variation allowable by such use of these gages, are given in the following table:

SIZES OF LIMIT GAGES FOR ROUND IRON.

Nominal Diam. of Iron.—Inches.	Large Size, + end. Inches.	Small Size, — end. Inches.	Total Variation. Inches.
¼	.2550	.2450	.010
5/16	.3180	.3070	.011
⅜	.3810	.3690	.012
7/16	.4440	.4310	.013
½	.5070	.4930	.014
9/16	.5700	.5550	.015
⅝	.6330	.6170	.016
11/16	.7585	.7415	.017
⅞	.8840	.8660	.018
1	1.0095	.9905	.019
1⅛	1.1350	1.1150	.020
1¼	1.2605	1.2395	.021
1⅜	1.3860	1.3640	.022
1½	1.5115	1.4885	.023
1⅝	1.6370	1.6130	.024
1¾	1.7625	1.7375	.025
1⅞	1.8880	1.8620	.026

Round iron 2 in. in diameter and over should be rolled to nominal diameter.

Chain

Standard—ADOPTED, 1917.

1. *Scope.*—These specifications cover chain for Locomotives, cars and general shop purposes, but do not cover Sling, Hoist and Crane chain.

I. MANUFACTURE.

2. *Process.*—(a) The chain may be made of either iron or steel, and may be welded by either the electric or fire process.

(b) Iron chain shall be manufactured from a grade of wrought iron that will meet the requirements of the A. R. A. specifications for Refined Wrought Iron Bars.

(c) Steel chain shall be manufactured from steel which has been made by the open-hearth process, and which shall be ductile and of satisfactory welding quality.

(d) Chain 5/16 in. in diameter or less may have links twisted, if so specified on the order; all other sizes shall have straight links.

II. PHYSICAL PROPERTIES AND TESTS.

2. *Tensile Test.*—Samples from finished chain shall conform to the minimum requirements as to tensile properties given in Table No. 1, the elongation being determined in a length of from 12 to 18 in. to the nearest link.

3. *Proof Test.*—(a) All chain shall be proof-tested by subjecting it to the loads given in Table No. 1, and when so tested shall stand these loads without showing defects.

(b) The manufacturer shall furnish a certificate of proof-test to the purchaser or his representative.

4. *Test Specimen.*—Tension test specimens shall consist of not less than 2-ft. lengths cut from the finished chain.

5. *Number of Tests.*—One tension test shall be made to represent each 200 ft. or fraction thereof ordered.

III. Permissible Variations.

6. *Length.*—The length of 100 links, inside to inside of end links, shall not exceed the values given in Table No. 1 by more than two, and shall be measured after proof-test has been made. In making this measurement a load not to exceed 10 per cent of the proof load shall be applied so that the slack may be taken up.

TABLE NO. 1.

Diameter of bar.	Proof-test loads. Pounds.		Breaking loads. Pounds.		Elongation. Per cent.		Maximum length. 100 links.	Normal weight. 100 feet.
Inches.	Steel.	Iron.	Steel.	Iron.	Steel.	Iron.	Inches.	Pounds.
¼..	1,650	1,500	3,300	3,000	12	10	102	75
5/16..	2,650	2,400	5,300	4,800	12	10	114.7	110
⅜..	3,700	3,400	7,500	6,800	12	10	125	165
7/16..	5,100	4,700	10,200	9,400	12	10	137.5	205
½..	6,700	6,100	13,400	12,200	12	10	150	265
9/16..	8,500	7,800	17,000	15,600	12	10	168	325
⅝..	10,500	9,600	21,000	19,200	12	10	176	425
11/16..	12,500	11,600	25,000	23,200	12	10	195	520
¾..	15,100	13,800	30,200	27,600	12	10	213	610
13/16..	17,600	15,800	35,200	31,690	12	10	225	725
⅞..	20,600	18,800	41,200	37,600	12	10	238	810
15/16..	23,500	21,200	47,000	42,400	12	10	250	925
1....	26,900	24,500	53,800	49,000	12	10	263	1,025
1 1/16..	30,400	27,600	60,800	55,200	12	10	295	1,225
1⅛..	34,100	31,000	68,200	62,000	12	10	325	1,350
1¼..	42,100	38,300	84,200	76,600	12	10	353.5	1,650
1⅜..	.....	.....	.....	112,000	..	15	355	1,100
1½..	.....	.....	.....	134,400	..	15	390	2,450
1⅝..	.....	.....	.....	138,200	..	15	425	2,875
1¾..	.....	.....	.....	165,000	..	15	475	3,200
1⅞..	.....	.....	.....	190,000	..	15	525	3,640
2....	.....	.....	.....	216,000	..	15	575	4,200

7. *Weight.*—The weight of the chain shall not vary more than 3 per cent above and 5 per cent below the weight given in Table No. 1. Excess over the allowance permitted will not be paid for.

IV. Workmanship and Finish.

8. *Workmanship.*—(a) The chain shall be free from injurious defects and shall have a workmanlike finish. The diameter of the welds shall not be perceptibly less than the diameter of the bar, and unless otherwise specified shall not exceed the diameter of the bar by more than 25 per cent.

(b) Prior to inspection, the chain shall be free from paint or any other coating which would tend to conceal defects.

V. Inspection and Rejection.

9. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

10. *Rejection.*—Material which, subsequently to the above tests at the mills or elsewhere, and its acceptance, develops weakness or imperfections, or is found to have injurious defects, will be rejected and shall be replaced by the manufacturer at his own expense.

11. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Platform Safety Chains

Recommended Practice—adopted, 1894; revised, 1906.

Platform Safety Chains for passenger equipment cars shall be located 14½ in. each side of center; to be suitably attached to under side of platform timbers, and to be of such length that when extended horizontally the chain with hook shall measure 12¾ in. from face of end timber to bearing point of hook, and the chain with eye shall measure 2¾ in. from face of end timber to bearing point of eye. The hook shall not be more than 1¼ in. thick transversely, and the eye shall be not less than 1½ in. wide, or less than 4 in. long in its opening. When facing end of car the chain

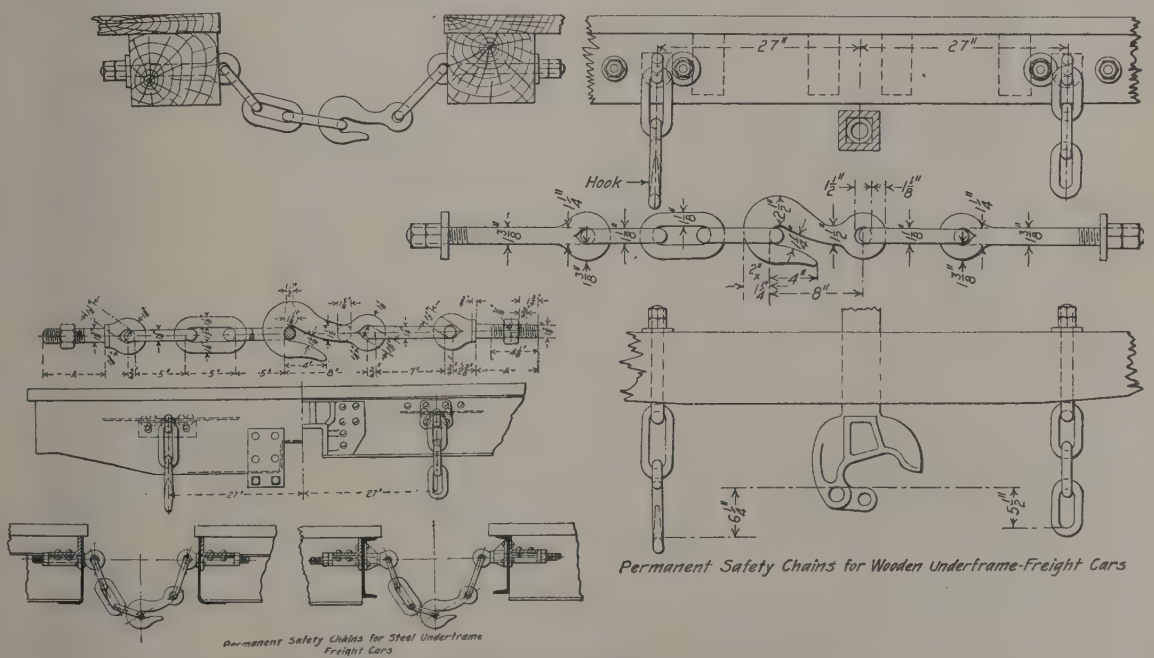


Fig. 2780—A. R. A. Recommended Practice for Safety Chains.

fitted with hook shall be on the left-hand side, and the chain fitted with eye on the right-hand side.

Safety Chains, for Steel and Wooden Freight Cars

Recommended Practice—ADOPTED, 1894; REVISED, 1904.

The use of safety chains on freight cars is not recommended, but when they are used on cars for special service a location is recommended as shown in Fig. 2780.

Dimensions and Threads of Wrought Pipe

Standard—ADOPTED, 1899; REVISED, 1908.

The words "wrought pipe" in the above heading include wrought iron and steel pipe.

The Standard of the Section for threads for wrought iron pipe and couplings is what is known as the Briggs Standard, as determined by the Pratt and Whitney gages. These gages were made by the Pratt and Whitney Company from an autograph copy of a table made by M. Robert Briggs personally, who originally established and published these standard threads.

Diameter of Tube.			Screwed Ends.		
Nominal inside. Inches.	Actual inside. Inches.	Actual outside. Inches.	Thickness of metal. Inch.	No. of threads per inch. No.	Length of perfect screw. Inch.
⅛	0.269	0.405	0.068	27	0.19
¼	0.364	0.540	0.088	18	0.29
⅜	0.493	0.675	0.091	18	0.30
½	0.622	0.340	0.109	14	0.39
⅝	0.824	1.050	0.113	14	0.40
¾	1.047	1.315	0.134	11½	0.51
1	1.380	1.660	0.140	11½	0.54
1¼	1.610	1.900	0.145	11½	0.55
1½	2.067	2.375	0.154	11½	0.58
2	2.467	2.875	0.204	8	0.89
2½	3.066	3.500	0.217	8	0.95
3	3.548	4.000	0.226	8	1.00
3½	4.026	4.500	0.237	8	1.05
4	4.508	5.000	0.246	8	1.10
4½	5.045	5.563	0.250	8	1.16
5	6.065	6.625	0.280	8	1.26
6	7.023	7.625	0.301	8	1.36
7	7.981	8.625	0.322	8	1.46
8	8.937	9.625	0.344	8	1.57
9	10.018	10.750	0.366	8	1.68
10	11.000	11.750	0.375	8	1.79
11	12.000	12.750	0.375	8	1.90
12					

Tapers of conical tube ends, 1 in 32 to axis of tube. (¾-inch per foot.)

By the late action of the Manufacturers of Wrought-iron Pipe, 9-inch outside diameter has been excepted from the original list, as above noted, the diameter now adopted being 9.625 instead of 9.688 inches given in the Briggs table

Pipe, Welded

Standard—ADOPTED, 1917.

I. MANUFACTURE.

1. *Process.*—(a) Steel used in the manufacture of pipe shall be of a soft, weldable quality made by the Bessemer process.

(b) The wrought iron used in the manufacture of pipe shall be double-refined.

(c) All pipe 2 in. nominal or under may be butt-welded, but all pipe larger shall be lap-welded.

II. PHYSICAL PROPERTIES AND TESTS.

2. *Tension Test.*—The material shall conform to the following minimum requirements as to tensile properties:

	Steel.	W. I.
Tensile strength, lb. per sq. in.	50,000	45,000
Elastic limit, lb. per sq. in.	30,000	.....
Elongation in 8 in.	18	12

3. *Hydrostatic Tests.*—All pipe shall be tested to the following hydrostatic pressures:

4. *Flattening Test.*—For steel pipe over 2 in. in diameter, a section 6 in. in length shall be flattened until the distance between the plates is one-third the outside diameter of the pipe, with the weld located 45 deg. from the line of direction of the applied force, without developing cracks.

	Standard Grade Pipe. Single Thickness.		Extra Strong Pipe. Double Thickness.	
Size.	Butt.	Lap.	Butt.	Lap.
⅛	700	.....	700	.....
¼	700	.....	700	.....
⅜	700	.....	700	.....
½	700	.....	700	.....
¾	700	.....	700	.....
1	700	.....	700	.....
1¼	700	.....	1,500	.....
1½	700	1,000	1,500	2,500
2	700	1,000	1,500	2,500
2½	...	1,000	.....	2,000
3	...	1,000	.....	2,000
3½	...	1,000	.....	2,000
4	...	1,000	.....	2,000

	Standard Grade Pipe. Single Thickness.			Extra Strong Pipe. Double Thickness.		
Nominal Diameter, In.	Outside Diameter, In.	Weight of Pipe per Lin. Ft. Threaded with Couplings.		Outside Diameter, In.	Weight of Pipe Per Lin. Ft. Plain Ends.	No. of Threads.
⅛	.405	.25		.405	.31	27
¼	.540	.43		.540	.54	18
⅜	.675	.57		.675	.74	18
½	.840	.85		.840	1.09	14
¾	1.050	1.13		1.050	1.47	14
1	1.315	1.68		1.315	2.17	11½
1¼	1.660	2.28		1.660	3.00	11½
1½	1.900	2.73		1.900	3.63	11½
2	2.375	3.68		2.375	5.02	11½
2½	2.875	5.82		2.875	7.66	8
3	3.500	7.62		3.500	10.25	8
3½	4.000	9.20		4.000	12.51	8
4	4.500	10.89		4.500	14.98	8

Ten per cent of each lot shall be weighed and a comparison made with the sample. All pipe shall be rejected that varies more than 5 per cent from that given in the above table.

5. *Fracture Test.*—For wrought-iron pipe, a section 6 in. in length shall be flattened until broken by repeated blows of a hammer or by pressure; the fracture developed shall have a fibrous appearance.

6. *Bend Test.*—For wrought iron or steel pipe 2 in. or under in diameter, a sufficient length of pipe shall bend cold through 90 deg. around a cylindrical mandrel, the diameter of which is 15 times the nominal diameter of the pipe, without developing cracks at any portion and without opening in the weld.

7. *Test Specimens.*—Test specimens shall consist of sections cut from a pipe; they shall be smooth on the ends and free from burrs.

8. *Number of Tests.*—One of each of the above tests shall be made from each diameter of pipe for each 2,000 ft. or less.

III. WEIGHTS.

9. *Weights.*—The standard weights for pipes of various inside diameter are as follows:

IV. WORKMANSHIP AND FINISH.

10. *Workmanship.*—For pipe 1½ in. in diameter or under, the outside diameter at any point shall not vary more than 1-64 in. over nor more than 1-32 in. under the standard.

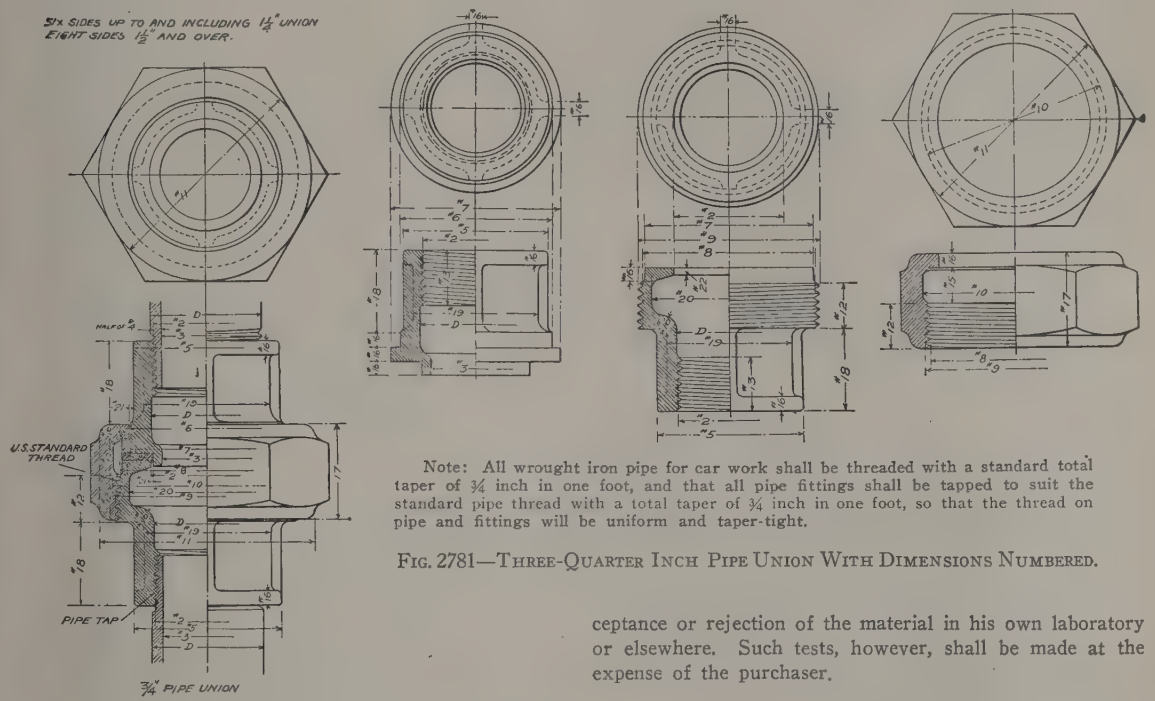
For pipe 2 in. in diameter or over, the outside diameter shall not vary more than 1 per cent over or under the standard. All pipe shall be provided with the prevailing standard thread, which shall make a tight joint when tested to the internal hydrostatic pressure at the mills. The threads shall not vary more than 1½ turns either way when tested with a Pratt & Whitney standard gage. All burrs at the end of the pipe shall be removed.

11. *Finish.*—The finished pipe shall be reasonably straight and free from injurious defects.

V. Inspection and Rejection.

12. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.



Note: All wrought iron pipe for car work shall be threaded with a standard total taper of ¾ inch in one foot, and that all pipe fittings shall be tapped to suit the standard pipe thread with a total taper of ¾ inch in one foot, so that the thread on pipe and fittings will be uniform and taper-tight.

Fig. 2781—Three-Quarter Inch Pipe Union With Dimensions Numbered.

DIMENSIONS FOR STANDARD PIPE UNIONS.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
¼-inch	375	.270	105	.59	63	78	.80	.85	.89	1.05	.26	¼	27	.2225	.08	.5625	¼	.59	.615	.006	.05
⅜ "	496	364	132	76	.80	96	.98	1.05	1.09	1.29	.33	5/16	18	.2625	10	.6925	3/16	.76	.76	.006	06
½ "	630	494	136	90	95	1 11	1.13	1.20	1.24	1.45	.34	⅜	18	.2825	.11	.7325	⅜	.90	.905	.006	07
¾ "	783	.623	160	1.16	1 21	1.38	1.40	1.49	1 54	1 78	40	7/16	14	.3025	.12	.8225	7/16	1 03	1 20	.006	08
1 "	992	824	168	1 38	1 43	1 61	1.63	1.72	1 77	2.02	42	½	14	.3225	13	.8725	½	1.24	1 43	007	.09
1 "	1.246	1.048	198	1 74	1.79	1 98	2.01	2.13	2.19	2 49	49	9/16	11	.3625	15	1 0025	9/16	1 565	1 76	.007	.10
1¼ "	1.592	1 380	212	2 12	2.18	2.37	2.40	2 52	2.58	2.90	53	6	11	.3825	16	1 0725	9	1 91	2.15	.007	.11
1½ "	1.831	1 610	221	2.40	2 46	2.66	2 69	2.81	2.87	3.20	.55	7	11	.4025	17	1.1225	1.0	2.18	2 40	007	13
2 "	2 306	2 067	239	2.89	2.95	3 16	3 19	3.31	3 38	3 74	60	8	11	.4225	18	1.2025	1.1	2 66	2 90	.008	14
2½ "	2.775	2.468	307	3.39	3.45	3 67	3.70	3 86	3 93	4 39	77	9	8	5225	23	1 5225	1.2	3 16	3.41	.008	.16
3 "	3.401	3.067	334	4.07	4.13	4.36	4.40	4.56	4.63	5 13	84	1.0	8	.5625	25	1.6525	1.3	3.81	4.08	.008	.18
3½ "	3.901	3.548	353	4.61	4.68	4 91	4.95	5 11	5 19	5 72	.88	1.1	8	6025	27	1.7525	1 4	4 31	4 63	.008	.20
4 "	4.4	4.020	.374	5.15	5.22	5.47	5 51	5.67	5 75	6 31	94	1.2	8	6225	28	1.8425	1 5	4.81	5 19	.008	.22

DESCRIPTION ACCOMPANYING TABLE OF MALLEABLE PIPE UNIONS

NUMBERS AT THE HEAD OF THE COLUMNS ABOVE ARE THOSE GIVEN IN THE DIMENSION LINES ON TABLE A.

Column No. 1 in table represents the nominal diameter of pipe.
Column No. 2 represents diameter of pipe at one-half the height of full thread nearest solid section of pipe.
Column No. 3 represents the internal diameter of the pipe.
Column No. 4 represents the difference between columns Nos. 2 and 3, and is equal to twice the thickness of metal in pipe measured from inside line to one-half the height of thread, as specified before.
Column No. 5 represents the outside diameter of end of pipe union and is taken as *No. 2, plus twice* No. 4, plus an arbitrary increment.
Column No. 6 is equal to No. 5 plus an increment varying from .04 to .07 of an inch. This increment was allowed for the purpose of being able to slip the nut over upper swivel end of union.
Column No. 7 is No. 6 plus an amount varying between 15 and 25. This lip created is considerably in excess of what exists on present pipe unions for the reason that we find the surface between the lip and the corresponding part of nut is often damaged, and the bearing surface, when the full strength of the man is used on the wrench, is sufficient. We assume that a man would pull about 30 pounds on a wrench, with a possibility of using less force on pipes of small diameters. For that reason we made a variation in the width of lip, which lip, theoretically, would be uniform for all sizes of pipe. The nut itself has been strengthened to prevent the lip from deflecting upward.
Column No. 8 is No. 7, plus an increment varying from .02 to .04 of an inch.
Column No. 9 is No. 8, plus twice the height of the thread.
Column No. 10 is No. 9, plus an increment varying between .04 and .08 of an inch.
Column No. 11 is No. 10, plus one and one-half times No. 4.
Column No. 12 is two and one-half times No. 4, and was figured especially for bearing surface, so that the thread would not wear away too rapidly when the nut is occasionally removed.
Column No. 13 has been assumed arbitrarily, but in all cases is greater than the length of full thread on standard pipe.
Column No. 14 represents the number of threads per inch in length of nut. This thread, we believe, should be United States Standard form and not sharp thread.
Column No. 15 is taken arbitrarily, but is based on the probable requirements of manufacturers for tapping out the nut.
Column No. 16 is three-fourths of No. 4.
Column No. 17 represents the full height of nut, and is equal to No. 12, plus No. 15, plus No. 16.
Column No. 18 is the amount of projection outside of nut.
Column No. 20 is No. 2, plus No. 4, plus an arbitrary increment.
Column No. 20 is No. 7, less No. 16, with slight modifications.
Column No. 21 represents the clearance at several points, as indicated on print.
Column No. 22 is assumed arbitrarily.

13. *Rejection.*—Material which, subsequent to above tests at the mills or elsewhere, and its acceptance develops weak spots, cracks or imperfections, or is found to have injurious defects, will be rejected and shall be replaced by the manufacturer at his own expense.

14. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Bolts and Nuts

THE BOLTS AND NUTS USED in car construction have been covered by American Railway Association specifications as follows:

1. *Scope.*—These specifications shall apply to all bolts and nuts.

Recommended Practice—ADOPTED, 1916.

MANUFACTURE.

2. *Process.*—The bolts and nuts may be wrought iron or steel, made in accordance with A. R. A. Specifications for Refined Wrought Iron Bars or Mild Steel Bars.

CHEMICAL PROPERTIES AND TESTS.

3. *Chemical Composition.*—The steel for the bolts shall conform to the requirements of the A. R. A. Specifications for Mild Steel.

PHYSICAL PROPERTIES AND TESTS.

4. *Tension Tests.*—The wrought iron or steel shall conform to the physical properties as specified in the A. R. A. Specifications for Refined Wrought Iron Bars and Mild Steel Bars.

FERMISSIBLE VARIATIONS.

5. *Gage of Bolts.*—Rods shall conform to the limits as specified in A. R. A. Specifications for Refined Wrought Iron Bars or Mild Steel Bars.

SPECIFICATIONS FOR BOLTS AND NUTS.

6. *Threads.*—Nuts shall be so tapped that a U. S. standard plug gage of normal size will pass through the nut, and in that position be snug and not show an appreciable shake. Bolts to be threaded so as to fit the nut in such a manner that it may be turned to within one of the threaded portion of the bolt. When in this position there shall be no appreciable shake.

7. *Dimensions of Bolt Heads and Nuts.* Table No. 1.—Finished bolts and nuts shall conform to dimensions in Table No. 1. Short diameter of rough bolt heads and nuts may vary from this table as follows: For nuts under ½ in., 1-16 in. under and 1-64 in. over; for nuts ½ in. and larger, 1-16 in. under and 3-64 in. over. All other dimensions of nuts and heads of bolts may vary 1-16 in. either way, except that for bolts and nuts under ½ in. only 1-32 in. variation either way will be permitted.

8. *Tapping of Nuts.*—The nuts shall be tapped so that, when applied, the angle between the bearing surfaces shall not exceed two deg., as shown by the cut.

TABLE No. 1

Diameter of Screw.	SCREW THREADS.			NUTS. Hexagon and Square.				HEADS. Hexagon and Square.			
				Short Diameter.		Thickness.		Short Diameter.		Thickness.	
	Threads per In.	Diameter at Root of Thread.	Width of Flat.	Rough.	Finish.	Rough.	Finish.	Rough.	Finish.	Rough.	Finish.
¼	20	.185	.0062	½	7/16	¼	3/32	3/8	5/16	3/16	1/8
5/16	18	.240	.0074	19/32	17/32	5/16	1/4	13/32	11/32	13/64	11/64
3/8	16	.294	.0078	11/16	5/8	3/8	5/16	1/2	7/16	1/4	7/32
7/16	14	.344	.0089	25/32	23/32	7/16	3/8	37/64	17/32	9/32	1/4
½	13	.400	.0096	7/8	13/16	½	7/16	3/4	11/16	5/16	9/32
9/16	12	.454	.0104	31/32	29/32	9/16	½	27/32	25/32	11/32	5/16
5/8	11	.507	.0113	1 1/16	1	5/8	9/16	15/16	7/8	25/64	23/64
¾	10	.620	.0125	1 1/4	1 3/16	¾	11/16	1 1/8	1 1/16	15/32	½
7/8	9	.731	.0138	1 7/16	1 3/8	7/8	13/16	1 5/16	1 1/4	17/32	15/32
1	8	.837	.0156	1 5/8	1 9/16	1	15/16	1 1/2	1 7/16	3/4	11/16
1 1/8	7	.940	.0178	1 13/16	1 3/4	1 1/8	1 1/16	1 11/16	1 5/8	27/32	25/32
1 1/4	7	1.065	.0178	2	1 15/16	1 1/4	1 3/16	1 7/8	1 13/16	15/16	7/8
1 3/8	6	1.160	.0208	2 3/16	2 1/8	1 3/8	1 5/16	2 1/16	2	1 1/32	31/32
1½	6	1.284	.0208	2 3/8	2 5/16	1½	1 7/16	2 1/4	2 3/16	1 1/8	1 1/16
1 5/8	5½	1.389	.0227	2 9/16	2½	1 5/8	1 9/16	2 7/16	2 3/8	1 7/32	1 7/32
1¾	5	1.491	.0250	2 3/4	2 11/16	1¾	1 11/16	2 5/8	2 9/16	1 5/16	1¼
1 7/8	5	1.616	.0250	2 15/16	2 7/8	1 7/8	1 13/16	2 13/16	2¾	1 13/32	1 11/32
2	4½	1.712	.0277	3 1/16	3 1/16	2	1 15/16	3	2 15/16	1½	1 7/16
2¼	4½	1.961	.0277	3½	3 7/16	2¼	2 3/16	3 3/8	3 5/16	1 11/16	1 5/8
2½	4	2.175	.0312	3 7/8	3 13/16	2½	2 7/16	3¾	3 11/16	1 7/8	1 13/16
2¾	4	2.425	.0312	4¼	4 3/16	2¾	2 11/16	4 1/8	4 1/16	2 1/16	2
3	3½	2.629	.0357	4 5/8	4 9/16	3	2 15/16	4½	4 7/16	2¼	2 3/16
3¼	3½	2.879	.0357	5	4 15/16	3¼	3 3/16	4 7/8	4 13/16	2 7/16	2 3/8
3½	3¼	3.100	.0384	5 3/8	5 5/16	3½	3 7/16	5¼	5 3/16	2 5/8	2 9/16
3¾	3	3.317	.0416	5 3/4	5 11/16	3¾	3 11/16	5 5/8	5 9/16	2 13/16	2¾
4	3	3.567	.0416	6 1/8	6 1/16	4	3 15/16	6	5 15/16	3	2 15/16
4¼	2⅞	3.798	.0434	6½	6 7/16	4¼	.....	6 3/8	6 5/16	3 3/16	.....
4¼	2⅞	3.798	.0343	6½	6 7/16	4¼	4 3/16	6 3/8	6 5/16	3 3/16	3 1/8
4½	2¾	4.028	.0454	6 7/8	6 13/16	4½	4 7/16	6¾	6 11/16	3 3/8	3 5/16
4¾	2⅝	4.255	.0475	7¼	7 3/16	4¾	4 11/16	7 1/8	7 1/16	3 9/16	3½
5	2½	4.480	.0500	7 5/8	7 9/16	5	4 15/16	7½	7 7/16	3¾	3 11/16
5¼	2½	4.730	.0500	8	7 15/16	5¼	5 3/16	7 7/8	7 13/16	3 15/16	3⅞
5½	2⅜	4.953	.0526	8 3/8	8 5/16	5½	5 7/16	8¼	8 3/16	4 1/8	4 1/16
5¾	2⅜	5.203	.0526	8¾	8 11/16	5¾	5 11/16	8 5/8	8 9/16	4 5/16	4¼
6	2¼	5.423	.0555	9 1/8	9 1/16	6	5 15/16	9	8 15/16	4½	4 7/16

9. *Length.*—The finished length of the bolt shall not vary more than ⅛ in. from the ordered dimension and, unless otherwise specified, the threads shall be cut 2½ times the diameter of the bolt.

Workmanship and Finish.

10. *Workmanship.*—The heads of all bolts shall be neatly formed, firmly joined to the body of the bolt, free from large projecting fins and no nicking or reduction of the size of the body of the bolt by dies.

11. *Threads.*—Bolts and nuts shall be cut with a U. S. and A. R. A. standard thread, the threads being cut full and clean. Unless otherwise specified, each bolt shall be furnished with a nut screwed on.

12. *Finish.*—Where the keyways are cut in the ends of bolts, they shall be full and clean and the metal around them shall show that it has not been injured by cutting the keyways more than is necessary.

Inspection and Rejection.

13. *Inspection.*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

(b) The purchaser may make the tests and inspection to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests and inspection shall be made at the expense of the purchaser.

All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

14. *Rejection.*—Material which, subsequently to above tests at the mills or elsewhere and its acceptance, develops weak spots or imperfections, or fails to pass any one of the tests herein required, or properly thread or weld, when so specified, will be rejected and shall be replaced by the manufacturer at his own expense.

15. *Rehearing.*—Samples tested in accordance with this specification, which represent rejected material, shall be preserved for fourteen days from date of test report.

Standard—adopted, 1909; revised, 1914.

Fig. 2782—Standard Castle Nuts, Cotter Pins and Location of Cotter Pin Holes in Projecting Bolt Ends.

Screw Threads

Standard—adopted, 1872; revised, 1882.

The Sellers or Franklin Institute system of screw threads, bolt heads and nuts is the standard of the Association, and repeated action of the Association has deprecated the use of any other system and encouraged the careful maintenance of these standards. See Proceedings 1872, pages 18 and 21; Proceedings 1879, pages 82 and 83; Proceedings 1882, page 229.

A set of gages for standard screw threads and a standard inch scale, 2 feet long, are held in the office of the Secretary for reference.

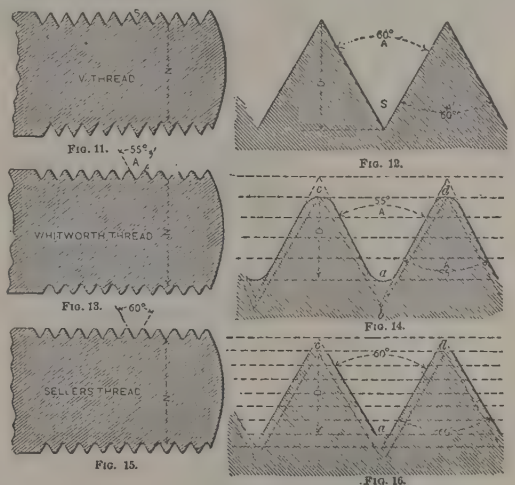


Fig. 2783—Screw Threads.

Mr. Sellers, who proposed this system of screw threads, described it in an essay read before the Franklin Institute of Philadelphia, April 21, 1864, as follows:

"The proportions for the proposed thread and its comparative relation to the sharp and rounded threads, will be readily understood from the accompanying diagram in which Figs. 11 and 12—the latter on an exaggerated scale—represent a sharp thread, Figs. 13 and 14 a rounded top and bottom to the English proportion, Figs. 15 and 16 the flat top and bottom, all of the same pitch. The angle of the proposed thread is fixed at 60°, the same as the sharp thread, it being more readily obtained than 55°; and more in accordance with the general practice in this country. Divide the pitch, or, which is the same thing, the side of the thread, into eight equal parts, take off one part from the top and fill in one part in the bottom of the thread, then the flat top and bottom will equal one-eighth of the pitch; the wearing surface will be three-quarters of the pitch, and the diameter of screw at bottom of the thread will be expressed by the formula:

$$\text{Diameter} = \frac{1{,}299}{\text{number of threads per inch.}}$$

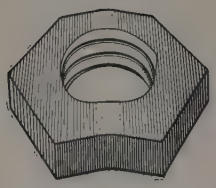


Fig. 2784—Hexagon Toggle Lock Nut. Jones Positive Nut Lock Company.

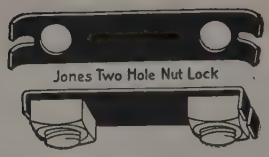


Fig. 2785—Application of Jones Multiple Two-Hole Nut Lock. Jones Positive Nut Lock Company.

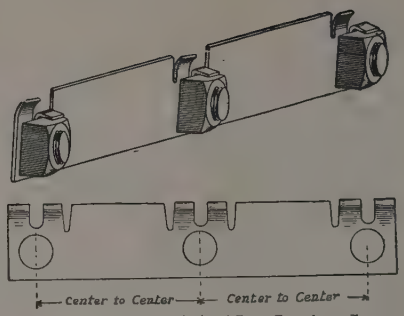


Fig. 2786—Multiple Nut Lock. Jones Positive Nut Lock Company.

Fig. 2787—Stevenson Permanent Nut Lock. Safety Nut & Bolt Company.

Fig. 2788—National Lock Washer. National Lock Washer Company.

Fig. 2789—Realock Nut. Flannery Bolt Company.

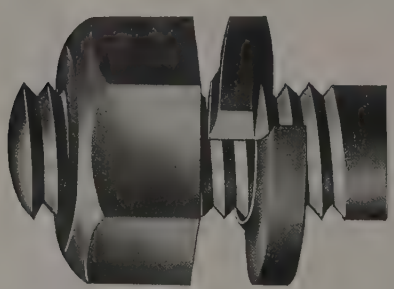


Fig. 2790—Application of National Lock Washer. National Lock Washer Company.

Fig. 2791—D. S. Holder Nut and Lock Nut. Standard Safety Nut Corporation.
(*See also Page* 1088.)

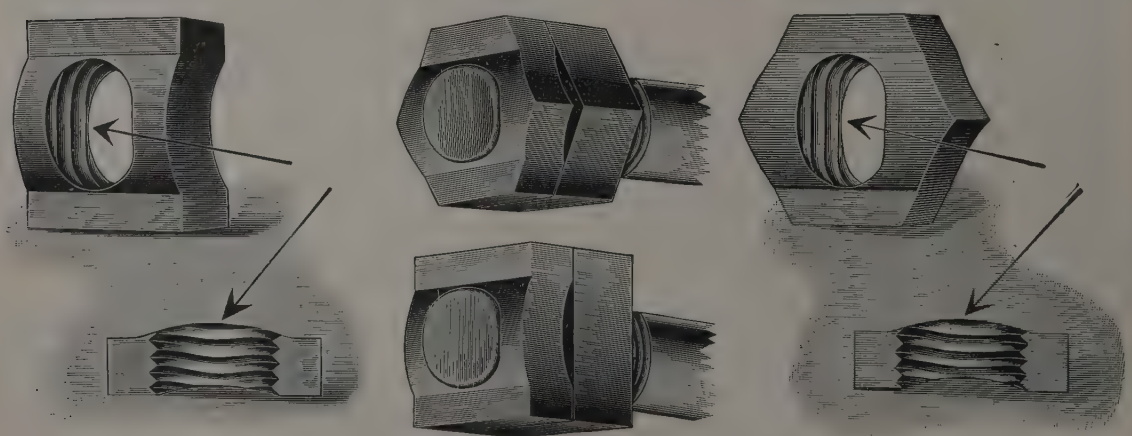


Fig. 2792—Square and Hexagon Grip Nuts, Showing Curve in Thread-Pitch Exaggerated to Show Locking Method. **Grip Nut Company.**
(*See also Page* 1087.)

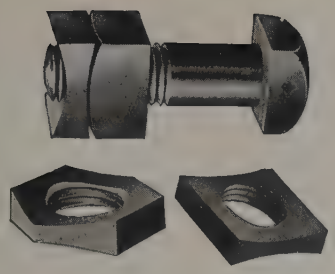
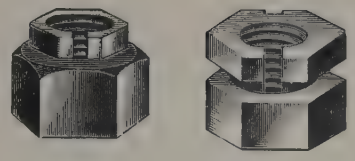
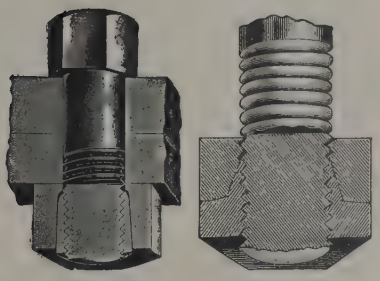


Fig. 2793—Boss Nut
Boss Nut Company.
(*See also Page* 1085.)





Original. Improved.

Fig. 2794—Columbia Lock Nuts and Application. Columbia Nut & Bolt Company, Incorporated.
(*See also Page* 1086)

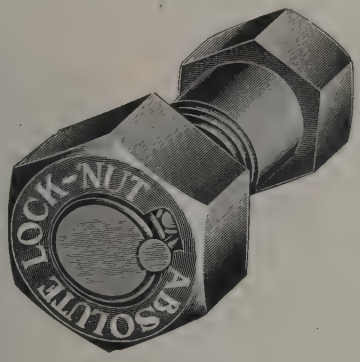


Fig. 2795—Removal of Absolute Lock Nut, Showing Ordinary Nail Inserted. American Lock Nut Company.

Fig. 2796—Bartley Multiple Nut Fastener. American Nut & Bolt Fastener Company.

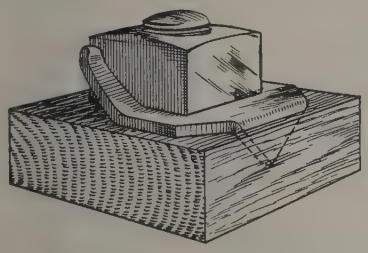


Fig. 2797—Bartley Diamond Tang Fastener for Application to Wood. American Nut & Bolt Fastener Company.

Fig. 2798—Bartley Flange Nut Fastener. American Nut & Bolt Fastener Company.

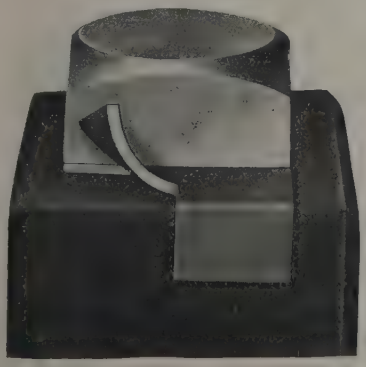


Fig. 2799—Bar Nut Lock, Applied to Square Nut.

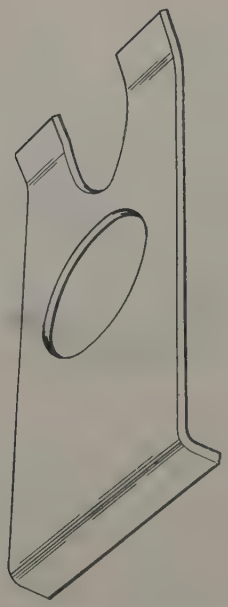


Fig. 2800—O. S. Nut Lock.

Fig. 2801—Bar Nut Lock, Applied to Hex Nut.

American Nut & Bolt Fastener Company.
(*See also Page* 1084.)

Bartley Fastener
O. S. Nut Lock
American Washer

Among the various types of nut and bolt fastening devices manufactured by the American Nut & Bolt Fastener Company, the Bartley Nut Fasteners, the O. S. Nut Lock, and the American Lock Washer are of especial value in railroad service. The construction and repair of railroad cars require the use of many bolted connections, all of which are necessarily subjected to the vibration and repeated impacts incidental to the movement of traffic. It is absolutely essential, if such traffic is to be moved with safety, that these connections shall remain securely fastened, regardless of the severity of any stresses which may be encountered.

Fig. 2802—O. S. Nut Lock

No parts of a railroad car are more continuously subjected to the disintegrating effect of vibration and impact, than are the trucks, nor is the effective and positive fastening of bolted connections more imperative than on this part of the equipment.

The problem of devising adequate nut and bolt fastening facilities for use on car trucks is greatly complicated by the fact that trucks must be adapted for quick and easy dismantling. The frequent necessity for changing wheels, and making various running repairs, demand that nut and bolt fasteners for this service shall be capable of ready application, quick disengagement, and so designed that they can be used an indefinite number of times without appreciable deterioration of the locking principle.

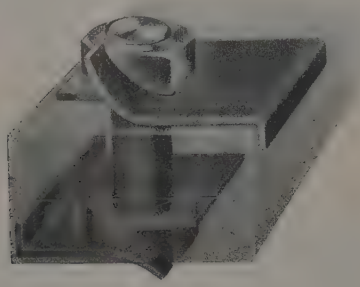


Fig. 2803—Bartley Nut and Bolt Fastener

All of these features together with the equally important advantages of economy and simplicity may be found in either the Bartley Nut and Bolt Fastener—Fig. 2803—or the O. S. Nut Lock Fig. 2804. The application of these two devices differs slightly but is very simple and effective. The locking member is composed of a comparatively thin plate, having at one end a flanged portion adapted to engage with the edge of an arch bar or similar permanent part. The other end has a circular opening of suitable size to accommodate the bolt, and is slotted so that after the nut has been tightly screwed down, a flexible strip of the locking plate can be bent up so as to interpose a positive obstruction preventing any tendency of the nut to loosen. In the case of the O. S. Nut Lock the end of the locking strip is bent up against the face of the nut while in the Bartley Nut and Bolt Fastener one corner of the locking strip is bent up alongside of the nut. In the latter device a similar flexible strip is used under the head of the bolt. The locking member is composed of a special steel plate having a very high degree of ductility and toughness; it is, therefore, possible to reapply these devices any number of times as this special steel will stand the necessary amount of bending, without failure.

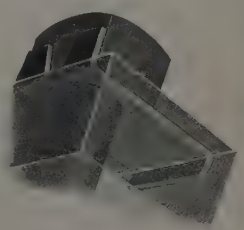


Fig. 2804—O. S. Nut Lock as Applied

The American Lock Washers have been subjected to every conceivable test with the most successful results and are in general use on locomotive and car frames and on railroad track joints, crossings, frogs, switches as well. They are also extensively used on shop motors and machinery or wherever a reliable lock for bolts and nuts is essential.

This washer is made from a special grade of steel, tempered and heat treated so as to impart a permanent resiliency to the finished washer.

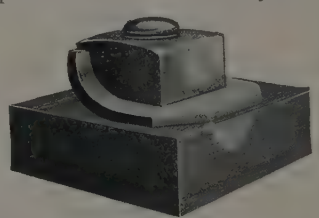


Fig. 2805—Bartley Nut and Bolt Fastener as Used on Wood

The method of heat treating this carefully selected steel involves the use of the most modern heating furnaces, oil baths and tempering ovens.

The users of American Lock Washers and other nut locking devices manufactured by the American Nut & Bolt Fastener Company receive the benefit of broad experience and an absolute guarantee against defective material or workmanship.

Fig. 2806—American Lock Washer, Plain Pattern

Fig. 2807—American Lock Washer, Rib Pattern

Fig. 2808—American Lock Washer, Positive Pattern

For other products and branch offices, see classified and alphabetical indexes.

THE AMERICAN NUT AND BOLT FASTENER CO., PITTSBURGH, PA.

The Boss Lock Nut

The Boss Lock Nut is a simple and reliable means for maintaining the complete security of bolted connections, regardless of vibration, sudden shocks or other loosening tendencies. A lock nut of this character is generally recognized as being very essential to the safe and economical operation of any railroad, owing to the extensive use of bolted fastenings in practically all branches of railway service and the vital necessity that these fastenings shall remain in a tight and serviceable condition.

The use of lock nuts will prolong the service obtainable from cars and locomotives owing to the positive security of all their bolted parts; accidents caused by missing nuts will be avoided; a large reduction can be effected in the quantity of bolts consumed and as lock nuts will insure tight bolted fastenings on any class of equipment on an entire railroad system, a very noticeable decrease in maintenance expenditure may be anticipated.

Fig. 2809—Application of Boss Lock Nuts to Passenger Truck and Axle Light Suspension

Boss lock nuts are used as second or jamb nuts. A common nut is first applied and the lock nut is then screwed up tightly against it or until the arched surface in contact with the common nut is nearly flattened out, as shown in Fig. 2810. When Boss lock nuts are applied in this manner they provide a positive protection against the tendency to bolted parts to work loose.

The Boss Lock Nut is a single piece of steel made into an auxiliary nut, with top and botton surfaces concave and identical. It is tapped with a natural thread and can be applied to a bolt more easily and quickly than a common nut. When turned with the fingers until the sharp impinging edges of the nut are in contact with the outer edges of the holding nut, one-half to three-quarters turn with a wrench causes the bolt, the holding nut, and the auxiliary nut to practically become a unit, all parts of which are held in non-rotatable relation to each other so that no shock or vibration will cause the Boss nut to release its hold. It is possible to use the Boss nut alone, but this is recommended only on bolts subject only to shearing strains. The various sizes of Boss Lock Nuts possess from 50 to 90 per cent of the strength of the bolts on which they are used.

Fig. 2810—Application Showing Boss Lock Nuts Turned on with Fingers Until Edges Touch Primary Nuts, Then Locked with a Wrench.

An important characteristic of the Boss nut is that it locks securely to undersize or defective bolts, and to rolled or cut threads. It does not destroy or injure bolt threads and it may be used repeatedly without appreciable loss of holding power. Being simple in construction, no instructions are necessary for its use.

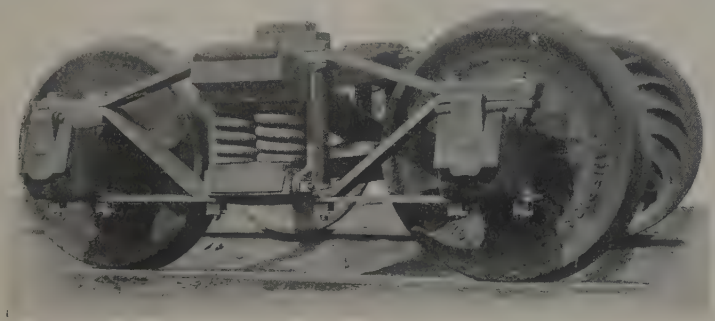


Fig. 2811—Application of Boss Lock Nuts to Arch Bar Truck

Because of these characteristic features the Boss nut is especially useful for application to car draft rigging and trucks, to motion-work of locomotives, to locomotive trailing trucks, or in every place where the bolted parts are subject to vibration.

For other products and branch offices, see classified and alphabetical indexes.

BOSS NUT COMPANY, CHICAGO, ILLINOIS

Columbia Lock Nut and Simplicity Cotter Key

The extremely severe service to which railroad rolling stock is subject, often without the proper care and attention, makes it necessary that bolted fastenings be secured against the possibility of working loose. The safety requirements are a further demand upon the security of these fastenings.

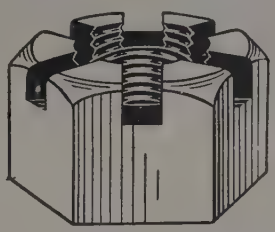


Fig. 2812—Columbia Slotted Nut—Made in All Sizes

The purpose of the Columbia lock nuts is to provide this security. These nuts consist of two parts which fit together as a perfect unit. The inner part is threaded to receive the bolt, is slotted throughout its length and on the outside has downward taper which fits a corresponding taper on the inside of the outer part.

When the wrench is applied to the outer part, or binding nut, the inside part travels down the tapered sides, closing the slot and firmly imbedding the threads of the nut in those of the bolt. The inner part pinches and clinches at the same time. When it is drawn down flush with the top of the binding nut, the two parts are securely locked together and to the bolt threads.

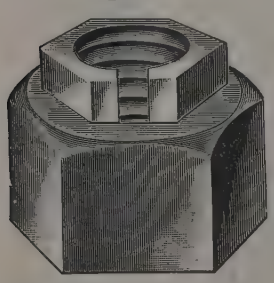


Fig. 2813 — The Original Columbia Lock Nut Assembled—Made Hexagon and Square

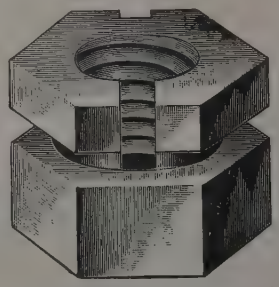


Fig. 2814 — The Improved Columbia Lock Nut Assembled—Made Hexagon and Square

A perfect fastening is formed as the thread is gripped at all points. Application is easy since these nuts turn without binding, and grip without grinding or distorting the thread contour. It will not rattle off; to the contrary, any such movement tends to tighten it.

The field of application includes places where unlimited draw bolt strains and tight fastenings are required on freight and passenger car parts, such as with column bolts, journal box bolts, draft gear, ladders, etc.

The improved nut being threaded in both parts, it can be locked on a bolt without resting against any bearing as on brake rods, rail points, etc. It can be used in any place where an ordinary nut is used, and in addition to having locking features derived from squeezing the tapered cone into the recess, it has the cross thread lock which is obtained by placing two nuts on the same bolt in jam nut style.

The Columbia Gib Nut has been developed to meet the growing demand for a three-thread nut

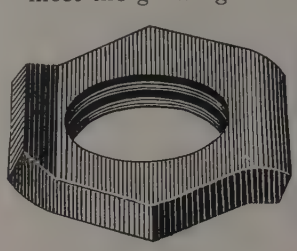


Fig. 2815—Columbia Hexagon Gib Nut

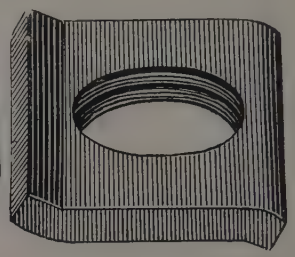


Fig. 2816—Columbia Square Gib Nut

lock. The points which have guided its design are security, and economy in cost and application.

Its simplicity is evident and is responsible for a low manufacturing cost as well as for making it easy to apply. The threads are cut straight through, and are the same as the threads on the bolt. The nut can be applied with the fingers, up to the holding nut—a feature which represents a saving in time and money. A wrench is required only to set it tight, and it can be used with either side up. Owing to its shape, it will not injure or mar the threads of the bolt or nut in any way.

The holding power is derived from the bent down edges, which, upon coming in contact with the surface of the holding nut, cause the Gib Nut to tip over at an angle and forces its threads into the threads of the bolt, thus forming a jam.

The sizes of Gib Nuts range from ⅜ in. up to and including 2 in., in both square and hexagon shapes and U. S. Standard threads, unless ordered otherwise.

The Simplicity Cotter Key is merely a short strip of steel having three tooth-like projections with flat tops. One of the end projections is bent to one side of the process of manufacture, the middle

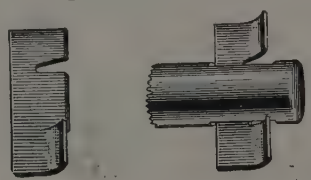


Fig. 2817 — The Simplicity Cotter Key

projection fits in the bolt structure, and the other end projection is bent after the key is inserted.

The advantage over the ordinary riveted split key lies in the greater ease of application and removal. To apply, it is only necessary to insert in the slot and bend over one tooth. When removal is required either of the end teeth can be bent easily to the normal position.

Standard sizes for standard diameter bolts are manufactured but the range is not limited. Practically any length, width, or thickness can be accommodated.

For other products and branch offices, see classified and alphabetical indexes.

Grip Nuts

A simple but efficient means for securing the nuts on bolts used where they are subject to considerable vibration and strain has been provided in the Grip Nut and the Grip Unit Nut.

The Grip Lock Nut is a one-piece, self-locking nut for use on all bolts subject to vibration, shocks, strains and stretch, where a permanent locking of the bolt is required. This nut is made in various styles to meet all requirements.

This nut is made from a special section of steel having an arch running longitudinally through the bar. The nut is blanked from the bar, then threaded through the arch, gaged and deflected. The gaging for thickness insures uniformity of lock. The deflection is made by bringing a pressure—a hammer blow—to bear on the crown of the arch in such a manner as to change the pitch of the thread only in the top portion

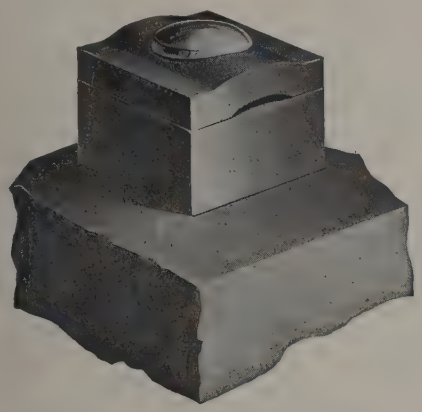


Fig. 2818—Application of Grip Nut No. 1

of the nut. This deflection sets up a frictional resistance through the spiral path of the threads when applied to a bolt. As only those threads in the top portion of the nut are deflected it may be started on the bolt with a finger fit; when turned with a wrench to the full thread of the nut it automatically locks, and can be removed with a wrench, but in no other way.

This nut may be re-used as often as service demands without losing its locking feature.

The Grip Lock Nut is of the U. S. standard—100 per cent thread—with the exception of the thickness which is approximately half a U. S. nut.

The Grip Lock Nut No. 1 used as in Fig. 2818 has the advantage of being cheaper than two commercial nuts, and has a further advantage through the saving of material made in the length of the bolt. A greater factor of safety is obtained through the application of a nut that locks permanently on the bolt, and maintenance costs are reduced by preventing loss, damage and delay.

The Grip Unit Nut No. 3 is of the U. S. standard dimensions and it has all the advantages of the U. S. standard nut and the one-piece self-locking nut—it is a combination of the two. This nut is made hot. In the process of manufacture an arch or rib is formed across the top of the nut through the center. The nut is then threaded, after which it is gaged and deflected. The deflection is accomplished through bringing slow pressure to bear on the top of the arch causing the metal to flow or bend downward in the top

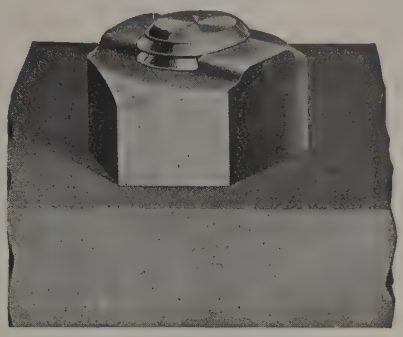


Fig. 2819—Grip Unit Nut No. 3

portion of the nut. In Fig. 2820 the lines were drawn straight across the nut before the nut was deflected, for the purpose of showing that the deflection is only in the top portion. It will be seen here that from the center down the lines remain straight. Since the deflection is in the threads in the top portion only, the nut will turn half way on the bolt with a finger fit, but it must be turned to the full thread with a wrench when it automatically locks. It can be removed only with a wrench.

The application of the Grip Unit Nut No. 3 is recommended on all bolts, holding metal to metal, and subject to vibration, shocks, strains and stretch and where a permanent locking of the bolt is required.

The cost of the Grip Unit Nut is less than the cost of a commercial nut and an efficient auto-

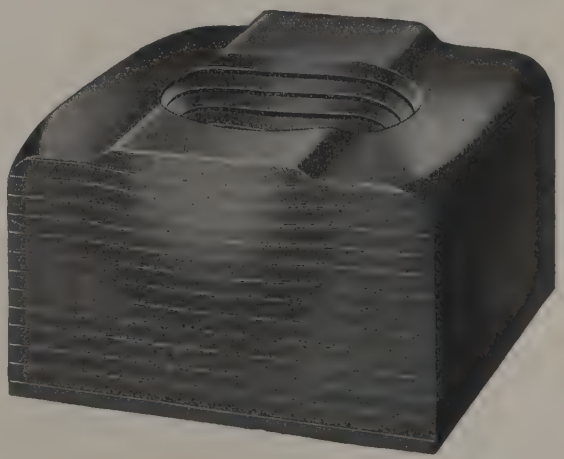


Fig. 2820—Grip Unit Nut No. 3 showing how the top threads only are deflected

matic lock nut, and, since the Unit Nut performs the double duty of holding and locking, a shorter bolt can be used. The Grip Unit Nut fulfills all requirements with a liberal factor for safety.

The "DS" Holding and Lock Nuts

The excessive vibration and shock to which all parts of rolling stock and equipment are subjected tend to loosen bolted connections, unless suitable precautions are taken to maintain such connections in a permanently tight condition.

The "DS" Nut furnished by the Standard Safety Nut Corporation has been designed to accomplish this result. It is manufactured in two types—

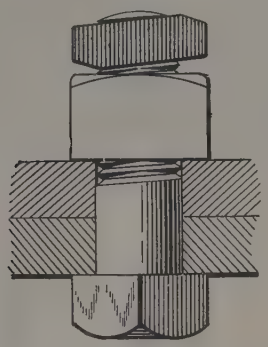


Fig. 2821—"DS" Lock Nut On Bolt Before Being Seated

a Lock Nut and a Holding Nut; the same principle is followed in the design of both types. The Lock Nut is designed for use with a common nut while the Holding Nut, being made thicker and heavier, replaces both the common nut and the Lock Nut at the same time securely locks itself on the bolt when tightened up to the work. Both types of these nuts are made in either the square or hexagon shapes and are tapped with U. S. standard threads.

The "DS" Lock Nuts and Holding Nuts are fool proof. They may be applied with either side

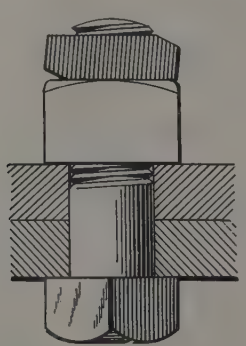


Fig. 2822—Position of "DS" Lock Nut After Being Wrenched Down Flat

up or down. They can be used over and over again indefinitely without injury to either the bolt or nut threads and without impairing their locking efficiency. Being a "finger fit" on the bolt the cost of application is no greater than that of a common nut.

The "DS" Lock Nut is shown in Fig. 2821, in position on the bolt before being seated. As it is tapped with U. S. standard threads it may be turned on the bolt by hand, requiring the use of a wrench only after it comes in contact with the common nut.

Fig. 2822 shows its position on the bolt after

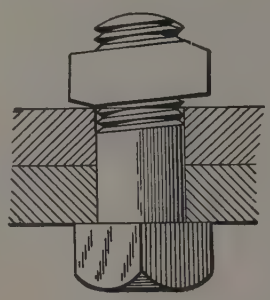


Fig. 2823—"DS" Holding Nut in Position on Bolt Before Being Seated

it has been tightened down flat. In this position it is securely locked on the bolt and to the common nut.

The "DS" Holding Nut is shown in Fig. 2823, in position on the bolt before being seated, and Fig. 2824 shows the Holding Nut wrenched down flat against a solid abutment.

"DS" Lock Nuts are made in sizes from ⅜ in. to 1¾ in., and the "DS" Holding Nuts in sizes from ⅜ in. to ⅝ in. These nuts are threaded on a center line which is slightly at an angle with the seating surface, consequently when being applied first

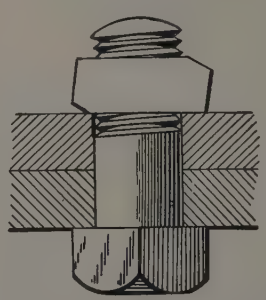


Fig. 2824—"DS" Holding Nut Wrenched Down Flat

contact with the part to be fastened is made at one point only,—see Figs. 2821 and 2823. Upon turning the nut further, by means of a wrench complete bearing over the entire seating surface is obtained—Figs. 2822 and 2824. The gripping action which takes place on the threads has no effect other than the generation of sufficient friction to hold the nut securely in place.

"DS" Holding Nuts are used wherever safety demands a nut that will positively stay tight, such as on car roofs, siding, door tracks, running boards, etc. They eliminate the necessity of using two nuts —a common nut and a lock nut—and also permit the use of shorter bolts, resulting in a large saving in labor and material costs.

Foreign and Industrial Cars

THE USE OF AMERICAN BUILT RAILWAY EQUIPMENT has become world-wide on foreign railroads and in industrial operations. Therefore, this class of equipment is included in this book so that information on the entire scope of American carbuilding may be available. The widely varying conditions encountered in freight and passenger service in foreign lands has necessitated the construction of many different types of cars; in some countries—particularly in European freight traffic—small cars of the four-wheel type predominate while in other countries—Cuba, Mexico, South America, South Africa, Australia, China and other parts of the Orient—eight-wheel or double-truck cars, very similar to those on American railways, are extensively used in main line service.

Passenger Cars

Passenger cars used on the railways throughout the world range from the very simply constructed wooden third-class car to large, finely appointed steel equipment which compares favorably with the best types of passenger cars in use on American railways.

In European countries and many parts of the British Empire passenger cars of the side-door compartment type are in general use, but in other parts of the world, particularly in Latin America, the end-door type, similar to American railway equipment, is extensively used. In many countries the railroads operate first class, second class, and third class passenger coaches; many of the progressive railways have dining and sleeping cars, and also baggage, express, and other types of passenger train equipment similar to those used on American railways.

Generally these cars are equipped with American types of couplings and brakes but European and special types of appliances are also provided when necessary to conform to the practice already established on the railway for which the cars are designed.

Freight Cars

The freight cars are built in both the four-wheel and eight-wheel types and include box cars, gondolas, flat, hopper, tank, and other types. Many of the lighter cars are provided only with hand brakes but the use of power brakes —vacuum type or some other type of air brake—is quite extensive on the heavier equipment.

The screw type of coupler, supplemented by side buffers, is in extensive use in European countries; in many other countries the American type of automatic coupler or a modification of it is used; the link-and-pin coupler, and various designs of hooks, springs, etc., are also used on much of the light equipment.

The four-wheel cars have the axles fixed to the car frame and are provided with springs—usually semi-elliptical, sometimes coil—over the axles. Some of these cars are of the closed-top type but in many cases they are simply small gondolas or open-top cars, provision being made to cover, with a tarpaulin, goods which are liable to damage from exposure to the weather.

The heavier eight-wheel cars are constructed along lines closely following American practice and are equipped with many of the same appliances—draft gear, automatic couplers, air brakes, etc.

Industrial Cars

The industrial car is used in almost every branch of industrial activity; in manufacturing plants, mines, lumber operations, sugar cane plantation, and in construction work. They are also used in quarries, sand and gravel plants, brick and clay works, steel mills, smelters, foundries, machine shops and in many other places for handling all classes of loose or package materials.

The classes of cars referred to as industrial includes many types of cars which often are also used in general railway service, and other smaller cars which are purely industrial.

These cars may be classified according to the industrial field in which they are used and according to their general form; dump cars, platform cars, hopper-bottom cars and various forms of rack cars.

Dump Cars

Cars of the dump type are adapted for handling a wide range of materials, and, because of the steep angle of discharge generally obtained, wet as well as dry materials may be dumped successfully. Cars of this type are used in mining and quarrying works; at sand and gravel plants; stone crushers; cement mills; fertilizer, phosphate and nitrate plants; powder works; smelters; clay, pottery, brick and glass works; by contractors for road paving, excavating and concrete work; in foundries for sand, slag and refuse and in chemical and various other industrial plants, particularly those using loose bulk materials.

Dump cars are made in various sizes and shapes to meet many requirements but differ considerably in details of design. The two general types are the box-body type and the V-body type; there are many modifications of both types. Generally, these cars are designed to dump toward either side, but they are also built so that the load may be discharged from the end.

Cars of the box-body type are used largely in construction work. They are generally referred to simply as "dump cars" although some of them are sometimes called "two-way" dump cars to distinguish them from "one-way" dump cars. In addition to the construction field, where excavating, filling and ballasting work is done, they are also employed around ore reduction plants, stone quarries and rock crushers, gravel and sand pits. They are useful for moving practically all classes of loose bulk materials and also such materials as pig iron, castings, small forgings, steel billets, scrap materials, etc.

The V-body dump car is generally built entirely of metal and to dump toward either side. It is particularly useful in industrial plants and for construction operations, because of its adaptability for handling any class of loose materials such as coal, ashes, sand, gravel, shale, rock, ore, earth, cinders, cement, concrete, clay, and other similar loose bulk material.

Another type of dump car is the rotary type which has

either a square box or a scoop type of body which can be rotated and dumped in any direction.

Hopper Bottom Cars

Hopper bottom cars suitable for use in steam railroad service are extensively employed for handling coal, ore and other substances and in the industrial field for moving large quantities of loose bulk materials such as ashes, coke, sand, gravel, crushed stone, earth, clay, fertilizer, etc. They have also been adapted for use at manufacturing plants, power houses, fertilizer works, coal and ore mines, and in refining operations.

Gable Bottom Cars

Gable bottom cars are particularly adapted for use on inclined and elevated tracks or trestles. The facility with which the load may be dumped to either or both sides makes them an efficient and economical type of car for delivering many kinds of loose bulk material to storage bins. They are used at coal yards and power houses; at mines for handling iron and copper ore; at brick yards for handling clay; at sand and gravel pits, and for many other similar purposes.

With slight modifications they are used with automatic and cable railways employed on the water front for handling coal from vessels and barges to storage bins and pockets.

Inclined Bottom Cars

Cars of the hopper-bottom type which discharge in the center, or of the gable-bottom type which discharge on the sides, meet many requirements but there are some places where inclined bottom cars which discharge on one side only, or at one end only, give more satisfactory service. Such cars serve to handle practically any class of loose material and are built in many different designs.

Platform Cars

The platform car, or "flat" car as it is generally termed, consists of a frame or flat body mounted on wheels and is used for general utility purposes at industrial plants or elsewhere. The service conditions vary widely and many variations in dimensions, capacity and details of designs are available; these cars are built in large eight-wheel units similar to those used in standard American practice and also in many different designs of small four-wheel cars.

Logging Equipment

Cars used for logging work usually consist of either a flat car or of two four-wheel trucks fitted with special types of log bunks. When trucks are used, the logs rest on the special bolster which forms the log bunk. The two trucks are sometimes connected together by a coupling beam, but frequently the logs form the only connection between the trucks.

On logging cars designed for hauling long logs, no platform is placed on the frame and the center sills are sometimes fitted with an adjustable section so that the distance between the truck centers can be adjusted to suit the length of the logs.

Cane Cars

Sugar cane plantations are operated in the United States, in Cuba, Porto Rico, Mexico, Central and South America, Hawaii, and other tropical countries. This has resulted in the development of many different types of cane cars to meet special requirements.

These cars are of two general groups; large double-truck or eight-wheel cars; and small four-wheel cars. They may be of the side discharge type, end discharge—not extensively used; or designed for hoist discharge or rake discharge. In the largest cane producing sections, especially in Cuba, car dumpers of the side tipping platform type are extensively used with side discharging type of car.

Four-wheel cane cars differ widely in design and are used extensively. With little change in details they are used on other than cane plantations for handling such material as sisal grass, henequen, manila, bananas, etc.

Other Types

In addition to the types described there are many other cars designed for a wide variety of uses. These include motor operated cars of many kinds; charging cars for foundry work; dryer cars of the "rack" design for use in brick manufacture, core oven work, and for creosoting operations.

Fig. 2825—First Class Vestibule Passenger Car for Ferro-Carril Central Norte. Builder, Bethlehem Shipbuilding Corporation, Ltd.

Fig. 2826—First and Second Class Passenger Car for E. F. de Marica, Brazil. Builder, Middletown Car Company.

Fig. 2827—Special President's Car for Estrada de Ferro Oeste de Minas. Builder, Bethlehem Shipbuilding Corporation, Ltd.

Fig. 2828—First Class Passenger Car with Compartment for Buenos Aires and Rosario. Builder, American Car and Foundry Company.

Fig. 2829—Third Class Passenger Car for Kwong Tung Yueh Han Railway. Builder, Bethlehem Shipbuilding Corporation, Ltd.

Fig. 2830—Third Class Passenger Car for Ferrocarril del Pacifico, Colombia. Builder, Watson Manufacturing Company.

Fig. 2831—Interior of Third Class Passenger Car for Ferrocarril del Pacifico, Colombia.

Fig. 2832—Interior of First Class Passenger Car for Ferrocarril de Amaga, Colombia.

Fig. 2833—First Class Passenger Car for Ferrocarril de Amaga, Colombia, S. A. Builder, The J. G. Brill Company.

Fig. 2834—First Class Vestibule Passenger Car for Chile State Railway. Builder, Middletown Car Company.

Fig. 2835—Sleeping Car for Cie. des Chemins de Fer Federaux de l'Est Bresilien. Gage, 3 ft. 3⅜ in.; Length Over Platform, 42 ft. 8⅛ in.; Width, 8 ft. 10⅜ in. Builder, Bethlehem Shipbuilding Corporation, Ltd.

Fig. 2836—First Class Passenger Car for Central Santa Lucia. Builder, The Gregg Company, Ltd.

Fig. 2837—Sleeping Car for Chilian State Railway. Gage, 5 ft. 6 in.

Fig. 2838—Interior of Sleeping Car for Chilian State Railway, shown in Fig. 2837.

Fig. 2839—Interior of Dining Car for Central Norte, shown in Fig. 2840.

Fig. 2840—Dining Car for Argentine Government Railway—Central Norte.

American Car and Foundry Company.

Fig. 2841—Combination First and Second Class Passenger Car for E. de Ferro de Goyaz.

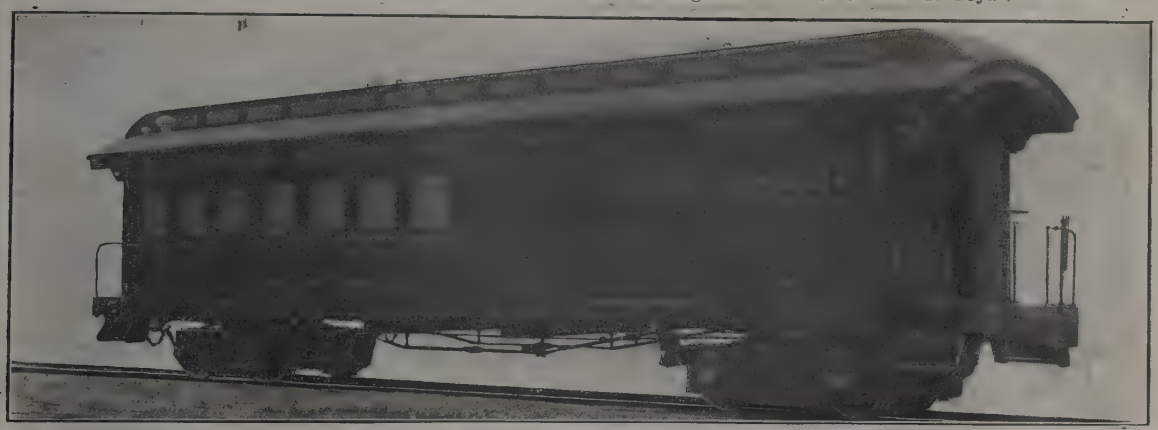


Fig. 2842—Combination Second Class and Baggage Car for Northern Railway of Costa Rica.

Fig. 2843—Combination Baggage, Mail and Guard Car for E. de F. Central de Rio Grande del Norte.

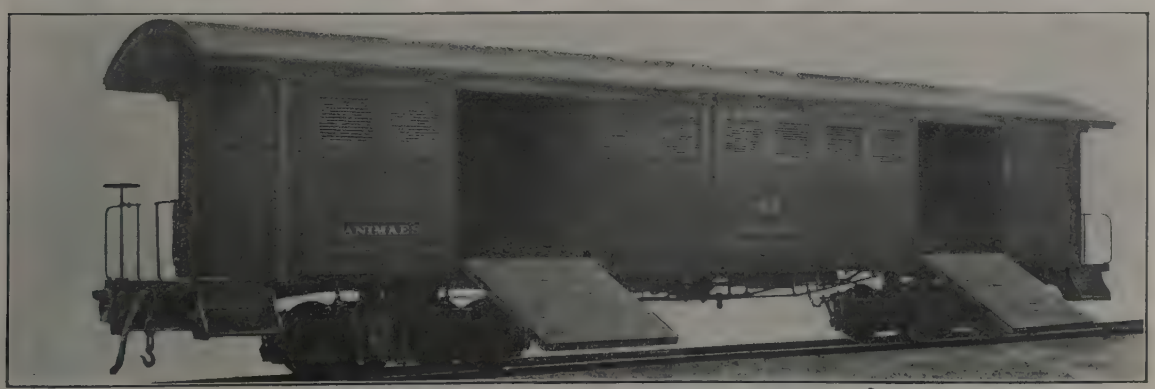


Fig. 2844—Combination Animal and Baggage Car for E. de F. Oeste de Minasi.

Bethlehem Shipbuilding Corporation, Ltd.

Fig. 2845—Steel Frame Box Car for the Russian Government Railways. Builder, American Car & Foundry Co.

Fig. 2846—Steel Framed 40 Metric Ton, Single Sheath Car for Russian Government Railways. Weight, 44,670 lb. Inside Length, 41 ft. 5⅝ in. Inside Width, 8 ft. 9 in. Inside Height, 7 ft. 9½ in. Builder, Pressed Steel Car Company.

Fig. 2847—All Steel 30-Ton Box Car for Tientsin Pukow Railway. Weight, 38,500 lb. Inside Length, 32 ft. 6 in. Inside Width, 9 ft. 6 in. Inside Height, 7 ft. 6 in. Builder, Western Steel Car & Foundry Company.

Fig. 2848—All-Steel Van for Nigerian Railway. National Steel Car Company.

Fig. 2849—Steel Underframe, Wooden Superstructure 20-Ton Box Car. Builder, Magor Car Corporation.

Fig. 2850—40-Ton Capacity Box for the U. S. Naval Station 17. Builder, The Gregg Company, Ltd.

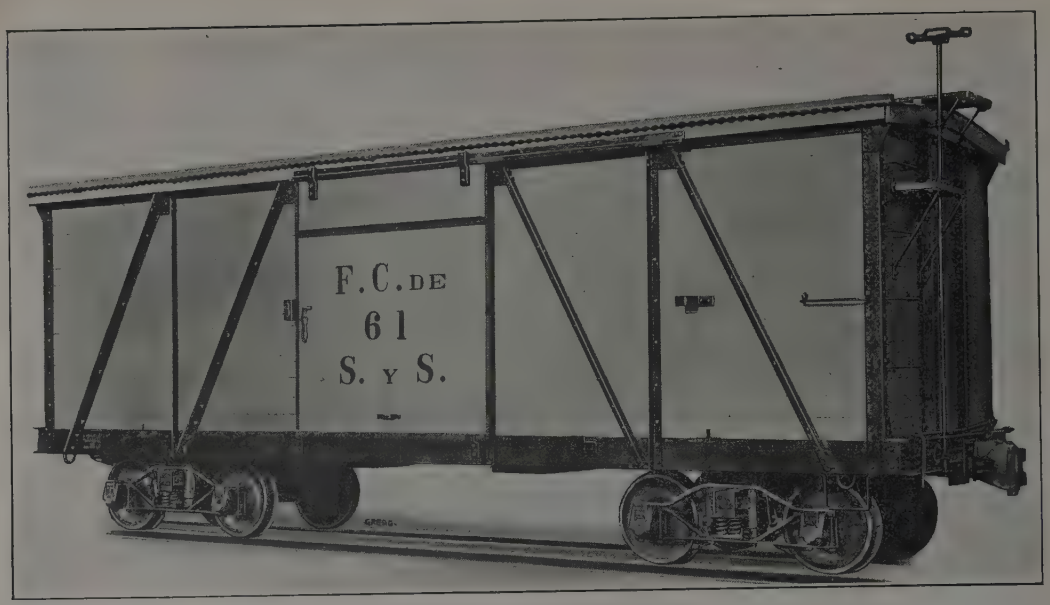


Fig. 2851—Composite Type Box Car, Framework of Steel; Capacity, 15-Tons; Gage, 42 in.; Inside Length, 24 ft.; Inside Width, 6 ft. 9 in.; Inside Height, 6 ft. 3 in.; Fitted with Hand Wheel Brake Acting on One Truck; Automatic Couplers. Builder, The Gregg Company, Ltd.

Fig. 2852—Steel Underframe, Steel Frame Superstructure 12-Ton Banana Car with Wood Slats. Builder, Magor Car Corporation.

Fig. 2853—Steel Underframe, Steel Frame Superstructure 30-Ton Fruit Car with Ventilated Wooden Sheathing. Builder, Magor Car Corporation.

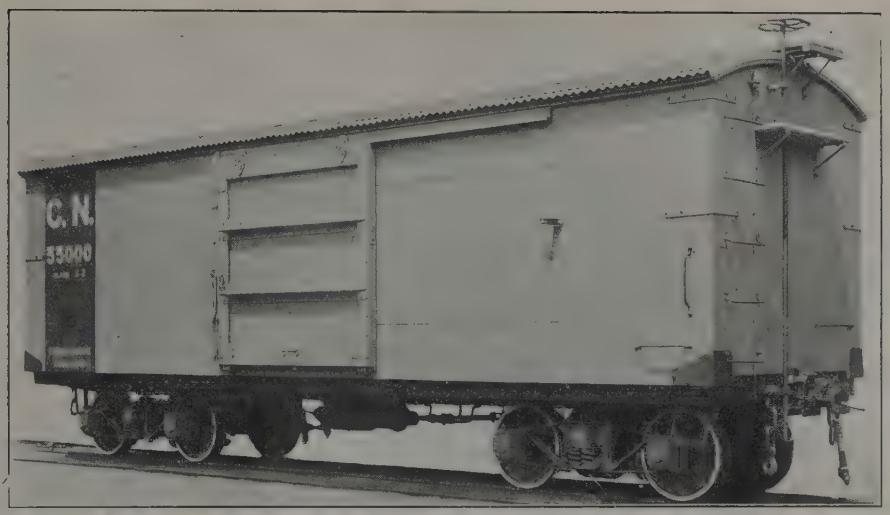


Fig. 2854—20-Ton Steel Underframe Box Car for the Argentine State Railway. Builder, Middletown Car Company.

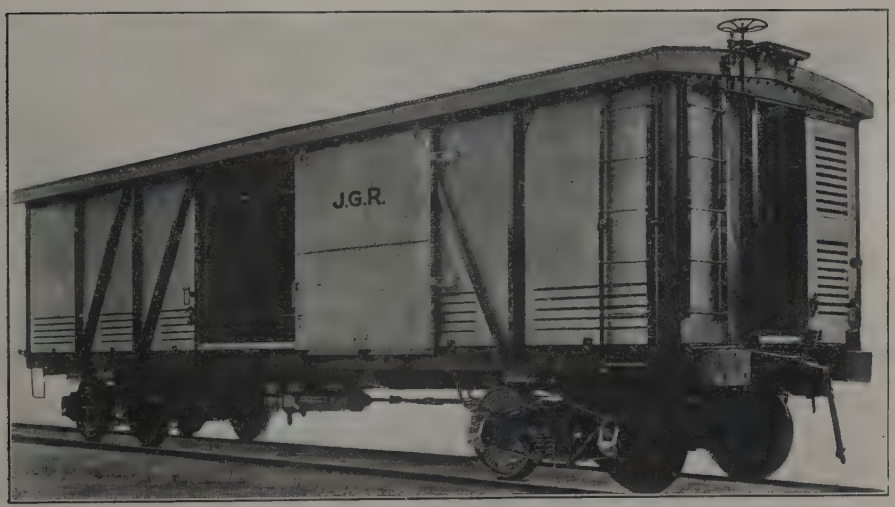


Fig. 2855—Steel Underframe, Composite Superstructure 30-Ton Box Car. Builder, National Steel Car Corporation, Ltd.

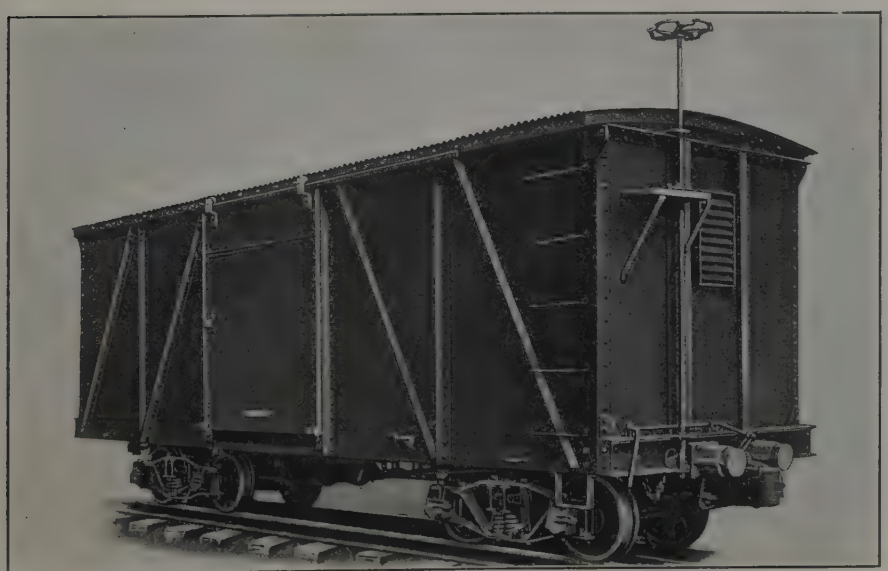


Fig. 2856—All-Steel Ventilated Box Car. Builder, The Gregg Company, Ltd.

Fig. 2857—Four-Wheel Type Steel Underframe Box Car for Paloma Railway, Uruguay. Builder, Middletown Car Company.

Fig. 2858—Two-Axle Box Car for the Russian Government Railways. Builder, Canadian Car & Foundry Company.

Fig. 2859—All-Steel Box Car for Serbian Government Railways. Builder, Middletown Car Company.

Fig. 2860—Steel Underframe and Steel Frame Box Car for Indian State Railways. Builder, Middletown Car Company.

Fig. 2861—Two-Axle, 1200-Pood (20-Ton) Box Car for the Russian Govern-

Fig. 2862—Composite Box Car. Steel Frame with Wood Floor and Sheathing. Capacity, 8 Tons. Link and Pin Self-Contained Spring Couplers, Semi-Elliptic Steel Springs, Rolled Steel Tire and Wrought Iron Center Wheels, Ventilator with Cover in Ends for Transporting Sugar, Gage One Meter. Inside Length, 15 ft. 6 in. Inside Width, 6 ft. 6 in. Inside Height, 6 ft. 6 in. Builder, The Gregg Company, Ltd.

Fig. 2863—Steel Underframe Stock Car for Compania Del Ferrocarril De Amaga. Builder, Middletown Car Co.

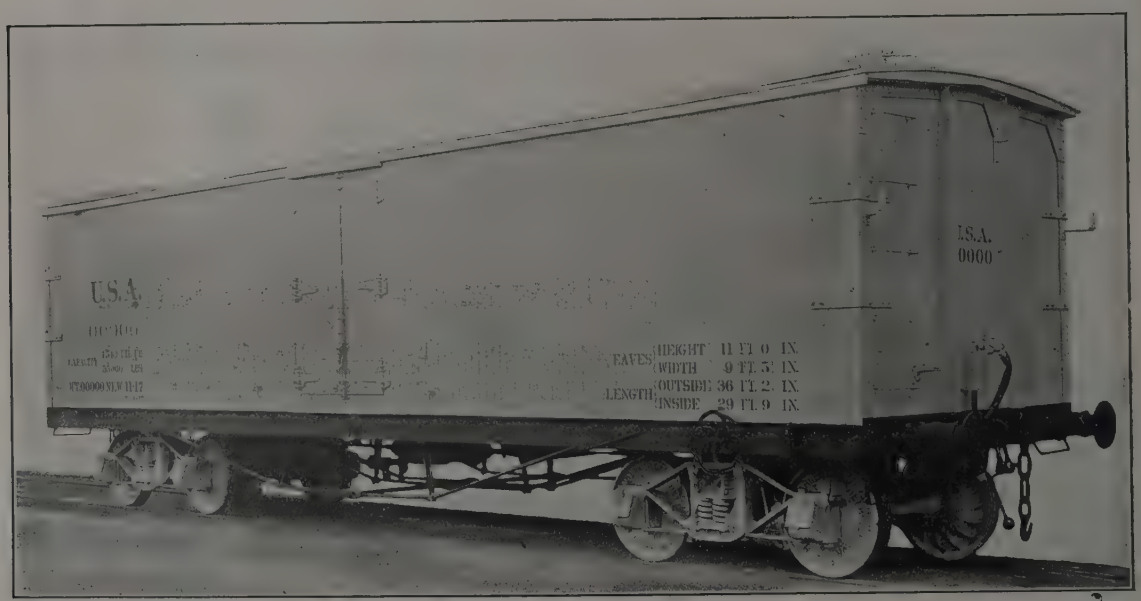


Fig. 2864—Refrigerator for American Expeditionary Forces.
Built by The Pullman Company—Haskell & Barker Plant.

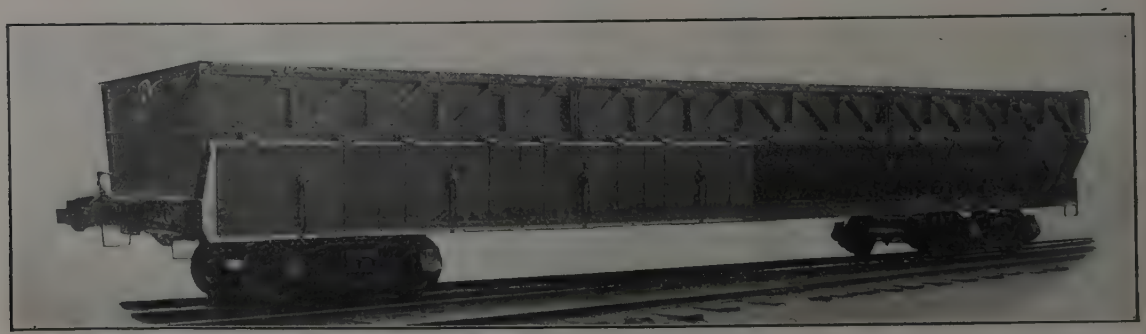


Fig. 2865—Steel Car for Use in Quenching Coke. Builder, American Car & Foundry Company.

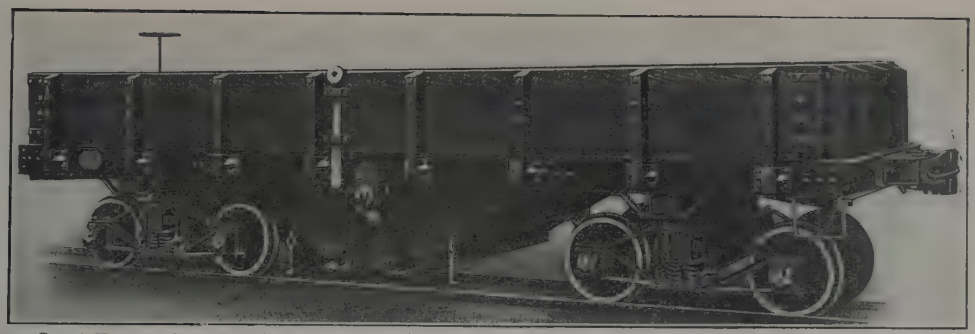


Fig. 2866—Steel Frame Gondola Car with Two Pockets and Discharge Doors in Bottom. Inside Length, 20 ft.; Inside Width, 6 ft.; Capacity, 10 Tons; Gage, 30 in.; Link and Pin Self-Contained Spring Couplers; Used for Track Ballast of Ashes, Sand, Rock, etc.; Also for Coal, Ore, etc. Builder, The Gregg Company, Ltd.

Fig. 2867—All-Steel, 50-Metric Ton Drop Bottom Gondola Car for the Russian Government Railways. Weight, 47,000 lb.; Inside Length, 40 ft.; Inside Width, 9 ft. 6¾ in.; Inside Height, 4 ft. 4 in.; Capacity, Level Full, 1,624 cu. ft. Builder, Pressed Steel Car Company.

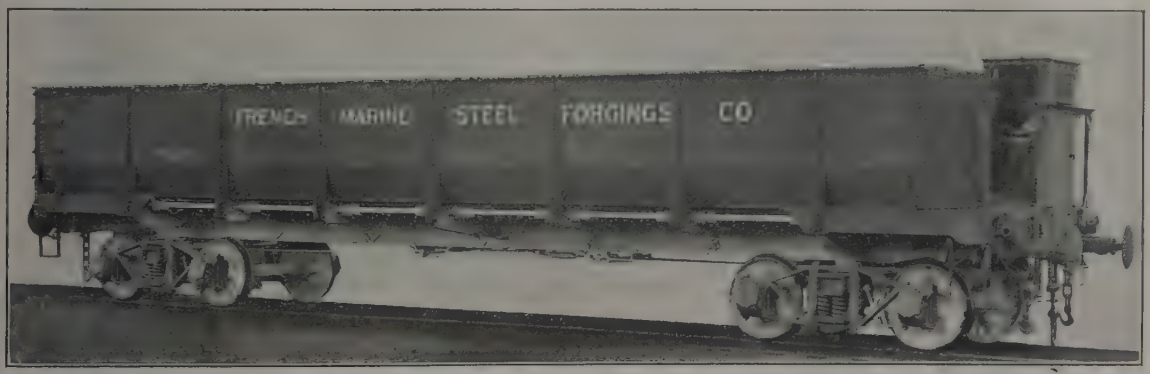


Fig. 2868—All-Steel, 50-Metric Ton Drop Bottom Gondola Car. Weight, 41,400 lb.; Inside Length, 38 ft. 2⅜ in.; Inside Width, 9 ft. 6¾ in.; Inside Height, 4 ft. 4 in.; Capacity, Level Full, 1,582 cu. ft.
Builder, Pressed Steel Car Company.

Fig. 2869—All-Steel Drop Bottom Gondola for India. Capacity, 50-Ton; Gage, 5 ft. 6 in.
Builder, National Steel Car Corporation, Ltd.

Fig. 2870—Steel Frame General Service Car for the Russian Government Railways. Inside Length, 39 ft. 11¼ in.; Inside Width, 9 ft. 2¾ in.; Inside Height, 4 ft. 4½ in.; Capacity, 110,300 lb.
Builder, American Car & Foundry Company.

Fig. 2871—All-Steel Drop Side Gondola Car for Serbian Government Railways.
Builder, Middletown Car Company.

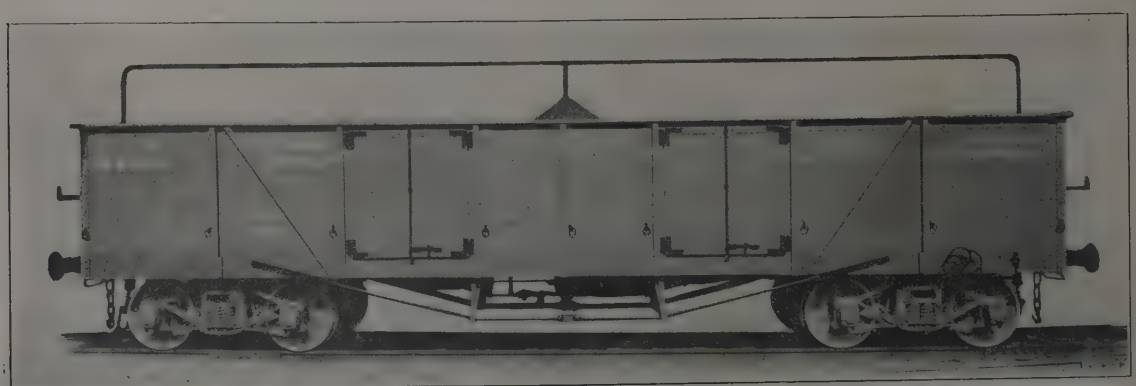


Fig. 2872—Standard Gage, 33-Ton High Side Gondola Car; Vertical Side Doors; Air and Hand Brakes; Length Over End Sills, 36 ft. 2¾ in.; Width Over Side Sills, 8 ft. 5¼ in.; Weight, 32,800 lb.
Built for American Expeditionary Forces.

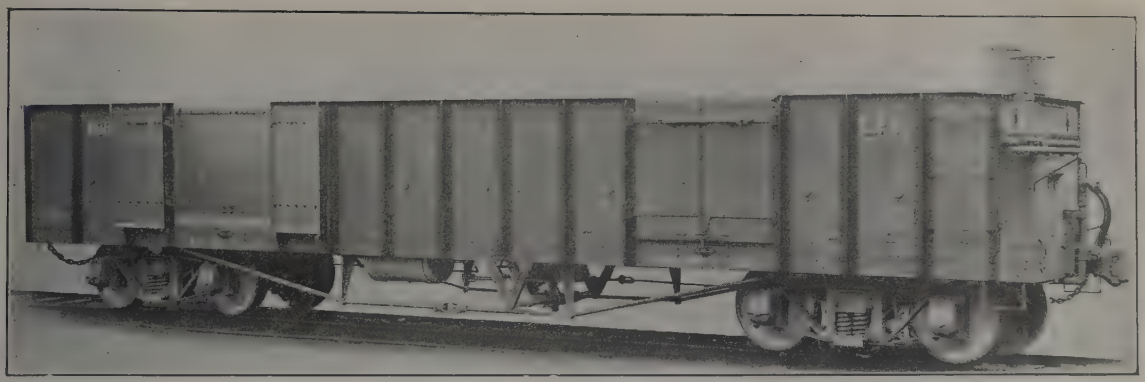


Fig. 2873—All-Steel, 35-Metric Ton Narrow Gage Gondola Car for Katanga Railway. Weight, 32,700 lb.; Inside Length, 37 ft.; Inside Width, 7 ft. 9 in.; Inside Height, 4 ft. 3 in.; Capacity, 1,218 cu. ft. Level Full, Builder, Pressed Steel Car Company.

Fig. 2874—Drop Side Gondola Car Built for the South African Railways. Builder, Pressed Steel Car Company.

Fig. 2875—Steel Underframe, Wooden Superstructure 25-Ton Capacity Drop Side Gondola Car. Builder, Magor Car Corporation.

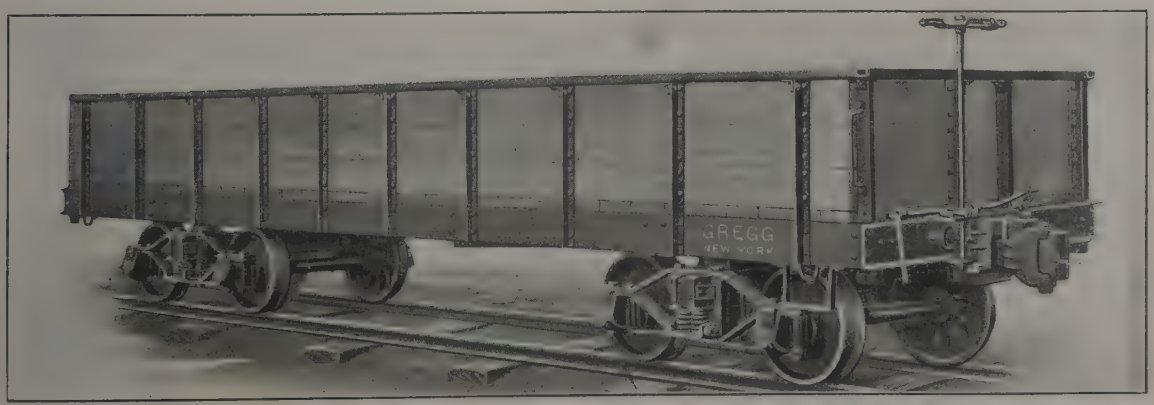


Fig. 2876—Steel Frame Gondola Car, 15-Ton Capacity. Length, 30 ft.; Gage, 1 Meter; Automatic Coupler; Hand Wheel Brake Action on One Truck. Builder, The Gregg Company, Ltd.

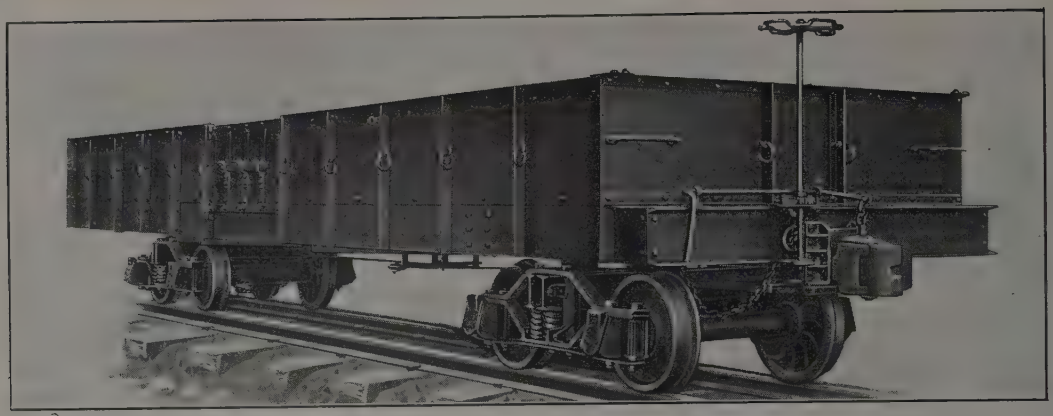


Fig. 2877—All-Steel Gondola Car with Steel Side Door. Builder, The Gregg Company, Ltd.

Fig. 2878—Steel Underframe Gondola Car for Morocco Railways. Builder, Middletown Car Company.

Fig. 2879—Steel, Wood Floor, 20-Ton, 4-Wheel Gondola Car for Paris, Lyons & Mediterranean. Builder, Pressed Steel Car Company.

Fig. 2880—Steel-Frame, Four-Wheel, Drop Side Gondola Car. Capacity, 8-Ton; Length, 10 ft. 8 in.; Width, 8 ft. 6 in.; Standard Gage. Builder, The Gregg Company, Ltd.

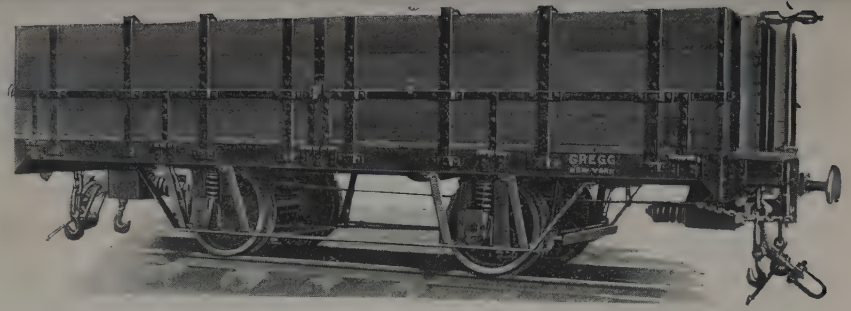


Fig. 2881—Steel-Frame Gondola. Capacity, 15,000 Kilos; Length, 16 ft. 5 in.; Width, 5 ft. 6 in.; Gage, One Meter; Top Half of Sides Lifts Out and Bottom Half Swings Down. Built for French Railroad by The Gregg Company, Ltd.

Fig. 2882—Steel Frame 20-Metric Ton Gondola Car for the French State Railways. Builder, The Eastern Car Company.

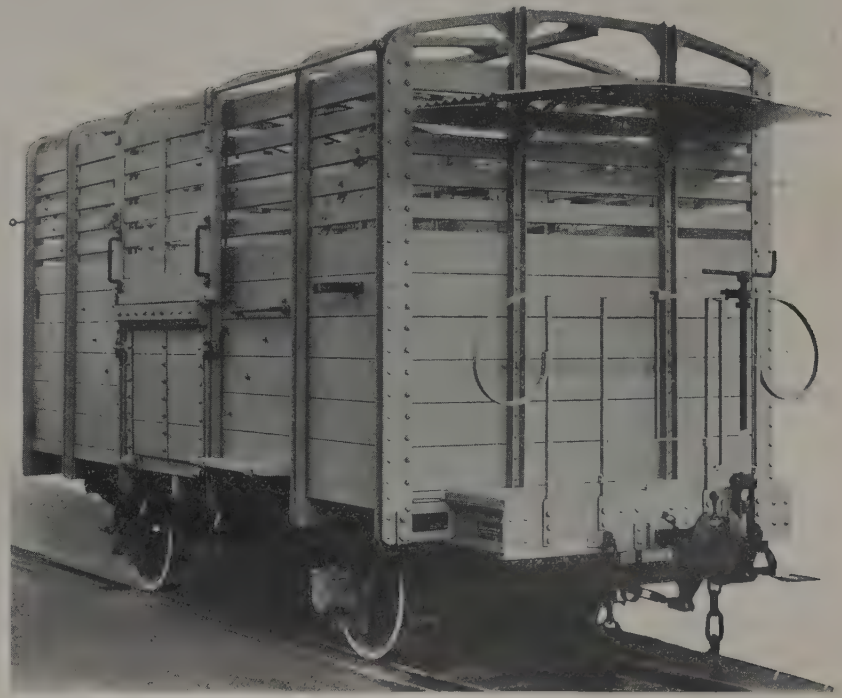


Fig. 2883—Four-Wheel Steel Rack Car for Java State Railways. Builder, Middletown Car Company.

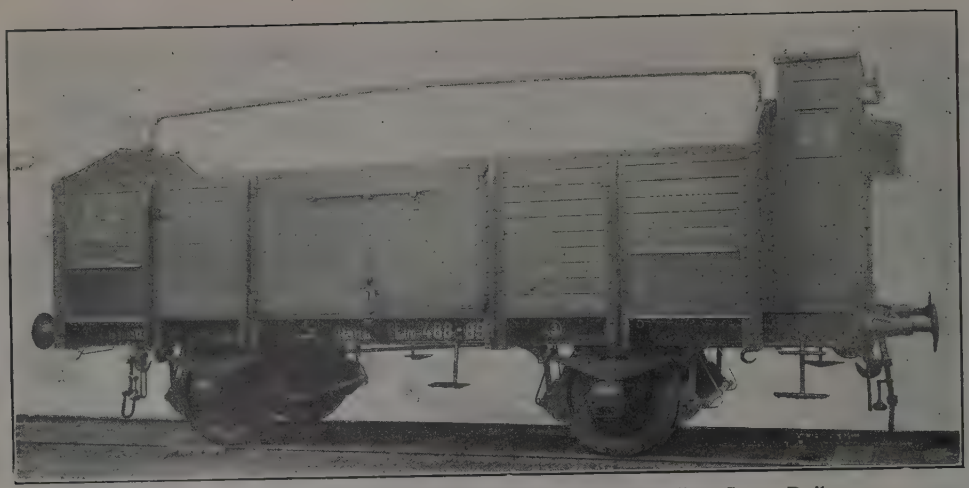


Fig. 2884—Steel Frame, Side Door Gondola Car for Italian State Railways.
Builder, American Car & Foundry Company.

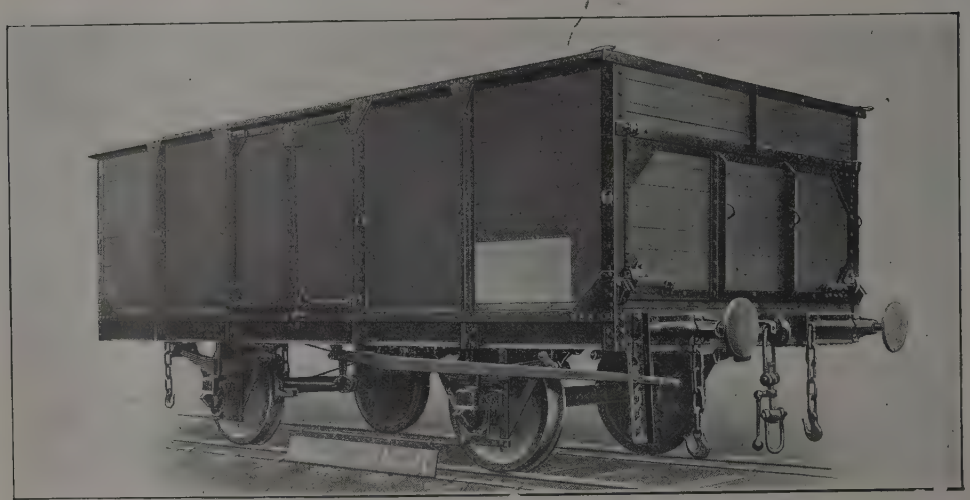


Fig. 2885—Steel Frame High Side Gondola, General Service Car with Side and End Doors; Inside Length, 20 ft. 6 in.; Width, 9 ft. 8 in.; Height, 5 ft.; Capacity, 20,000 Kilos; Wide Gage.
Built for the Compañia de los Caminos de Hierro del Norte de España.
The Gregg Company, Ltd.

Fig. 2886—Steel Frame High Side Gondola Car Similar to Car Shown in Fig. 2885, with Shelter for Brakeman. Built for the Compañia de los Caminos de Hierro del Norte de España.
The Gregg Company, Ltd.

Fig. 2887—Special Car for Transporting 16-Inch and Other Heavy Naval Guns. Complete Unit is 56 ft. long; Will Traverse Curves of 100 ft. Radius; Carries 286,000 lb. Built by The Pullman Company.

Fig. 2888—Steel Underframe 50-Metric Ton Flat Car for the Russian Government Railways. Weight, 40,800 lb.; Length Over Floor, 40 ft.; Width Over Floor, 8 ft. 11½ in. Builder, Pressed Steel Car Company.

Fig. 2889—All-Steel Flat Car for India. Capacity 50-Ton; Length, 40 ft.; Gage, 5 ft. 6 in. Builder, National Steel Car Corporation, Ltd.

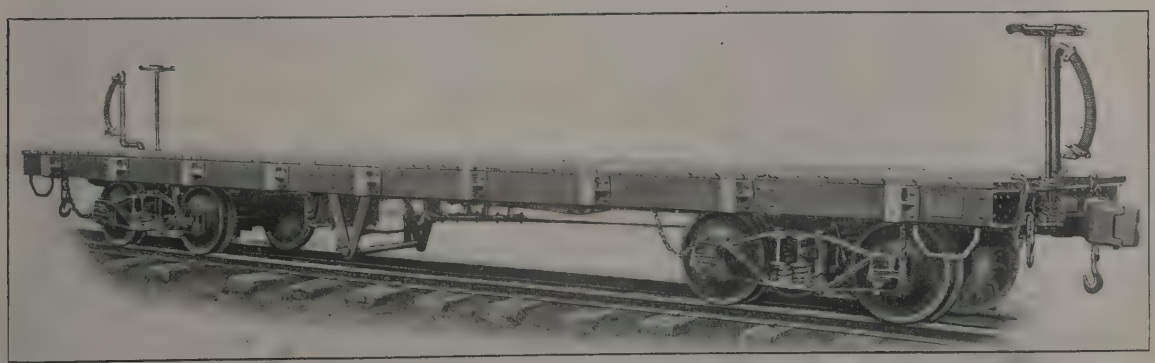


Fig. 2890—Steel Frame Flat Car. Capacity, 15-Ton; Length, 31 ft. 8 in.; Width, 7 ft. 3 in.; Gage, 36 in.; Equipped with Automatic Coupler, Safety Chains and Vacuum Brake. Built for the Ferrocarril de Cuzco a Sta. Ana Railroad, Peru. Builder, The Gregg Company, Ltd.

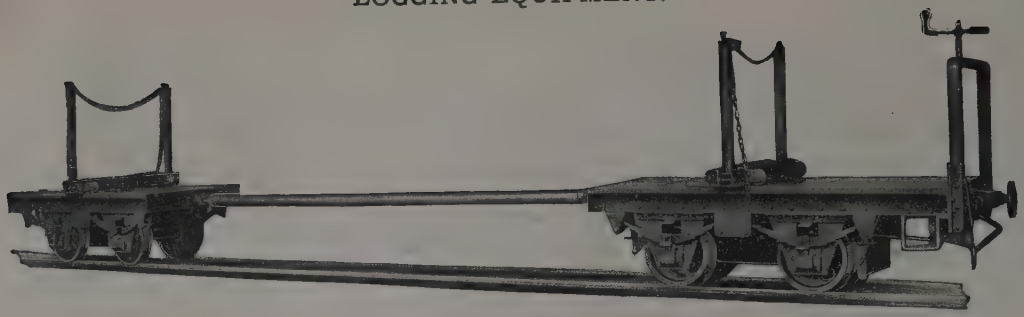


Fig. 2891—Combination Two-Truck Logging Car with Coupling Beam. Builder, Koppel Industrial Car and Equipment Company.

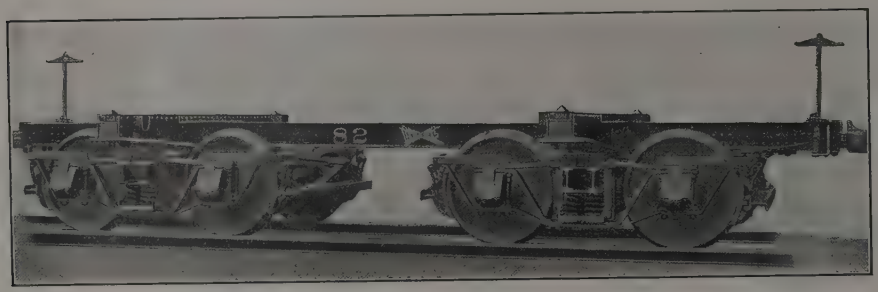


Fig. 2892—Steel Frame 30-Ton Capacity Logging Car. Weight, 15,000 lb. Builder, American Car & Foundry Company.

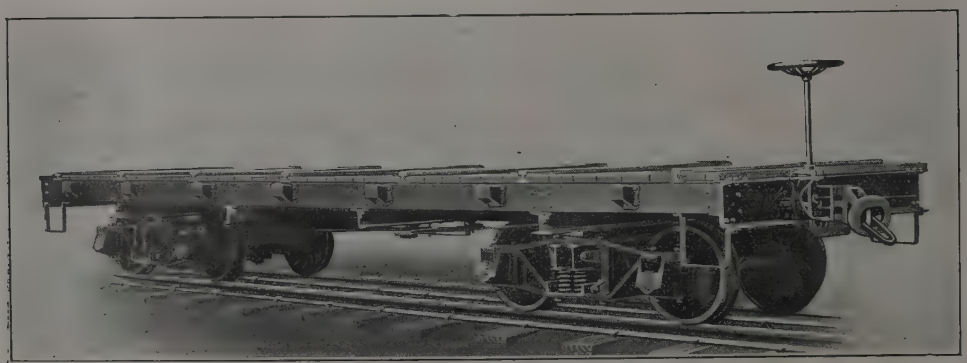


Fig. 2893—Steel Frame Logging Car with Composite Floor. Capacity, 15 Tons; Length, 24 ft. 0 in.; Width, 7 ft. 0 in.; Used in the Argentine Republic. Builder, The Gregg Company, Ltd.

Fig. 2894—15-Ton Logging Car, Skeleton Type with Two Bunks. Builder, Magor Car Corporation.

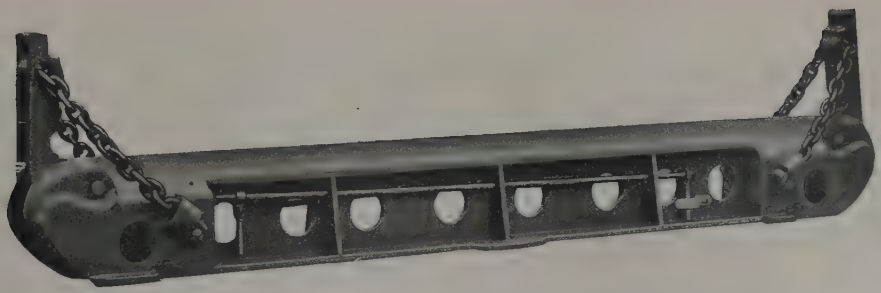


Fig. 2895—Russel Spear-Edge Cast Steel Drop Stake Logging Bunk.
Russel Wheel & Foundry Company.

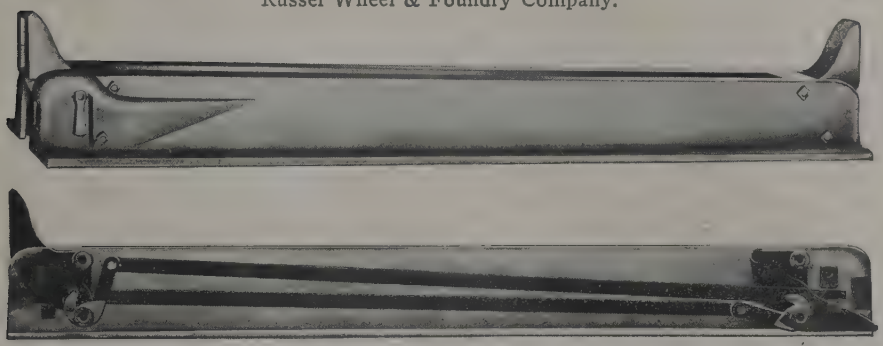


Fig. 2896—"Rainier" Automatic Log Bunk in Closed and in Tripped Positions.
Pacific Car & Foundry Company.

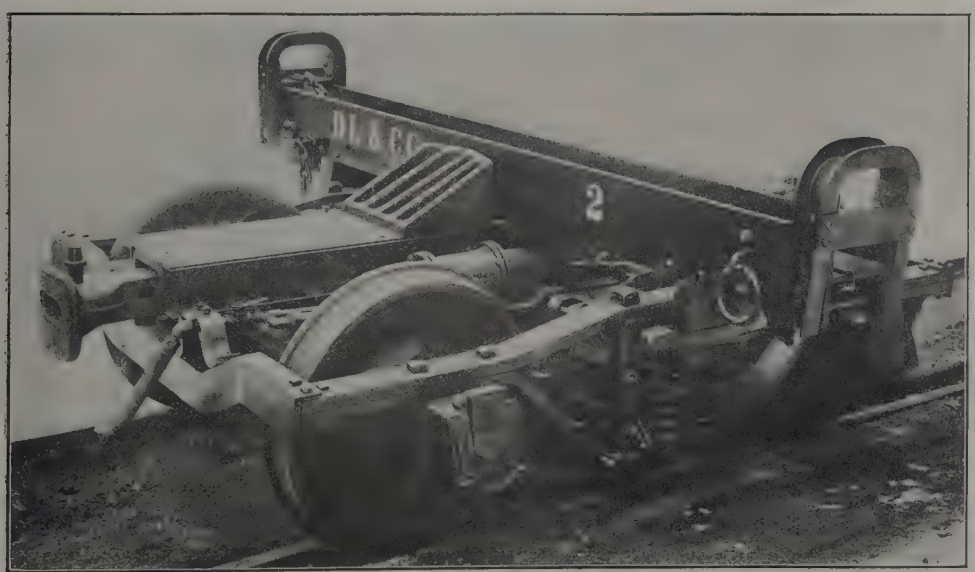


Fig. 2897—Logging Car Truck. Used in Pairs with Adjustable Reach Rod.
Builder, Magor Car Corporation.

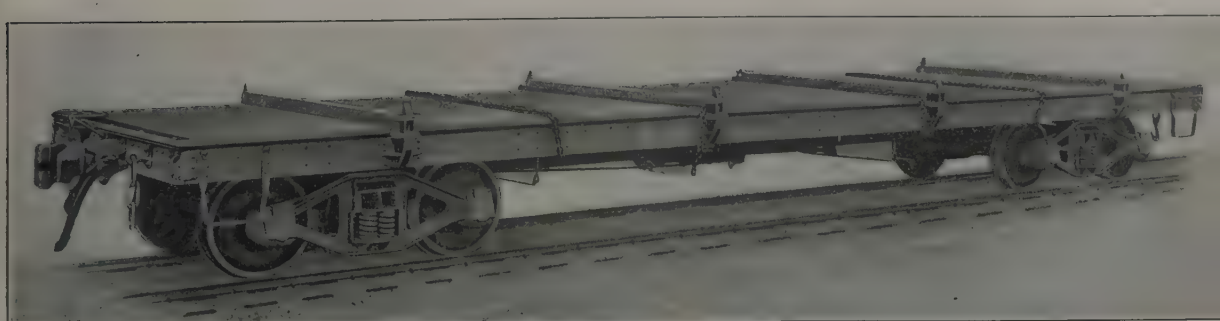


Fig. 2898—Steel Frame 40-Ton Capacity Logging Car. Weight, 31,500 lbs.; Length of Platform, 39 ft. 9 in.
Builder, The Bettendorf Company.

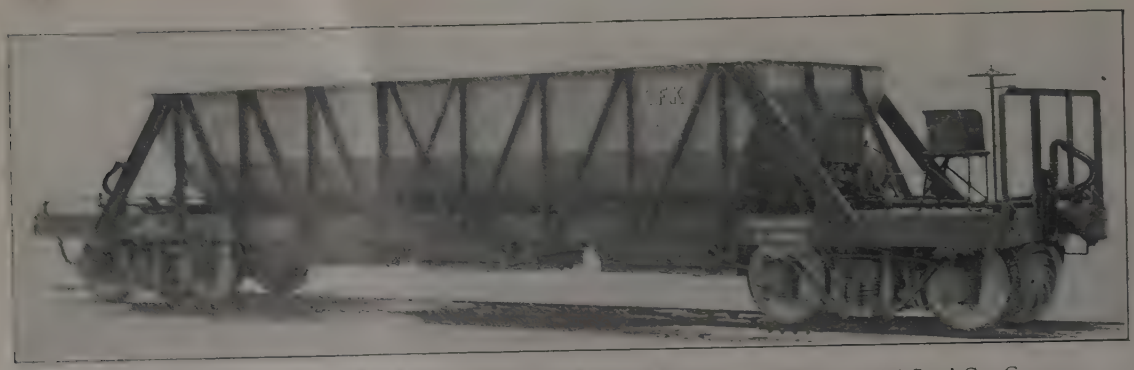


Fig. 2899—All-Steel, Narrow Gage Triple Hopper Car for Katanga Railway. Builder, Pressed Steel Car Company.

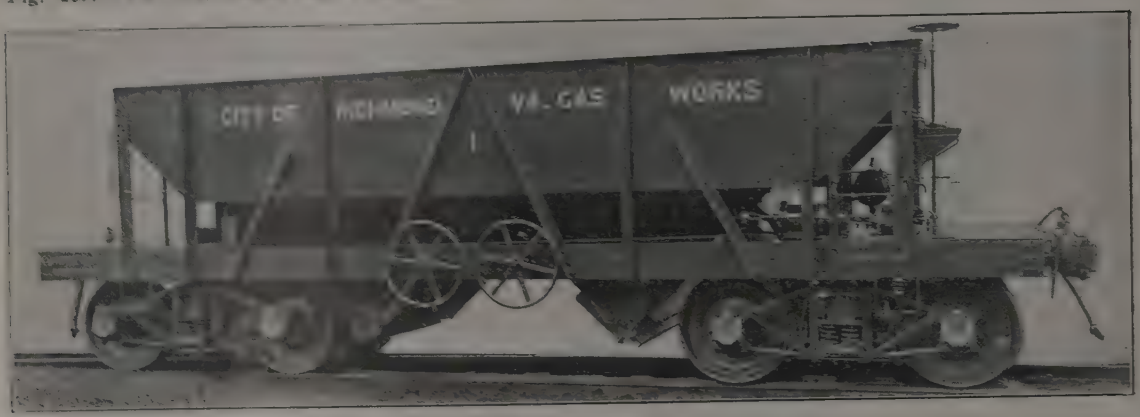


Fig. 2900—All-Steel Hopper Car. Builder, Magor Car Corporation.

Fig. 2901—All-Steel Hopper Car. Builder, National Steel Car Corporation, Ltd.

Fig. 2902—Steel Bottom Discharge Hopper Car for India. Builder, National Steel Car Corporation, Ltd.

Fig. 2903—Steel Hopper Car. Capacity, 3 cu. yd.; Gage, 36 in.; Single Bottom Door; Link and Pin Couplers; Hand Wheel Brake. Builder, The Gregg Company, Ltd.

Fig. 2904—Steel Hopper Car. Capacity, 9 cu. yd.; Gage, 30 in.; Three-Quarter Size Automatic Couplers; Hand Wheel Brake Applying on One Truck; Single Door in Bottom, Dumping Over the Track. Used for Carrying Ashes, Crushed Rock or Sand for Ballast; Coal, Ore and Other Similar Materials. Builder, The Gregg Company, Ltd.

Fig. 2905—30-Ton Capacity Calcine Hopper Car. Builder, The Youngstown Steel Car Company.

Fig. 2906—Steel Underframe Tank Car for the São Paulo Railways, Brazil. Capacity, 52,000 lb.; Gage, 5 ft. 3 in.; Length, 25 ft. 2 in.; Width, 9 ft. 3 in. Builder, Middletown Car Company.

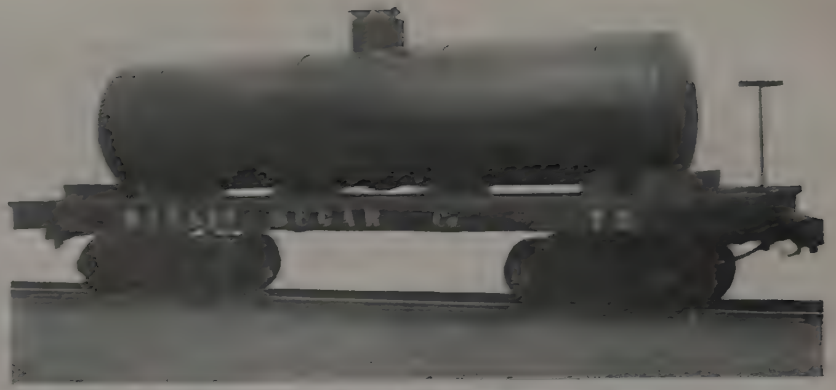


Fig. 2907—2,500 Gal. Capacity Tank Car for Hawaii Sugar Company. Builder, Magor Car Corporation.

Fig. 2908—5,000 Gal. Capacity Tank Car for Transporting Molasses. Builder, The Gregg Company, Ltd.

Fig. 2909—Four Wheel Tank Car. Capacity, 2,800 Gal.; Standard Gage. Builder, The Gregg Company, Ltd.

Fig. 2910—All Steel Cane Car for Cuba. Capacity, 60,000 lb. Builder, Standard Steel Car Company.

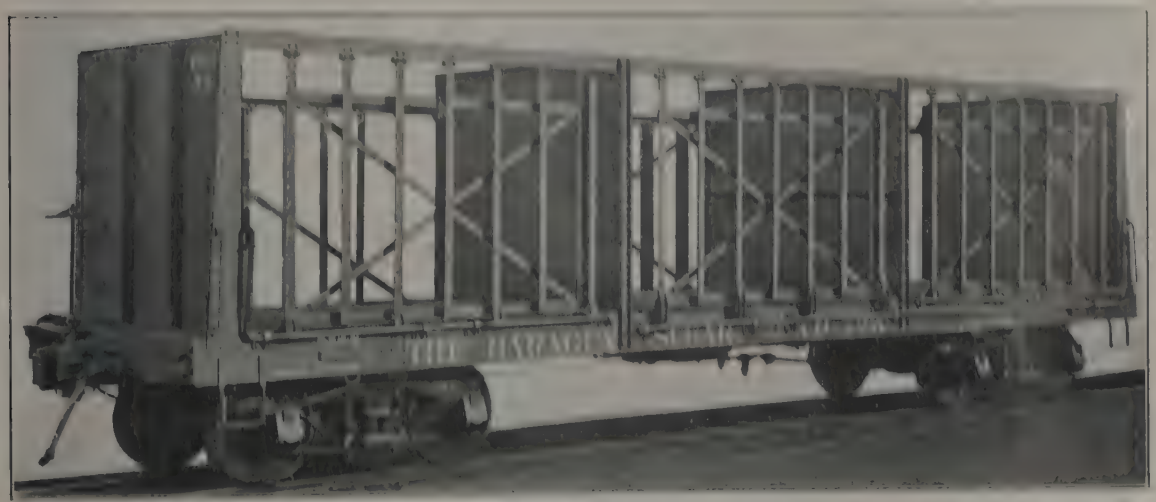


Fig. 2911—All Steel Sugar Cane Car for the Baragua Sugar Company. Builder, The Pressed Steel Car Company.

Fig. 2912—All Steel Side Discharge Cane Car for the United Sugar Companies of Mexico. Capacity, 40,000 Kilos; Length, 46 ft.; Width, 9 ft. 6 in. Builder, The Gregg Company, Ltd.

Fig. 2914—Steel Cane Car with Wood Floor. Builder, Standard Steel Car Company.

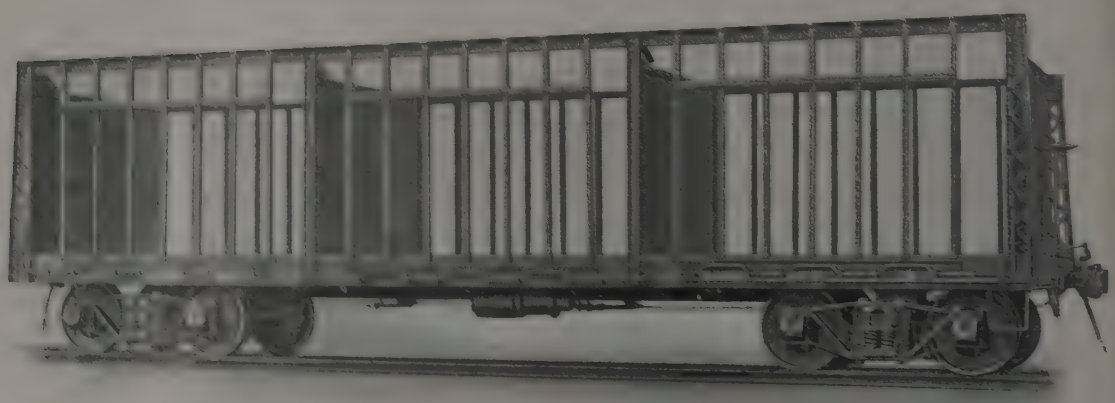


Fig. 2915—All-Steel Cane Car. American Car and Foundry Company.

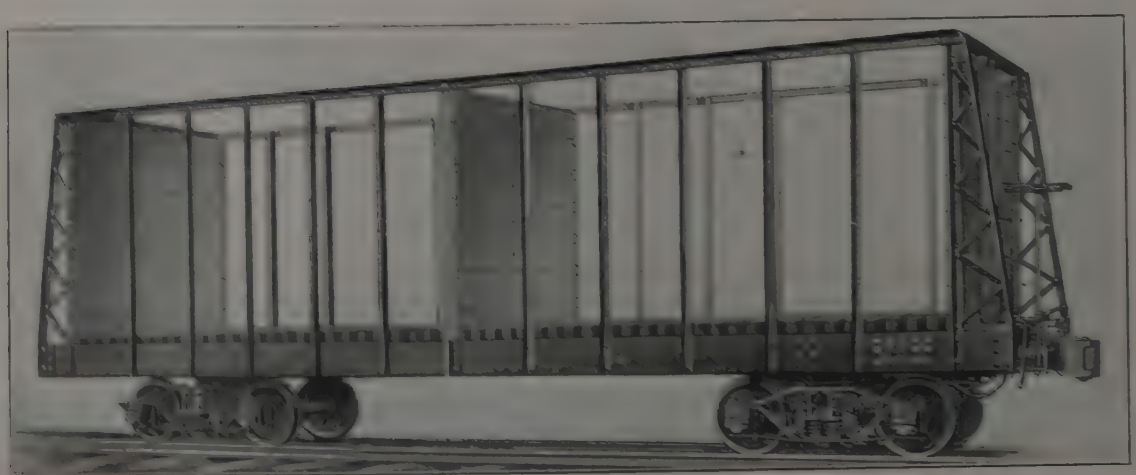


Fig. 2916—Steel Frame Hoist Discharge Type Cane Car. Builder, The Gregg Company, Ltd.

Fig. 2917—European Type 5-Ton Cane Car. Gage, 24 in. Equipped with Screw Brake on One Truck. Builder, Magor Car Corporation.

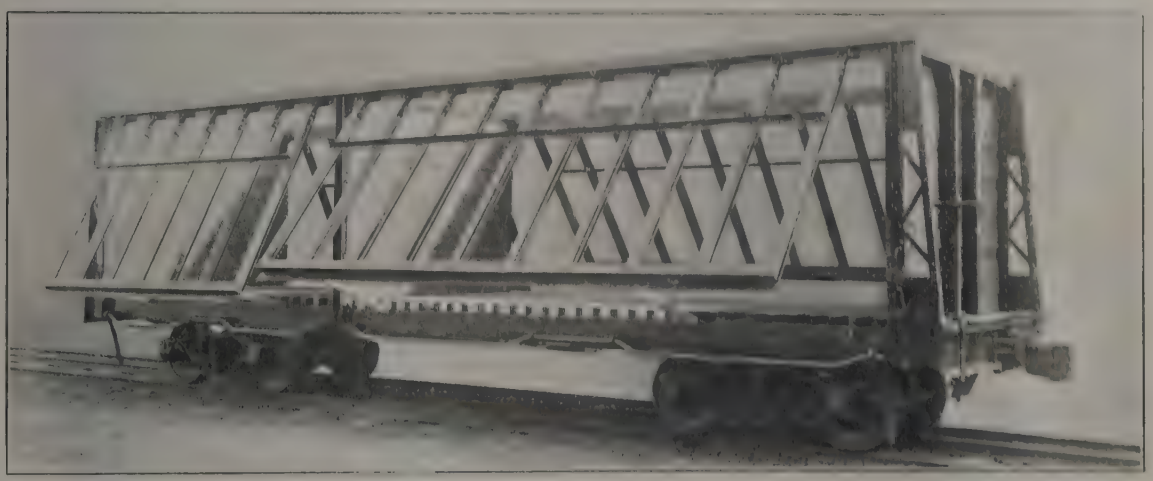


Fig. 2918—25-Ton One-Side Discharge Cane Car. Builder, Magor Car Corporation.

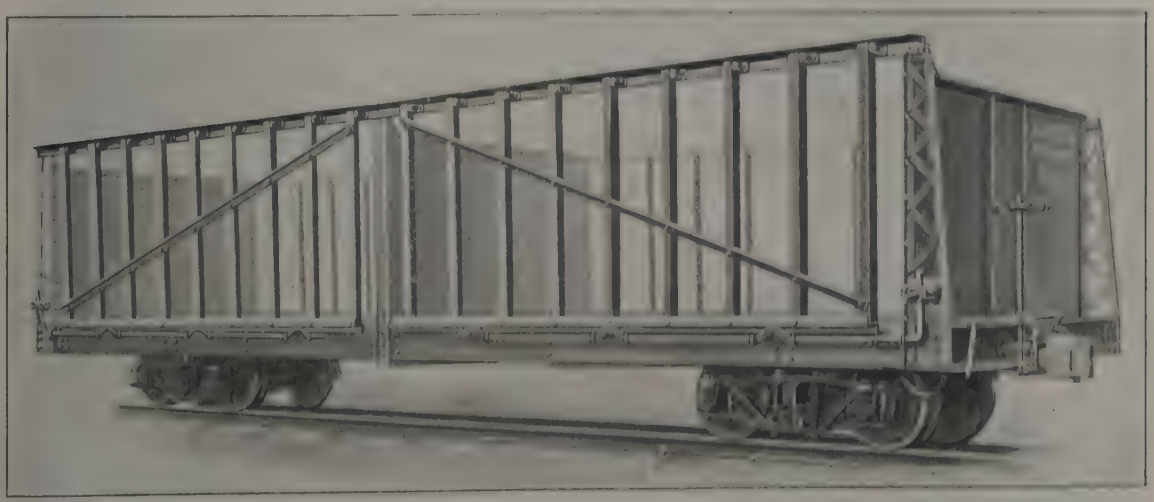


Fig. 2919—All-Steel Side Discharge Cane Car. Capacity, 20 Tons. Length, 30 ft.; Width, 8 ft., Gage, One Meter; Equipped with Hand Brake on One Truck. Builder, The Gregg Company, Ltd.

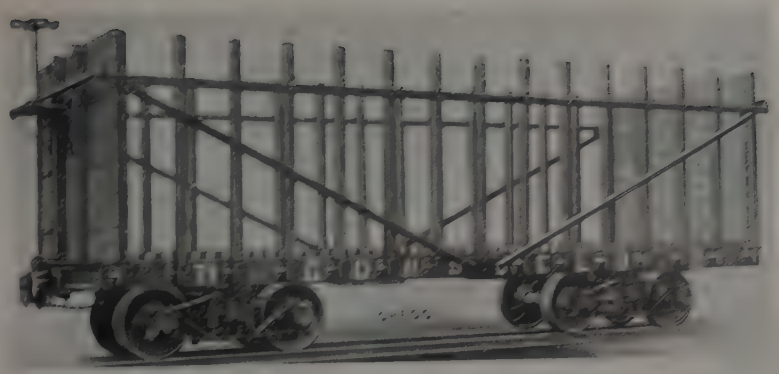


Fig. 2920—"Consuelo" Steel-Frame Car. Capacity 10 Tons; Length, 21 ft.; Width, 7 ft.; Three Quarter Size Automatic Couplers; Brake on One Truck; Superstructure of Wood, 5 ft. 9 in. High and Floor of Wood Cleats. Built for Plantation in Santo Domingo by The Gregg Company, Ltd.

Fig. 2921—Steel-Frame Sugar Cane Car. Side Discharge. Builder, Magor Car Corporation.

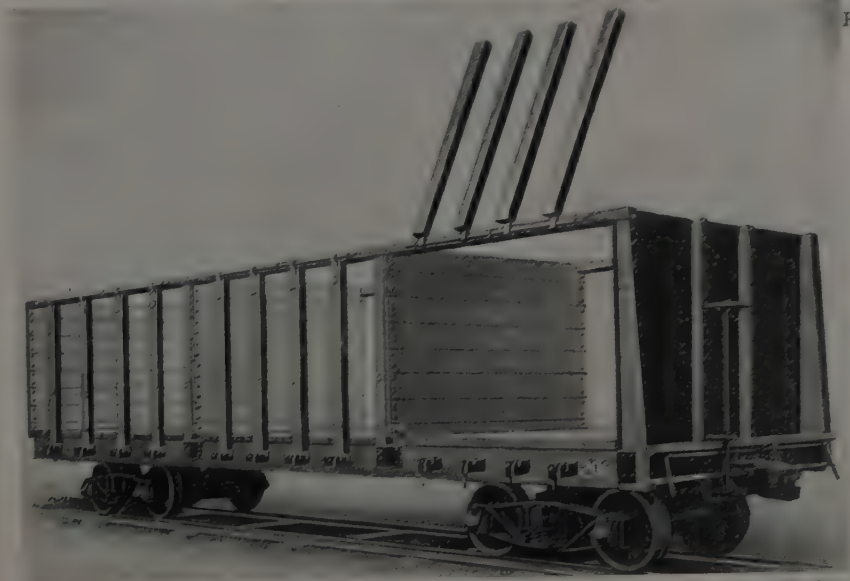


Fig. 2922—Steel-Frame Car. Capacity 15-Tons; Gage, 36 in.; Length, 30 ft.; Width, 7 ft.; Automatic Couplers; Hand Brake on One Truck; Wood Superstructure, 5 ft. High; Individual Release Top Hinged Stakes; Unloaded by Tipping Sidewise. Builder, The Gregg Company, Ltd.

Fig. 2923—"Conchita" All-Steel Car. Capacity, 25 Tons; Length, 32 ft.; Width, 8 ft. 6 in.; Standard Gage; One Compartment, Opening at End. Discharged on Tipping Table, Which Slides the Cane Out at the End, into the Feeder Pit. Builder, The Gregg Company, Ltd.

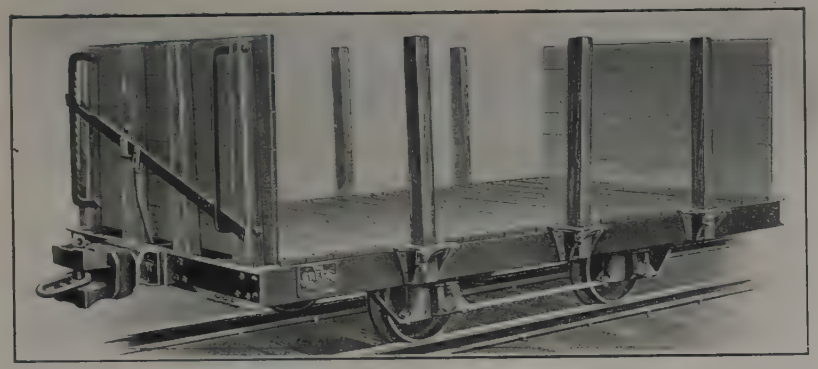


Fig. 2924—"Hawaiian" Steel-Frame Car. Capacity, 5 Tons; Length, 12 ft.; Width, 6 ft.; Gage, 36 in.; Link and Pin Self-Contained Spring Coupler; Quick Releasing Stake Pockets. Designed Especially for Use with Cane Carrier Feeders of the Rake Type. Builder, The Gregg Company, Ltd.

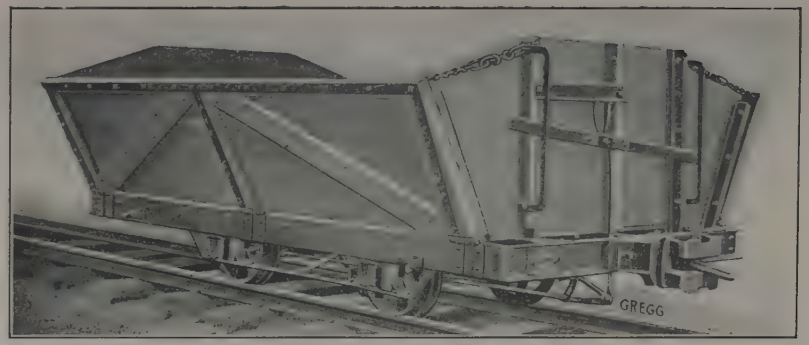


Fig. 2925—Steel Underframe Wood Floor, Sloping Side Door Car. Length, 12 ft.; Width, 6 ft.; Capacity, 5 Tons; Gage, 36 in. Principally Used in Hawaiian Islands and Philippines with Rake Type Feeders. Builder, The Gregg Company, Ltd.

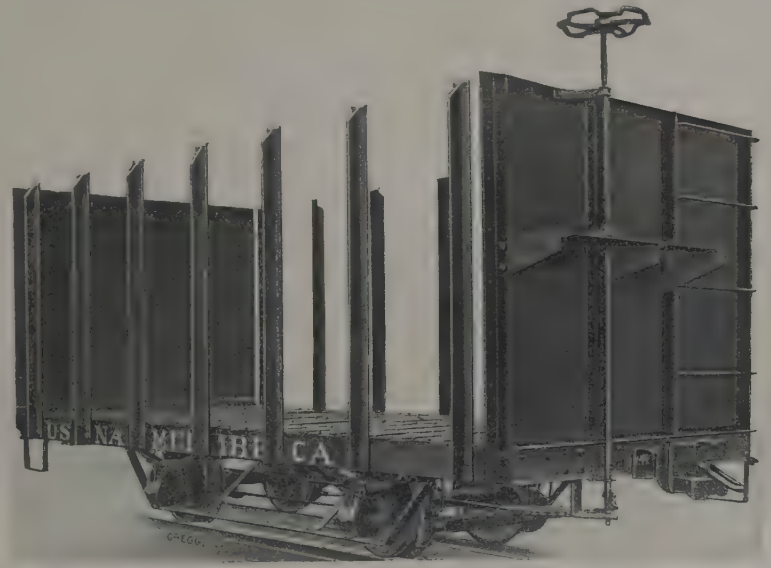


Fig. 2926—All-Steel Car, Capacity, 6 Tons; Length, 15 ft.; Width, 6 ft.; Gage, 75 Centimeters; Semi-Elliptic Springs; Link and Pin Self-Contained Spring Coupler; Stakes, 5 ft. 6 in. high; Car Designed for Use in Very Rough Hilly Countries, the Sheathed Ends Keeping the Cane from Sliding Forward. Hand Unloading. Builder, The Gregg Company, Ltd.

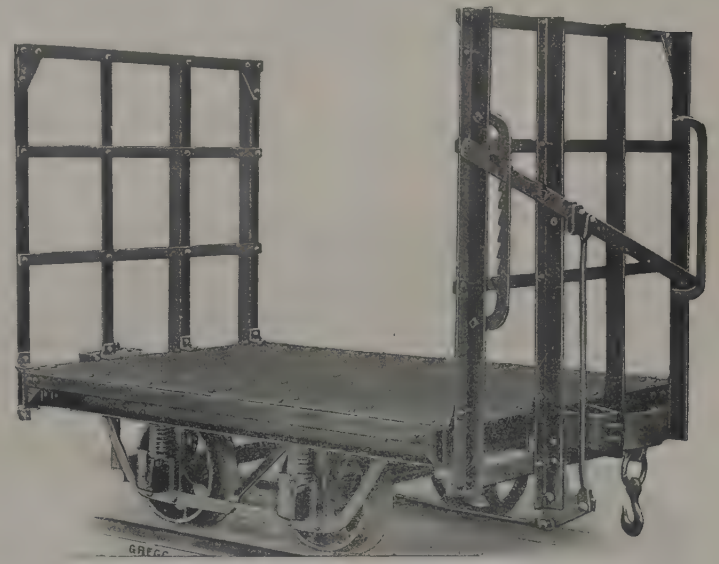


Fig. 2927—All-Steel Car. Capacities 1½ to 2 Tons; Gages, 50-30-24 Centimeter; Used in Cane Fields on Portable Track and the Load Transferred to Larger Cars at Loading Stations. Cane loaded Crosswise. On Small Plantations These Cars Are Hauled to the Mill by Animal Power or Light Locomotives. Builder, The Gregg Company, Ltd.

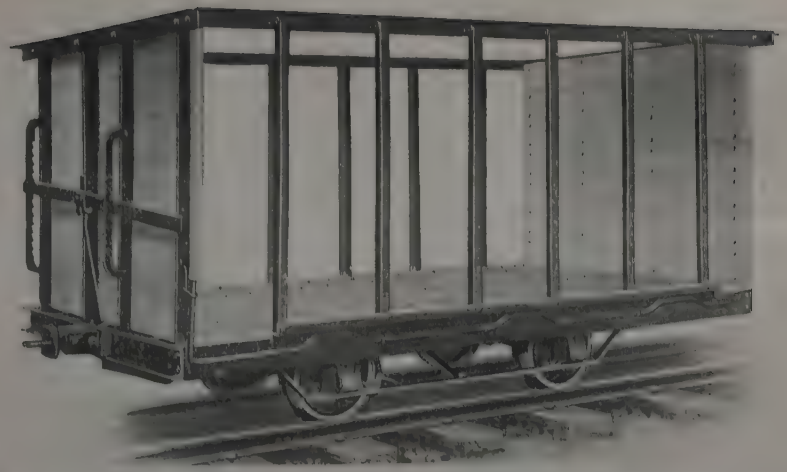


Fig. 2928 Steel Frame Side Discharge Cane Car. Capacity 5 Ton; Length, 12 ft.; Width, 6 ft.; Height, 5 ft.; Gage, 75 Centimeters; Equipped with Self Contained Link Pin and Pin Spring Couplers, and Locking Bar for Stakes. Builder, The Gregg Company, Ltd.

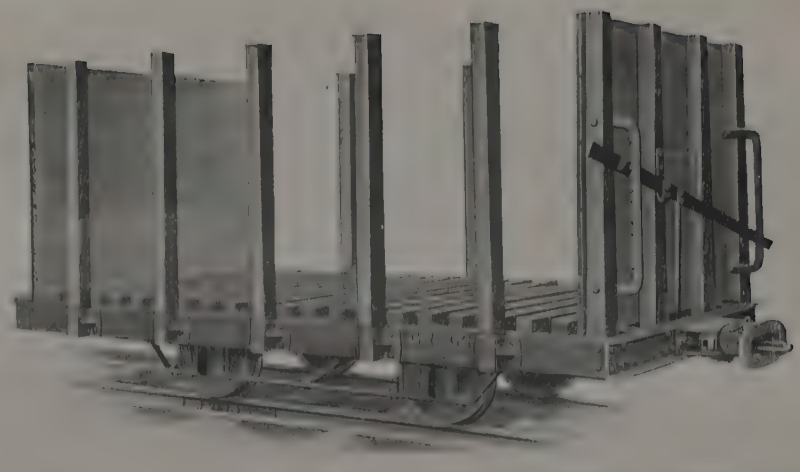


Fig. 2929 Steel Frame Cane Car. Capacity 5 Ton; Length, 12 ft.; Width, 6 ft.; Gage, 30 in.; Equipped with Link and Pin Spring Couplers, and Hand Lever Brake. As shown it is used for Unloading Cane by a derrick or by Removing the side stakes by a Rake Type Feeder. Builder, The Gregg Company, Ltd.

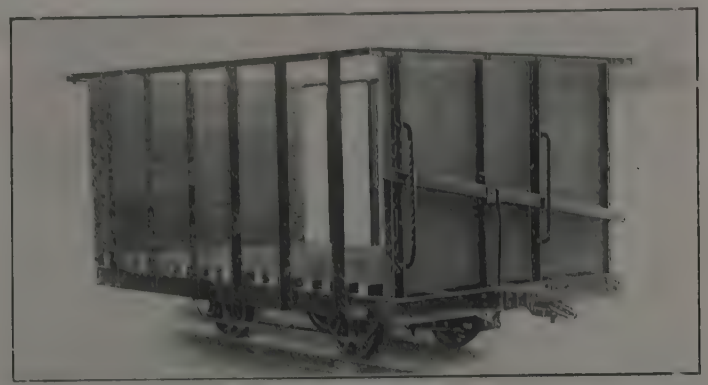


Fig. 2930—Steel Frame Car. Capacity 4 Tons; Length, 10 ft.; Width, 6 ft.; Link and Pin Self Contained; Spring Couplers; Superstructure, 4 ft. High. Adapted to Use on Portable Track in Place of Bull Carts in Cuba, Transferring the Load from Small to Large Cars, by Means of a Derrick. Builder, The Gregg Company, Ltd.

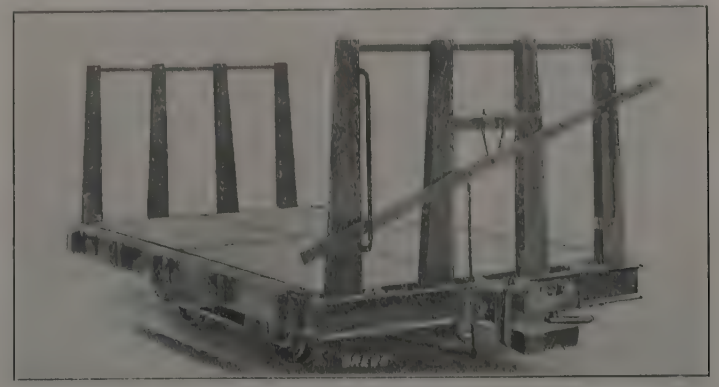


Fig. 2931—Steel-Frame Car. Capacity 5 Tons; Length, 12 ft.; Width, 6 ft.; Gage, 75 Centimeters; Link and Pin Self-Contained Spring Coupler; Cane Loaded Crosswise by Omitting the Side Stakes, or Lengthwise by Using Side Stakes. Adapted to Unloading by Rake Type Cane Carrier Feeders. Builder, The Gregg Co., Ltd.

Logging, Ore, Special Purpose Cars

A steel mine car of the type which is unloaded from the end is shown in Fig. 2932. The capacity is about 80 cu. ft. The floor of the car is wood and wooden brake blocks operate on all wheels. The wheels are self-oiling.

In all "Car Foundry" logging cars the journal brass is applied by locking in the box in such a way that it cannot be displaced by any shock that is likely to occur in service. This brass has been

Fig. 2932—Steel Mine Car, End-Unloading Type

tried out thoroughly by a number of large operators in West Virginia and has proved highly satisfactory for overcoming the displacement of truck journal brasses in loading or otherwise, which has been the cause of frequent annoyance and loss of time and money to logging operators, especially those working in mountainous territory.

A logging car of 40 tons capacity is shown in Fig. 2934. The length over the end sills is 40 ft.; the width, 9 ft. 0-5/8 in. Cars of this type have a wooden floor and can be equipped with special trip stakes, which are attached to the end of the bunks.

A wooden logging car is shown in Fig. 2935. The capacity is 25 tons; the length over buffers,

Fig. 2934—A 40-Ton Steel Logging Car

20 ft. 0 in.; the width over the bunks, 10 ft. 0 in. Special trip stakes which are attached to end of bunks can be furnished.

An example of "Car Foundry" ore car construc-

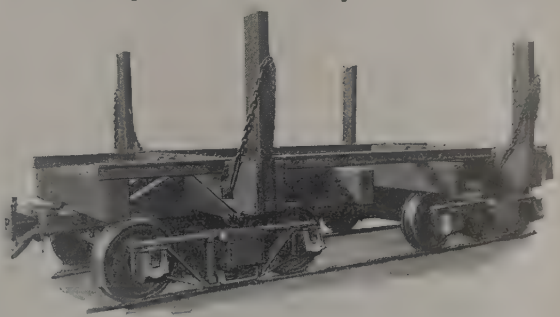


Fig. 2935—A 25-Ton Wooden Logging Car

tion is illustrated by a car of 75-tons capacity. When level full the cubic capacity of this particular car is 900 cu. ft. The length over the end sills is 21 ft. 3¼ in.; the length inside, 19 ft. 10 in.; the width over the side sills, 9 ft. 10⅞ in.; height from the rail to the top of the sides is 10 ft. 2 in.

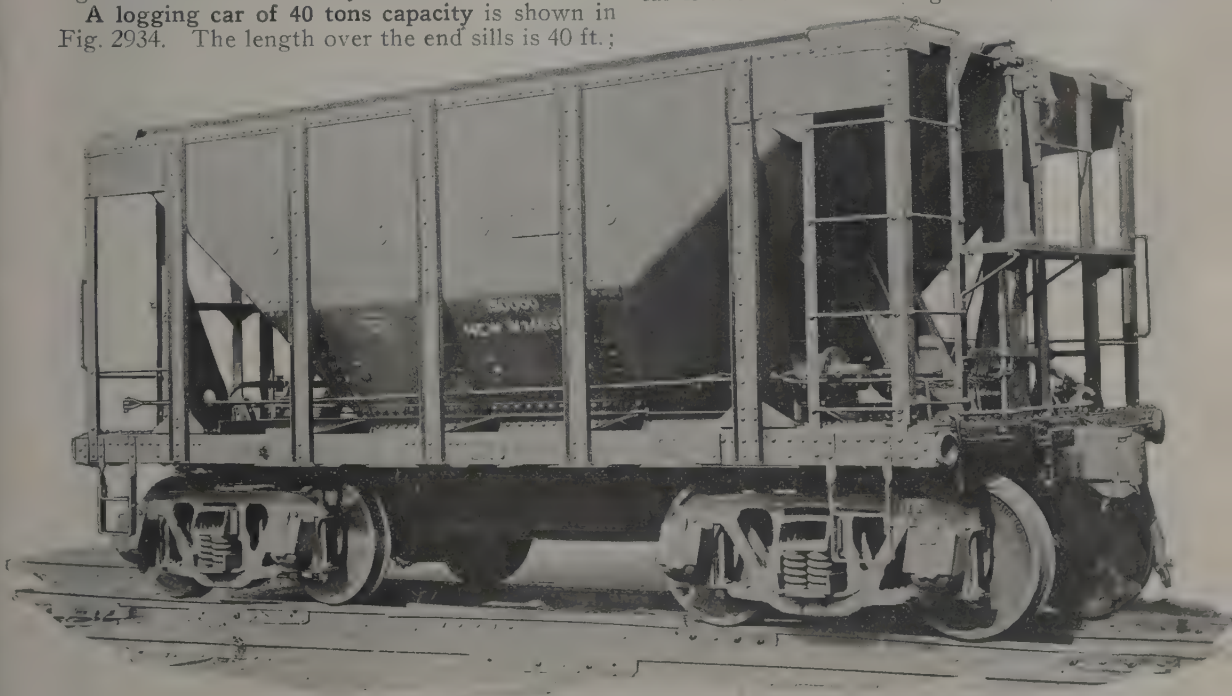


Fig. 2933—A 75-Ton Ore Car Built by the American Car and Foundry Company

Canadian Built Cars for Foreign Service

Canadian Car and Foundry Company, Limited—with its subsidiaries, Canadian Steel Foundries, Limited, and the Pratt and Letchworth Company, Limited—is composed of eight separate establishments. Of these, four of the most important, together with the general offices of the company, are located at Montreal, Quebec. The remaining plants are at Amherst, Nova Scotia, and at Brantford, Welland and Fort William, Ontario.

All kinds of freight and passenger equipment, mine and dump cars and also logging and industrial cars of various types are built by this company. It is thoroughly prepared to fabricate cars of either wood, steel, or of composite construction. The company is advantageously situated to handle export business, as the one plant at Amherst, Nova Scotia, is well located for ocean shipping either from St. John or Halifax, both of which ports are open throughout the entire year. From the four main plants at Montreal, export business is handled directly into ships in the open navigation season.

For convenience in operation the work is divided among the eight establishments as follows: Four plants manufacture freight and passenger cars as well as car specialties such as bolsters, brake beams, side bearings, springs and other appliances. Two plants produce steel and ferro-alloy castings including cast steel bolsters, truck side frames, locomotive frames, wheel centers, automatic couplers and various other steel specialties. One plant manufactures exclusively all classes of trackwork such as switches, frogs, diamond crossings or complete intersections for steam and electric railways, either of built up construction or of manganese steel. One plant is devoted exclusively to the production of malleable castings. In addition to the above there are two rolling mills operated in connection with the Canadian Car and Foundry Company, Limited. The accompanying illustrations have been selected as being typical of the equipment constructed by this company for foreign railroad systems.

The four-wheeled brake van, shown in Fig. 2936, was built for the Rhodesia Railways, Limited. It is intended for use as a guard and luggage van; a guard compartment is provided with a lookout on both sides. The underframe of this car is steel throughout. It is composed of rolled channel-section side, center and end sills, with a wooden body superimposed. The car has a capacity of 30,000 lbs., and is equipped with 33-in. chilled cast-iron wheels.

The special equipment applied to these cars includes a vacuum brake, having a control handle inside the guard's compartment. Two Ridsdale roof lamps were furnished, one in the guard's compart-

Fig. 2936—Brake Van of 3 ft. 6 in. Gage for Rhodesia Railways Limited

Length over end sills	21 ft. 0 in.	Extreme width over guard's lookout	9 ft. 6 in.
Wheelbase	11 ft. 0 in.	Height from rail to top of roof	10 ft. 11¼ in.
Width, inside	7 ft. 0 in.	Journals	4¼ in. by 9 in.
Length, inside	20 ft. 5 in.	Tare, complete	16,700 lbs.

For other products and branch offices, see classified and alphabetical indexes.

Canadian Built Cars for Foreign Service *(Cont'd)*

ment and one in the luggage section. The luggage section is also provided with two sliding doors, one on each side, mounted on a suitable track. The roof is of the arch type built to a true radius. This car was constructed for 3 ft. 6 in. track gage and has 4¼ in. by 9 in. journals together with automatic couplers and spring draft gear.

Fig. 2937—1,200 Pood—43,338 lb.—Covered Goods Wagon, Built for Russian Government

Length over end sills	24 ft. 11¼ in.
Wheel base	13 ft. 1½ in.
Width, inside	9 ft. 0 in.
Length, inside	22 ft. 9 in.
Width over roof at eaves	9 ft. 8 in.
Height from rail over roof	12 ft. 6 in.
Length over buffers	28 ft. 10¼ in.
Tare, complete	23,900 lb.

The four-wheeled covered goods wagon shown in Fig. 2937 was built for the Imperial Russian Government and is intended for the transportation

Fig. 2938—20 Metric Tons Capacity Open Goods Wagon, Built for the French State Railway

Length over end sills	7,299 mm.
Wheel base	3,600 mm.
Width, inside	2,500 mm.
Width, outside	3,064 mm.
Length, inside	6,600 mm.
Height of sides and ends	1,449 mm.
Length over buffer	8,448 mm.
Journals	140 x 250 mm.
Gage	1,435 mm.
Tare, complete	11,150 kg.

of general merchandise. It is also adaptable for military transport purposes as it is provided with facilities for handling horses or troops.

This car is of substantial design, and has a steel underframe composed of standard rolled sections, with a steel body frame. The roof is of the arch type and is built of galvanized rust-resisting iron. Russian standard forged drawbar hooks and screw couplings together with forged steel buffer stems have been applied.

It is also equipped with the Russian standard type Westinghouse automatic air-brake, and has in addition a screw type hand-brake which is operated from the brakeman's platform at the end of the car. The cars were built for the standard Russian gage of 5 ft. They are equipped with cast iron chilled wheels 39⅜ in. in diameter.

A four-wheel covered goods wagon of 15 metric tons capacity built for the British Government for use on the continent in Europe is shown in Fig. 2939 These wagons have steel underframes and steel superstructures, to which wood inside sheathing is applied. All specialties are in accordance with the Belgium State Railway standard. The cars are equipped with 965 mm. diameter solid rolled steel wheels, with hand-brakes acting on two wheels and operated from the side of the car by means

Fig. 2939—15 Metric Tons Capacity Covered Goods Wagon, Built for British Government for use in France

Length over end sills	7,360 mm.
Wheel base	4,000 mm.
Width, inside	2,550 mm.
Width over roof at eaves	2,850 mm.
Length, inside	7,300 mm.
Height from rail over roof	3,622 mm.
Length over buffer	8,510 mm.
Journals	110 x 205 mm.
Gage	1,435 mm.
Tare, complete	9,875 kg.

of a long lever. A continuous forged steel drawbar is used with screw couplings and self-contained cast steel buffers.

An open goods wagon of 20 metric tons capacity built for the French State Railway System is shown in Fig. 2938.

These wagons are equipped with the French State Railway standard screw brakes, cast steel buffers, forged screw couplings and drawbar hooks. The wheels are of solid rolled steel, 1,050 mm. diameter. The underframe and superstructure frame are composed of standard rolled steel sections and plates, to which the wood lining is bolted. Four doors have been fitted to each side.

The end tipping coal wagon shown in Fig. 2940 is of 10 tons capacity and was built for the Nigerian

Canadian Built Cars for Foreign Service *(Cont'd)*

Railway in West Africa. The body is mounted on a steel underframe built up of angle center sills, having channel-section side and end sills, securely connected together. The wheels are 33½ in. in diameter with wrought iron spokes and are fitted with steel tires. Screw hand-brakes are used with A. B. C. couplers and drawbars. The capacity of these wagons is 429 cu. ft. each and they are built for a gage of 3 ft. 6 in. They are equipped with end gates and side doors.

Fig. 2940—10 Tons Capacity End Tipping Coal Wagon, Built for the Nigerian Railway, West Africa

Length over headstock	17 ft. 0 in.
Wheel base	9 ft. 6 in.
Width, outside	7 ft. 0 in.
Width, inside	6 ft. 7¼ in.
Length, inside	16 ft. 7¼ in.
Height of sides and ends	4 ft. 0¼ in.
Journals	4¼ in. by 8 in.
Gage	3 ft. 6 in.
Tare, complete	12,200 lb.

The low-sided goods wagon shown in Fig. 2941 has a capacity of 20 tons and was also built for the Nigerian Railway. It has a steel underframe composed of open hearth rolled steel channel center, end and side sills securely fastened with angle connections, gusset plates and further reinforced by rolled steel angle truss rods. The sides and ends are hinged at the bottom to the underframe sills and can be folded down when required. The wheels on these wagons have wrought hubs and spokes; they are 33½ in. in diameter and are fitted with steel tires. A combination of automatic vacuum and screw hand-brakes is used together with A. B. C. couplers.

The coal car illustrated in Fig. 2942 has a capacity of 60 tons and was built for the South African Railways for service at the Durban coal station. This equipment has been specially designed and is provided with six coal buckets per car. The buckets are made of steel and are fitted with bottom gates to facilitate rapid discharge of the contents. The underframe center sill is of the fish-belly type and is composed of steel web plates, standard angle sections with top and bottom cover plates. The length of these cars over end sills is 40 ft. and the distance from center to center of trucks is 26 ft. They are equipped with a special design of screw brakes, operated by hand from the side of the car. The drawbar and links are of cast steel. The body is mounted on arch bar trucks having steel tired wheels, 24 in. in diameter adapted to a track gage of 3 ft. 6 in.

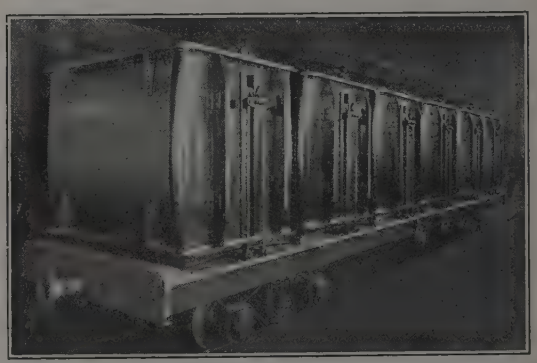


Fig. 2942—60 Tons Capacity Flat Car, Built for South African Railway, for use at Durban Coal Station

Length over headstock	40 ft. 0 in.
Centers of bogies	26 ft. 0 in.
Width over floor	8 ft. 0 in.
Journals	5 in. by 9 in.

In these examples of rolling stock, built by the Canadian Car and Foundry Company, Limited, it will be observed that all are of composite construction. It seems evident that where extensive repair facilities are lacking a composite car, with steel underframe and steel body framing with wood lining, presents physical and economic advantages which distinctly identify it as most suitable for service in the various countries where this equipment is to be operated. This type of car is strong, rigid and

Fig. 2941—20 Tons Capacity Arch Bar Bogie Low Sided Goods Wagon, Built for the Nigerian Railway, West Africa

Length over end sills	30 ft. 7 in.	Height of sides and ends	1 ft. 6 in.
Wheel base	20 ft. 0 in.	Journals	4¼ in. by 8 in.
Width, outside	8 ft. 2 in.	Gage	3 ft. 6 in.
Width, inside	7 ft. 10⅛ in.	Tare, complete	20,200 lb.
Length, inside	30 ft. 3½ in.	Capacity, level	357 cu. ft.

Canadian Built Cars for Foreign Service *(Cont'd)*

light, much easier to maintain than the all-steel car, has low heat conductivity and affords ample protection to lading—all at a comparatively moderate initial expenditure. While the capacity of these cars is smaller than commonly found on American railroads, it is nevertheless just as important that they be properly designed and constructed.

The tank car shown in Fig. 2943 is of 8,000 gallon capacity and is one of a number built for the Russian Soviet Government for use in transporting benzine, kerosene, naphtha or crude oil. It is mounted on standard American type arch bar trucks, with chilled cast-iron wheels, and "Simplex" bolsters and brake beams. The steel underframe is composed of rolled channel-section center sills with cover plates, and pressed steel angle side sills. The entire underframe is further reinforced by means of diagonal braces, made of standard rolled steel channels, rigidly connected behind the buffers. The tank is mounted on the underframe and is securely anchored by means of 6 pressed steel anchors together with 4 tank bands. It is equipped with the Nobel System as provided for the safe discharge of gasoline and with outlet valves as for use when crude oil is being transported. The car also has Russian Railway standard safety appliances, Russian special automatic air-brakes, screw hand-brakes, forged steel buffers, drawbar hooks and screw couplings, and is built to Russian standard gage of 5 ft.

Length over tank	30 ft. 6¾ in.	Truck wheel base	6 ft. 3 in.
Length over buffers	34 ft. 5½ in.	Gage	5 ft. 0 in.
Inside diameter of tank	7 ft. 2¾ in.	Extreme overall height	14 ft. 4½ in.
Extreme overall width	10 ft. 2 in.	Journals	5½ in. by 10 in.
Center to center of trucks	19 ft. 7 in.	Tare, complete	46,400 lb.

Fig. 2943—8,000 Gallon Tank Car for the Russian Soviet Government with Nobel Safety Arrangement

The Canadian Car and Foundry Company, Limited, has an engineering organization of extended experience in the design and construction of railway passenger and freight equipment for both domestic and foreign service. Particular attention has been devoted to the requirements of European and other overseas railway companies. A careful study of these requirements together with an accurate knowledge of traffic essentials in the various countries of the world, have enabled the Company to build cars of high operating efficiency and sound engineering construction.

All raw material required in the manufacture of railway car equipment is obtainable in Canada. These materials are available in enormous quantities and the business of fabrification into a form suitable for car construction purposes has reached a high state of development. It is now possible to obtain by far the greater percentage of finished car material within the Dominion of Canada.

It will be evident, therefore, in view of the availability of raw and finished car material in almost unlimited quantities, the possession of a highly trained car building organization together with unexcelled transportation facilities, that the Canadian Car and Foundry Company is in a position to produce all varieties of railway car equipment at very reasonable cost.

For other products and branch offices, see classified and alphabetical indexes.

CANADIAN CAR AND FOUNDRY CO., LIMITED, MONTREAL, CANADA

Standard, Special, and Foreign Car Equipment

The product of the Magor Car Corporation and the National Steel Car Corporation, Limited, embraces a great number of types and designs. All general classes of equipment are produced at either of the respective plants —at Passaic, New Jersey, or Hamilton, Ont., Canada, where these companies also have facilities to design completely and to construct economically all types of cars used on foreign railways, and those used for industrial purposes both in America and in foreign countries.

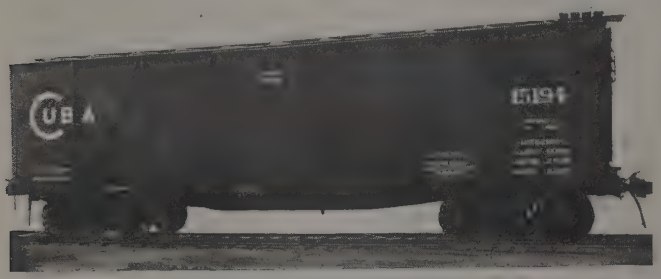


Fig. 2944—Composite Box Car for Cuba Railroad

Fig. 2945—Covered Goods Wagon, European Type

Ease of assembling all cars at destination is assured by Magor and National manufacturing methods which include the use of steel jigs and accurate milling processes. The long experience of both organizations in building cars for export is responsible for other valuable features of their service, which includes familiarity with the metric system and proper attention to details of packing, shipping and marking. A further advantage is found in the fact that the Passaic plant is located only twelve miles from the port of New York.

Freight cars for foreign service can be furnished in all types and capacities, both open and covered wagons being included. An example of the box cars used on the Cuba Railroad is illustrated in Fig. 2944. This car represents the tendencies of design in Latin American countries. It has double four wheel steel trucks, steel underframe equipped with automatic couplers and spring draft gear, composite superstructure and automatic air brakes.

A European type of covered goods wagons of 20-tons capacity is illustrated in Fig. 2945. This is representative of the type in common use on European Controlled Railways. It is of the four wheel type of semi-elliptic bearing springs, steel underframe, equipped with central screw couplings and side buffers, composite superstructure, screw hand brake with brakeman's cab at one end of car.

Sugar cane cars of the various designs used in different countries are built to dimensions and capacities desired. They range from the lightest Porto Rican type of 1½ tons capacity to the heaviest Cuban types with capacities of 30 tons. In Fig. 2947 is illustrated a 30-ton Cuban type of car, of the three compartment, one-way side discharge type.

Steel logging cars or logging trucks are built to suit individual requirements of customers and are usually of two-bunk and four-bunk types. Flat cars equipped with bunks for logging use are built to capacity, dimensions and gauge desired. An example of four-bunk car equipped with rails for log loader is shown in Fig. 2946. Maximum strength and economical operating cost are factors especially stressed in the design of all cars at the National and Magor Plants.

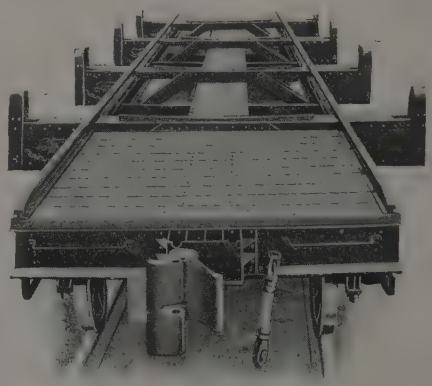


Fig. 2946—Four-Bunk Logging Car

Fig. 2947—Three Compartment, 30-ton Cane Car

For other products and branch offices, see classified and alphabetical indexes.

MAGOR CAR CORPORATION, NEW YORK, N. Y.
NATIONAL STEEL CAR CORPORATION, LTD., HAMILTON, ONT., CAN.

Steel and Wooden Box Cars.

In the development of the great railway systems which exist in America at the present time, it has been a notable fact that the amount of new-car construction which has been a part of this development yet which has been carried on in the individual railroad shops, is insignificant. Practically all railroads carry out the practice of making repairs themselves, but the problems involved in the designing and building of new equipment include not only those peculiar to car design but also those problems inherent in mass production, which is distinctly a manufacturing proposition.

Fig. 2948—All-Metal Ventilated Box Car Built by the Middletown Car Company for South American Operation

The circumstances which surround railroad operation in other countries do not differ materially from those in America in respect to fundamentals. When, therefore, the Standard Steel Car Company through its subsidiary, the Middletown Car Company, places its equipment and organization at the disposal of railroads which traverse territories outside the United States, it offers a service which has stood the test and may easily be the means of effecting substantial reductions in operating charges.

Ventilated box cars for the Central Railway of Brazil and constructed by the Middletown Car Company, are examples of all-metal construction. The general dimensions of these cars are given in the following table:

	Ft.	Inches	M/M
Length over Running Boards	35	8	10884
Length over Roof	34	7½	10554
Length over End Sills	34	0⅝	10373
Length over Striking Plates	35	2⅝	10735
Length inside of Car	34	0⅝	10373
Width over Eaves	9	4	2845
Width inside of Car	8	6	2590
Height, Rail to top of Brake Mast	12	5½	3797
Height, Rail to top of Running Board	11	10⁷/₁₆	3618
Height, Top of Floor to top of Side Plate	6	8¾	2051
Height, Top of Rail to Center of Coupler	3	5⅜	1050
Center to Center of Trucks	24	0	7315
Light Weight of Car (in Kilogrammes)	16,460		

The sides and ends of the body are made of steel plates held in place by pressed steel posts. The underframe is built from steel channels. Automatic couplers are provided as are also safety chains to guard against breaks-in-two. Both air and hand brakes are installed.

The trucks are of the arch bar type similar to trucks of this class used in American practice. The journals are 5½ in. by 10 in. and the journal boxes are of malleable iron.

Box cars for the French State Railways are an example of European design as carried out by the Middletown Car Company. Composite—wood and metal—construction characterizes these cars. The underframes are built up of steel channels; the side posts and corner posts are of angle irons.

No trucks are used in this design of car, only four wheels being used with each pair located near the ends of the car. The springs, four in number, are attached directly to the side sills and bear directly upon the journal boxes, which are made of malleable iron. The journals are 4¼ in. by 8 in.

These two cars merely indicate types; the resources of the Middletown Car Company are ample for the production of any desired design of box car for any kind of service. This company is completely organized and equipped for carrying on by the most approved and up-to-date methods, every function—from originating the design to completing the final step in the process of construction—incident to the building of a complete freight car of any type for use anywhere in the world. Designs can be made or submitted in either English or Metric units.

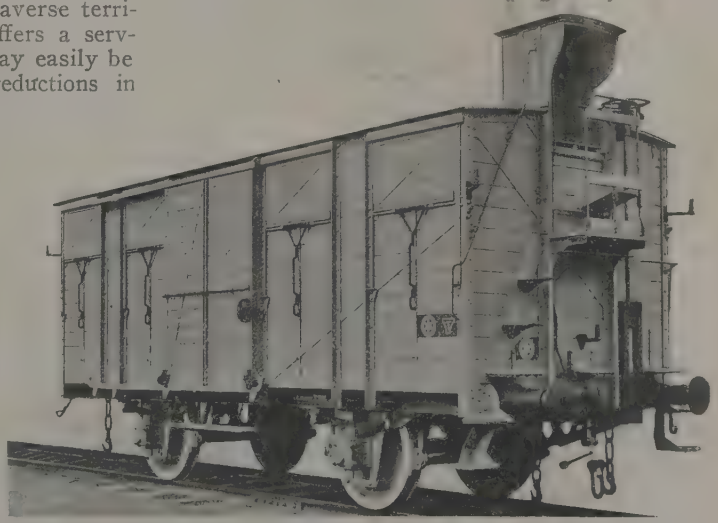


Fig. 2949—Composite French Box Car, Built by the Middletown Car Company

For other products and branch offices, see classified and alphabetical indexes.

STANDARD STEEL CAR CO. ITS SUBSIDIARY MIDDLETOWN CAR COMPANY PITTSBURGH, PA.

Steel and Wooden Stock Cars

In those countries where considerable areas still remain suitable for use in the industry of stock raising, the concentration of the packing industry in or near the cities has compelled the railroads to provide adequate facilities for the shipment of live stock, and the laws of the countries concerned usually make provisions as to the conditions which shall govern the traffic. It is highly important therefore that the car builder be thoroughly informed both as to suitable mechanical provisions as well as the legal requirements. The resources at the command of the Middletown Car Company include both these features.

Fig. 2950—All-Metal Stock Car Built by the Middletown Car Company for South American Use

The Chilian Longitudinal Railway taps an important grazing region of South America, and handles a large part of its cattle traffic in steel stock cars designed and built by the Middletown Car Company. One design of these cars has a capacity of 55,000 lb.—25,000 kilos—the weight of the car when empty being 22,968 lb—10,440 kilos.

The body has a built-up underframe, having channel center and side sills, further reinforced by two forged truss rods. The sides and ends are steel plates, the upper portion of the sides consisting of channel-shaped pressed steel slats. The roof consists of corrugated galvanized sheet iron.

The trucks are of the arch bar type with journals 4 in. by 8 in., the journal boxes being made of malleable cast iron.

For the Paloma Railways of Uruguay, the Middletown Car Company has built cattle cars which are somewhat similar in design to American types.

The bodies have steel underframes and wooden superstructures. Doors at both ends and both sides are provided. The side doors are the ordinary top-hung rolling door; the end doors open by sliding in guides in a vertical direction, the lifting being done by means of a hand wheel and a shaft around which a lifting chain winds. These end doors are primarily for feeding the cattle en route, and two troughs, which can be hung just below the door, are part of the equipment of each car. Roofs of corrugated galvanized sheet iron are used.

For coupling apparatus, screw-couplings and hooks are used and spring buffers absorb the shocks incident to starting and stopping. Hand brakes comprise the only brake equipment. The cars are built to operate on a track of 4 ft. 8½ in. gage. They weigh 14,700 kilos—32,340 lb.—and have a capacity of 30,000 kilos—66,000 lb.

The Middletown Car Company has plant and equipment at their disposal which is suitable for building all styles of stock cars, for operation on any of the railways throughout the world.

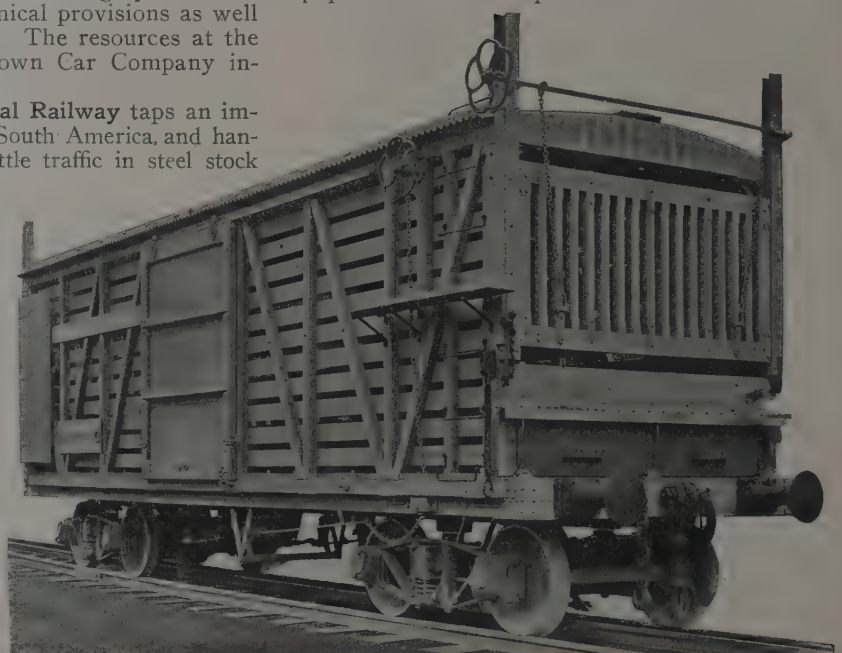


Fig. 2951—Wooden Stock Car Built by the Middletown Car Company for the Paloma Railways of Uruguay

For other products and branch offices, see classified and alphabetical indexes.

STANDARD STEEL CAR CO. ITS SUBSIDIARY MIDDLETOWN CAR COMPANY PITTSBURGH, PA.

Wooden and Steel Gondolas

The experience, equipment; and organization which has been developed by the Standard Steel Car Company and its subsidiary, the Middletown Car Company, represents an investment which has been made, in order that car design and building may be carried on for individual railroad companies outside the United States, more economically than it can be accomplished with the equipment at the disposal of the average railroad.

Gondola cars, of various types, form an important part of the rolling stock of European and South American railways. Having designed and built steel, wooden, and composite cars of this type for service in these countries, the Middletown Car Company has intimate knowledge of the requirements to be met.

Bogie flat wagons, similar to those built for the Cordoba Central Railway Company, Ltd., which is in the Argentine Republic, are adapted to carrying heavy loads of freight which is not bulky, such as pig or bar iron.

The car shown in the illustration weighs 11,525 kilos—25,355 lb.—and has a capacity of 60,000 lb. They are 40 ft. long over the headstocks and 7 ft. 6½ in. wide over the side sills. The inside depth of the body is one foot. The trucks are of the arch bar type and have journals 4¼ in. by 8 in.

Fig. 2952—Wooden Bogie Flat Wagon of 60,000 lb. Capacity, Built by the Middletown Car Company

All-steel gondolas built by the Middletown Car Company for the Argentine Railways are used in general freight service. They weigh 12,210 kilos—26,862 lb.—and have a capacity of 30,000 kilos—66,000 lb.

Fig. 2954—All-Steel Gondola of 66,000 lb. Capacity, Built by the Middletown Car Company

The car body is 33 ft. 10 in. long 7 ft. 9 in. wide, and 4 ft. high inside dimensions. The trucks are located 23 ft. apart at the centers. The journal boxes are malleable iron and provide for 4¼ in. by 8 in. journals. Link and pin couplers are used in conjunction with two safety chains and the cars are equipped with both air and hand-brakes.

Gondola cars of composite construction have been built by the Middletown Car Company for the French State Railways.

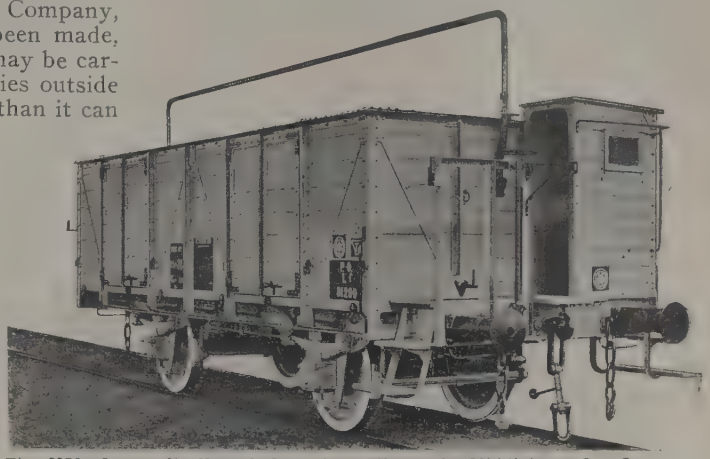


Fig. 2953—Composite French Gondola, Built by the Middletown Car Company

The underframes, side and end posts, and top rails are of structural steel; the sides and flooring are of wood. A tarpaulin pole is part of the superstructure and provides for a covering.

The cars are equipped with hand-brakes only and with the screw type of couplings and hooks. Buffers are used to absorb shocks at starting and stopping. Built to carry 20,000 kilos, the weight of the car itself is 10,750 kilos.

Each side of the car is provided with two sets of double doors hung from the sideposts and there is one door at each end of the car.

These cars have been selected from many similar designs which have been built by the Middletown Car Company and are representative of the capacity of the company which covers the entire field of steel and wooden car construction.

Miscellaneous Car Forgings

The problem of economically and quickly renewing worn out car forgings is often aggravated by the expense of making dies which, because they can only be infrequently used, necessitate the unwarranted tying up of money in such a way that little return can be had on it. The forgings shown on this and the succeeding page are typical

Fig. 2955—Safety Chain for French Railways

of those which the Middletown Car Company, having furnished the original equipment, is thus placed in a favorable position for supplying the various detail parts needed as repairs become necessary.

The Safety Chain shown in Fig. 2955 is in com-

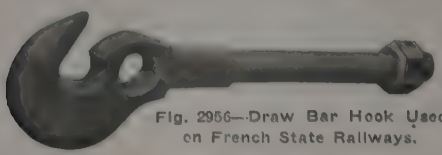


Fig. 2956—Draw Bar Hook Used on French State Railways.

mon use on French railways. It can be furnished as a complete piece or the parts of which it consists can be furnished separately.

A design of Draw Bar Hook which represents the practice of the French State Railways is

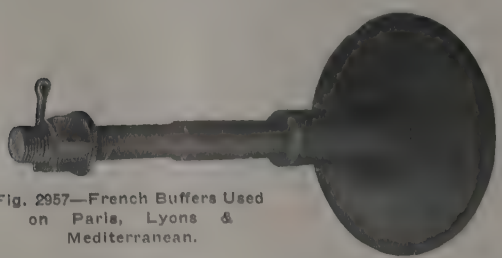


Fig. 2957—French Buffers Used on Paris, Lyons & Mediterranean.

shown in Fig. 2956. It can be supplied complete with nut and ready for application or the threaded end can be left rough to be finished as desired.

French Buffers of the type used on the Paris, Lyons & Mediterranean are shown in Fig. 2957. Allowance has been made for finishing stock at wearing points, the parts being ordered as "rough" or "finished."

nomical manufacture, this class of work requires special equipment such as is in use at the plant of the Middletown Car Company.

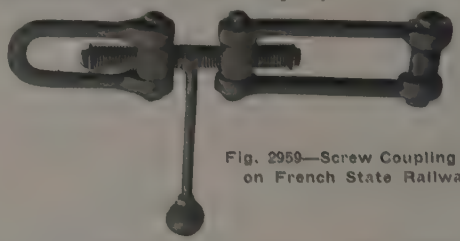


Fig. 2959—Screw Coupling Used on French State Railways.

The Box Wedges illustrated in Fig. 2960 are generally required in such small numbers by individual roads that it is not desirable or economical to make or purchase special equipment for the manufacture of such parts.

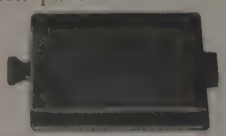


Fig. 2960—Box Wedge Used on French State Railways.

Hand brake levers of the style shown in Fig. 2962 are in use on the Indian State Railways.

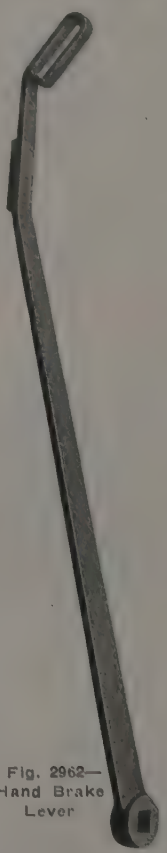


Fig. 2962—Hand Brake Lever

A Hand Brake Rod Fork, which has been applied to Paris and Orleans Railway box cars,

Fig. 2961—Hand Brake Fork Used on Paris & Orleans Box Cars

is shown in Fig. 2961. As an example of jaw forging, it is representative of what is required for brake gear parts.

A Forged Brake Beam of the type applied on the French State Railways is illustrated in Fig. 2958. The operations and material required to produce it enable special manufacturing equipment to vitally affect the cost of replacements.

The Brake Shaft and Nut in Fig. 2963 are examples of forgings which combine a variety of machine operations. This style of

Fig. 2958—Forged Brake Beam.

Fig. 2963—Brake Shaft and Nut—French Equipment.

The Screw Coupling shown in Fig. 2959 is an assemblage of forgings involving bending, drawing-out, drop forging, and upsetting. For economical manufacture, this class of work requires special equipment such as is in use at the plant of the Middletown Car Company.

brake shaft is in use on French cars.

The Brake Shoe Hanger and the Bell Crank Support, shown in Figs. 2964 and 2965 respectively

Miscellaneous Car Forgings

are typical of work which combines heavy bending with the forming of bosses, using as raw material, heavy round and flat bar iron or steel.

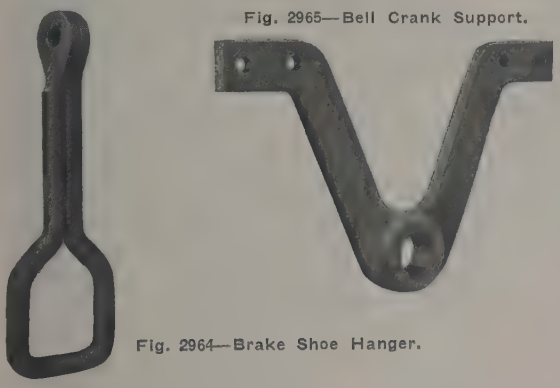


Fig. 2965—Bell Crank Support.

Fig. 2964—Brake Shoe Hanger.

A hand brake push rod and push rod jaw for French equipment is illustrated in Fig. 2966. These parts are furnished either as a complete unit or as individual pieces.

Fig. 2966—Hand Brake Push Rod, French.

The shutter Hasp shown in Fig. 2967 is the style applied to cars on the United States Military Railways. The equipment of the Middletown

Fig. 2967—Shutter Hasp Used on U. S. Military Railways

Car Company for the economical forging of these parts often makes the application of a new piece cheaper than attempting to repair the old one. The accuracy of the workmanship is guaranteed.

An end door hinge which has been applied to

Fig. 2968—End Door Hinge

freight cars on the French State Railways is illustrated in Fig. 2968. Interlocking eyes complicate this type of forging.

The Side Door End Hinge for French Gondola cars shown in Fig. 2970 is difficult as well as expensive to forge when facilities are limited.

The Door Fastener with its Handle, and the Shutter Hasp shown in Figs. 2972 and 2971 respectively are both of French design. Like the brake beam, they are less expensive when made with machinery which is not usually a part of railway shop equipment.

The Window Screen Frame for French cars, shown in Fig. 2969 is typical of that class of flat forging which involves the use of special bending and welding machinery. The uniformity

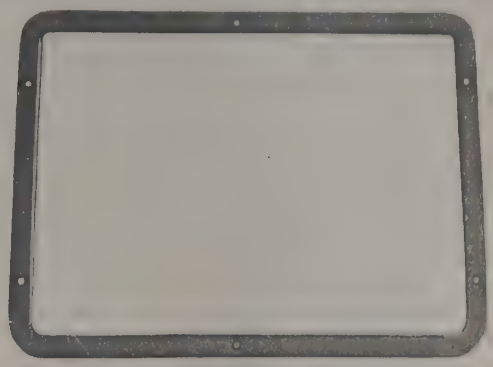


Fig. 2969—French Window Screen.

and neatness of product obtained through this method of manufacture is highly important.

The principal object in presenting these illustrations of specific car forgings is not to give concrete example of these parts, so much as it is to indicate types and classes of work. The operating conditions which surround the Middletown Car Company, place that organization in a position to furnish all classes of car forgings

Fig. 2970—Side Door End Hinge

Fig. 2971—French Design of Shutter Hasp

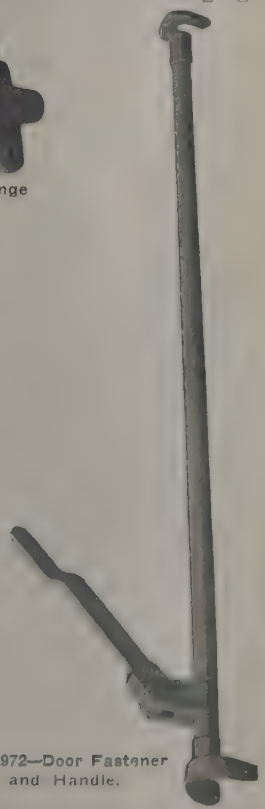


Fig. 2972—Door Fastener and Handle.

of standard quality, at a cost which should be considered by the average railroad in comparison with its own costs for the same work.

For other products and branch offices, see classified and alphabetical indexes.

Springs and Steel Tired Wheels

The Standard Steel Works Company has since 1871 been engaged in the manufacture of iron and steel products. This company now operates four tire mills, three mills for rolling steel wheels, ten open-hearth furnaces—capable of producing 200,000 tons of steel yearly—and has extended facilities for the manufacture of springs.

Coil and elliptic springs for car service are manufactured—unless otherwise ordered—to the carefully and scientifically developed "Standard" specifications. The selection of material is attended with the greatest care. Systematic tests are made of the output of all departments to insure the constant upholding of quality, well equipped chemical and physical laboratories being maintained for this purpose.

Fig. 2973—"Standard" Ribbed Elliptic Spring

All "Standard" springs pass through the testing department and are subjected to repeated applications of a load in excess of the working load in order that all permanent sets may be removed or any defects or weakness detected. A succession of loads within the working limits are then applied and the heights carefully noted for comparison with the specified heights, thus assuring the proper height under actual working conditions. The company has had extended experience in the manufacture of springs for foreign railways and the illustrations show a group of springs ready for shipment.

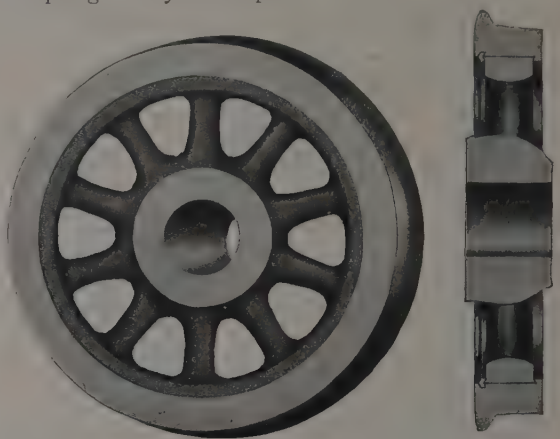


Fig. 2975—Spoked Steel Tired Wheel with Gibson Retaining Ring

Steel tires and other weldless steel rings in diameters from 16 to 120 in. and widths up to about 16 in. are a "Standard" product of the Standard Steel Works Company. Great care is given this work in the process of manufacture. The tires are made from an individual ingot cast of the proper weight and in such a manner as to reduce all piping and segregation to a minimum. This method also produces an ingot of fine grain.

The cast-steel spoke center wheel is a product of the Standard Steel Works Company with a steel tire held by shrinkage and a Gibson retaining ring. This design is shown in Fig. 2975. The wheel center has a dove-tail fit into the tire itself on one side and is held on the other side by a retaining ring of mild steel shaped to a wide V. This ring fits into a carefully machined slot in the tire and is held firmly in place by hammering the edge of the tire on to the ring.

Fig. 2974—"Standard" Elliptic and Coil Springs at the Pier Ready for Export

For other products and branch offices, see classified and alphabetical indexes.

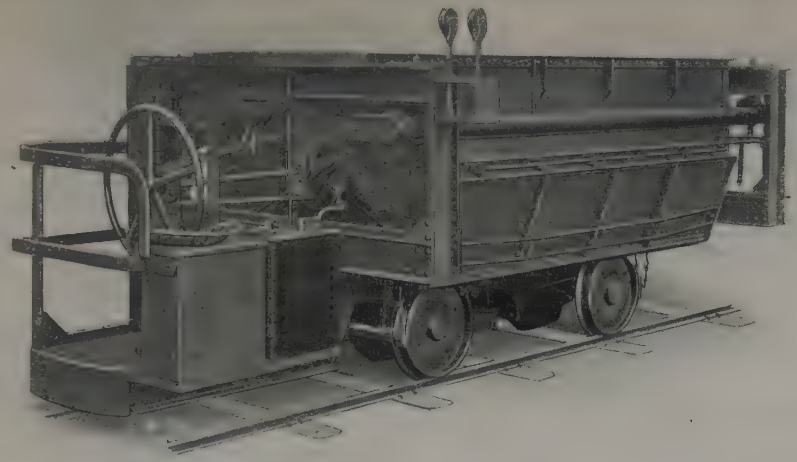


Fig. 2976—Electric 200 cu. ft. Gable Bottom Scale Car, Equipped with Registering Beam, Mechanical Brake, Two Motors, Drum Controller, Circuit Breaker and Overhead Collector. C. W. Hunt Company, Inc.

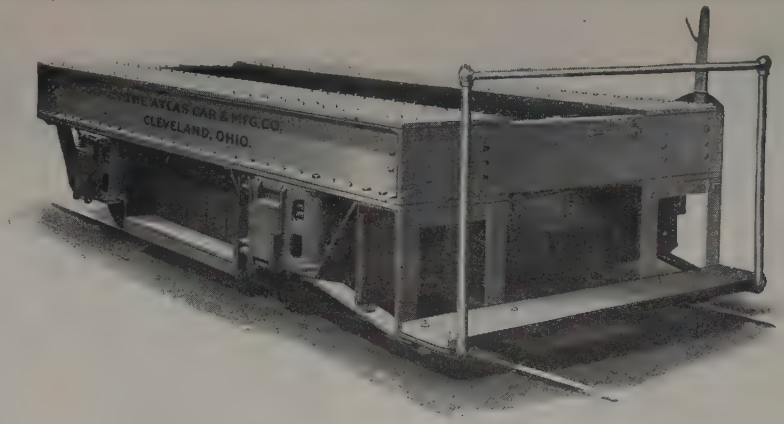


Fig. 2977—Storage Battery 60-Ton Flat Car. Length Over All, 14 ft. 3 in.; Width Over All, 7 ft. 3¾ in.; Height to Top of Decks.
The Atlas Car & Manufacturing Company.

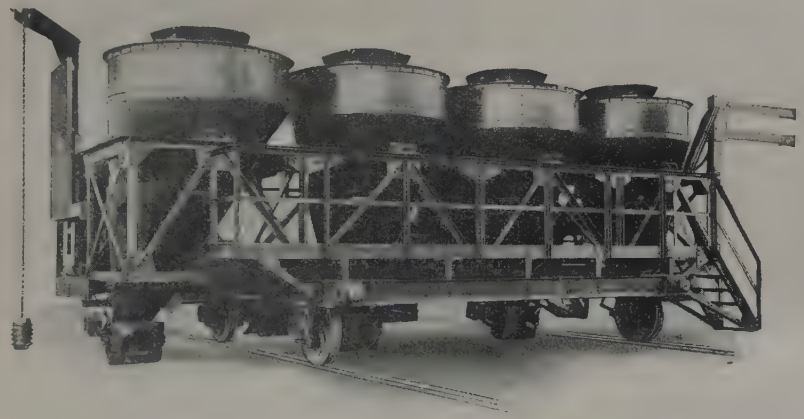


Fig. 2978.—Electric Four Hopper Coal Larry Car.
The Atlas Car & Manufacturing Company.

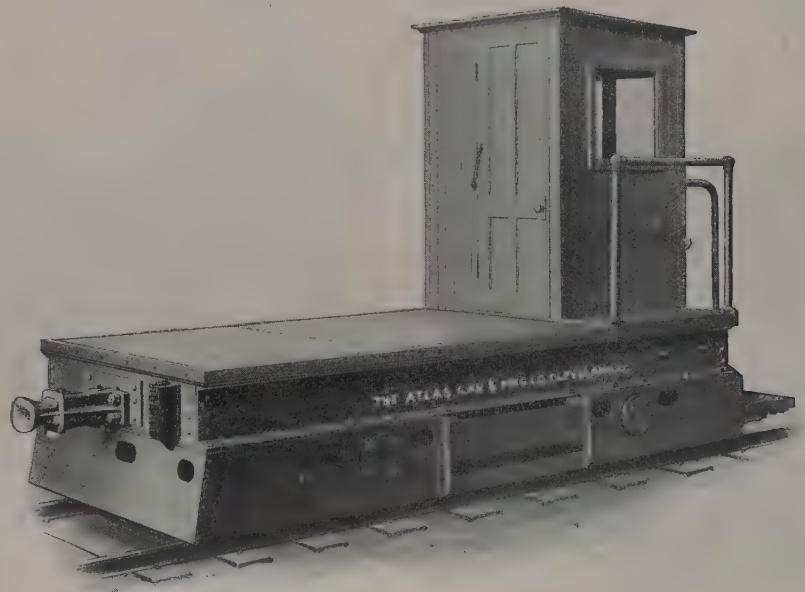


Fig. 2979—Sixty-Ton Capacity Storage Battery Flat Car.
The Atlas Car & Manufacturing Company.

Fig. 2980—Center Bottom Dump Car. Builder, Atlas Car and Manufacturing Company.

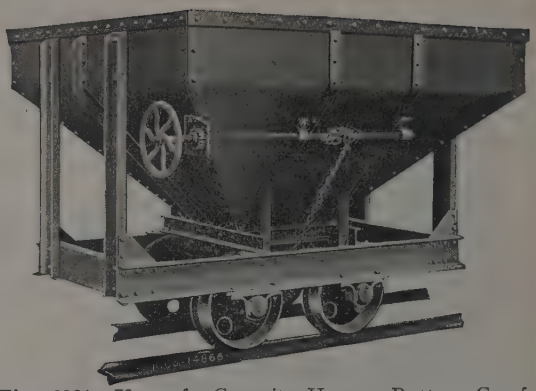


Fig. 2981—70 cu. ft. Capacity Hopper Bottom Car for Handling Ashes and Coal. Builder, Koppel Industrial Car and Equipment Company.

Fig. 2982—One Side Delivery Slate Car. Builder, Atlas Car and Manufacturing Company.

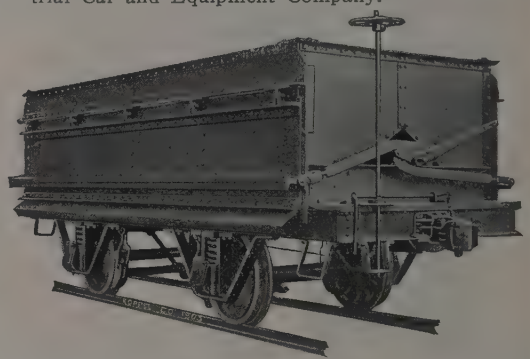


Fig. 2983—Gable Bottom Ore Car for Use in Copper Mine. Builder, Koppel Industrial Car and Equipment Company.

Fig. 2984—Motor Driven Self-Dumping Gable Bottom Car. Builder, C. W. Hunt Company, Inc.

Fig. 2985—Gregg Standard Gable Bottom Car. Builder, The Gregg Company, Ltd.

Fig. 2986—Gable Bottom Steel Car. Builder, Atlas Car and Manufacturing Company.

Fig. 2987—Side Dumping Car with Door Controlling Device. Builder, C. W. Hunt Company, Inc.

Fig. 2988—Charging Car, Arranged to Tip. Builder, C. W. Hunt Company, Inc.

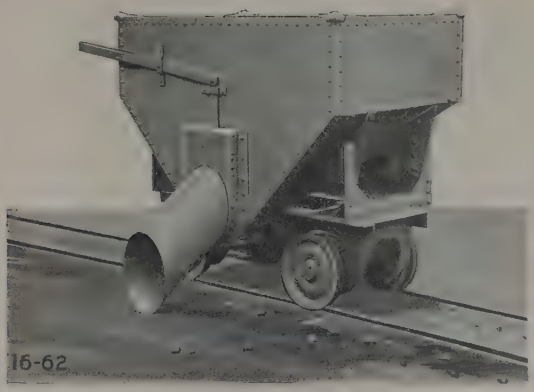


Fig. 2989—Special Built Car for Handling Bolts. Builder, C. W. Hunt Company, Inc.

Fig. 2990—Gregg Standard Side Discharge Concrete Car. Builder, The Gregg Company, Ltd.

Fig. 2991—Standard Side Discharging Car in Closed Position. Builder, Koppel Industrial Car and Equipment Company.

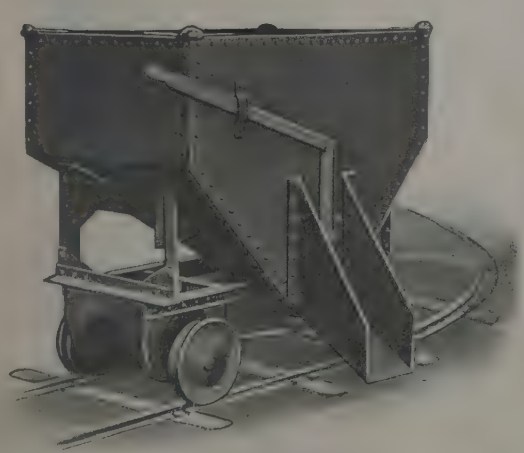


Fig. 2992—Standard 30 cu. ft. Side Discharge Car. Builder, C. W. Hunt Company, Inc.

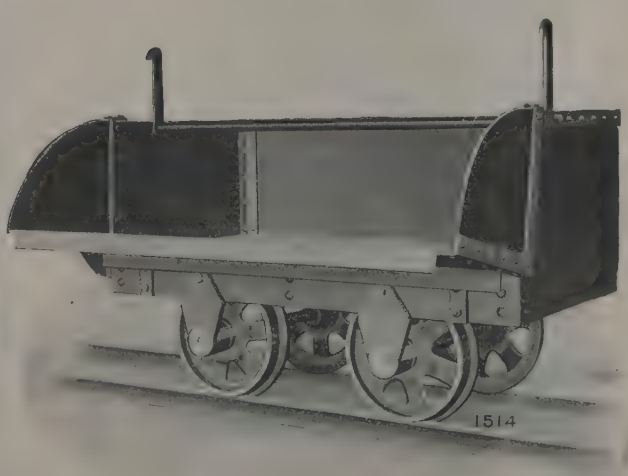


Fig. 2993—Drop-Side Coke or Coal Car. Capacity 500 lb. Builder, Whiting Corporation.

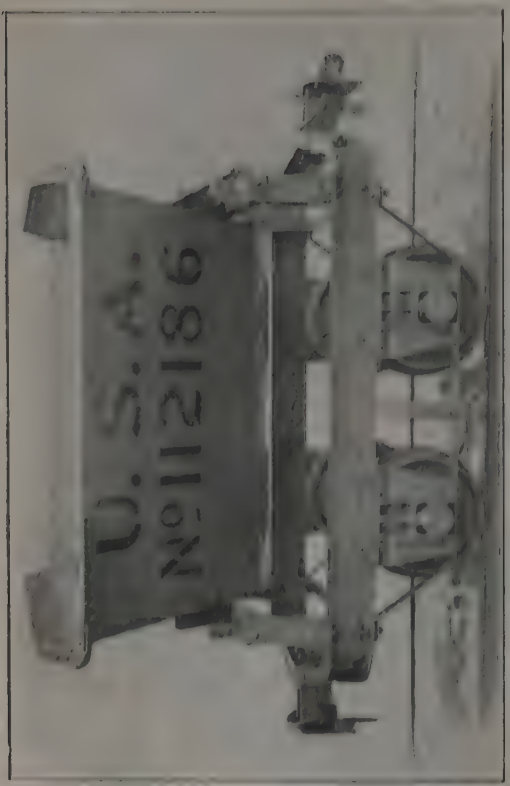


Fig. 2895—Two-Ton Side Dump Car. Capacity, 27 cu. ft. Loads and Unloads on Standard Track. Weight, 1,650 lb. Made by the Industrial Engineering Works.

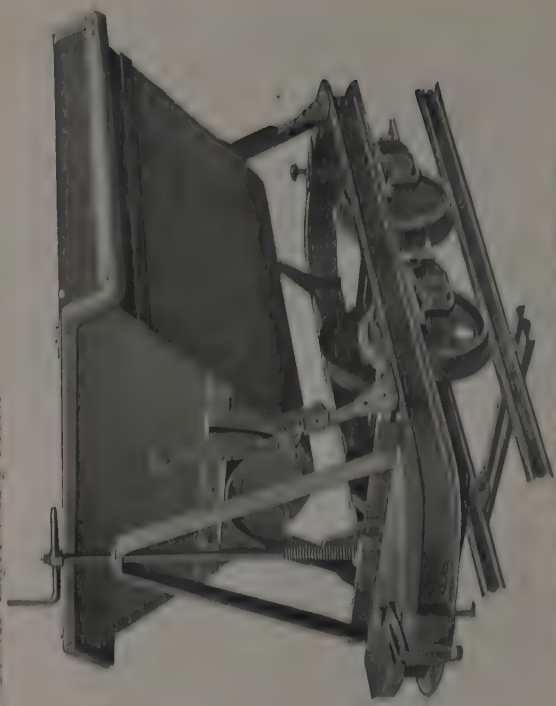


Fig. 2897—Standard Dump Car. Bodies Swung Sideways. Weight, 1,600 lb. Made by the Industrial Engineering Works.

Fig. 2894—Two-Ton Side Dump Car. Capacity, 40 cu. ft. Gauge, 36 in. Loads and Unloads on Standard Track. Weight, 2,000 lb. Made by the Industrial Engineering Works.

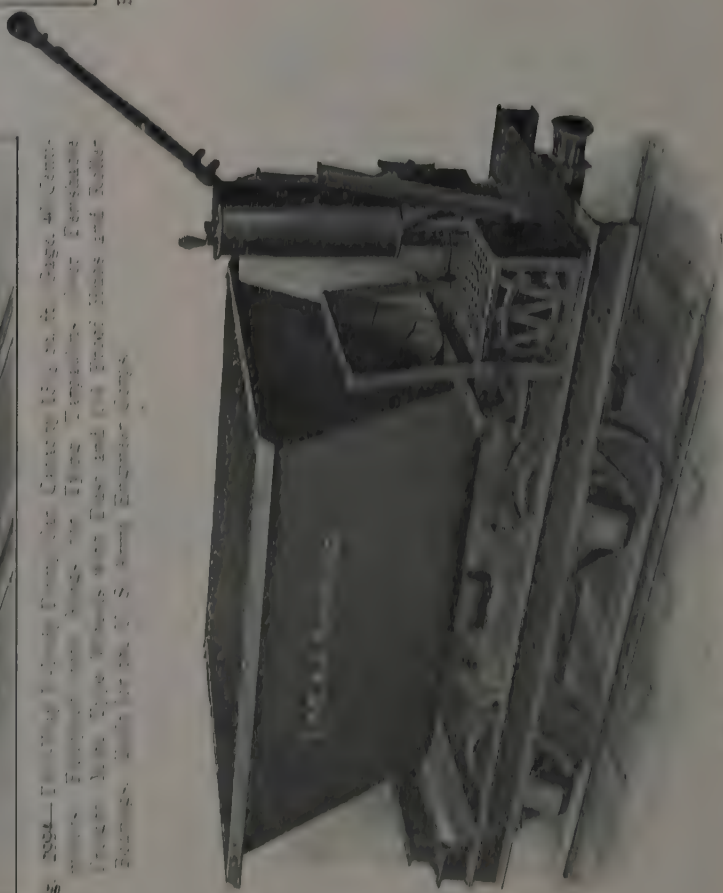


Fig. 2896—Side Dump Car Equipped with Motor. Capacity, 40 cu. ft. Weight, 2,000 lb. Made by the Industrial Engineering Works.

Fig. 2998. Chase Rocker Dump Car. Builder, The Chase Foundry and Manufacturing Company.

Fig. 2999. Gregg V-Body Dump Car. Builder, The Gregg Company, Ltd.

Fig. 3000.—Side Dump Car, Heavy Construction for Steam Shovel Use. Builder, The Atlas Car and Manufacturing Company.

Fig. 3001. Heavy Duty Quarry Car. Builder, The Atlas Car and Manufacturing Company.

Fig. 3002.—V-Body Dump Car for Handling Sand, Coal and Similar Material. Builder, Whiting Corporation.

Fig. 3003. Steel Rotary Dump Car. Capacity 1 cu. yd.; Gage, 24 in.; Dumps in Any Direction, the Body Turning on the Base. Adapted to Mines, Gravel Pits, Grading, Etc. Builder, The Gregg Company, Ltd.

Fig. 3004—Gregg Standard Scoop Dump Car with Swivel Body, for Dumping in Any Direction. The Gregg Company, Ltd.

Fig. 3005—End Dump Incline Car. Builder, The Atlas Car and Manufacturing Company.

Fig. 3006—Gregg Standard Ore Mine Car with Tipping Body Mounted on a Swivel. Builder, The Gregg Company, Ltd.

Fig. 3007—Coke Charging Car, Balanced Type. Builder, Whiting Corporation.

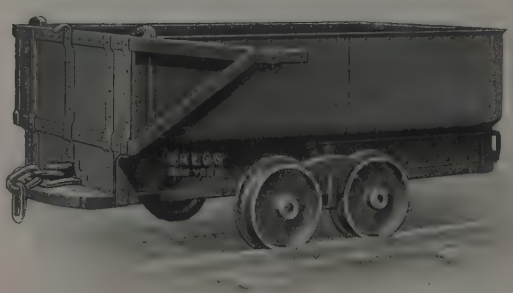


Fig. 3008—Gregg Standard Mine and Quarry Car. The Gregg Company, Ltd.

Fig. 3009—Standard All Around Dump Car. Builder, Koppel Industrial Car and Equipment Company.

Fig. 3010—Composite Car for Shaft Mine. Hockensmith Wheel & Mine Car Company.

Fig. 3011—Steel Mine and Quarry Car. Builder, Atlas Car and Manufacturing Company.

Fig. 3012—Iron Charging Car, Balanced Type. Builder, Whiting Corporation.

Fig. 3013—Low Quarry Car Made for Hand Loading with One End Open. Builder, Koppel Industrial Car and Equipment Company.

Fig. 3014—Charging Car. Builder, American Car and Foundry Company.

Fig. 3015—Mine Car. Builder, American Car and Foundry Company.

Fig. 3016—Side Discharge Dump Car. Builder, American Car and Foundry Company.

Fig. 3017—Mine Car. Cambria Steel Company.

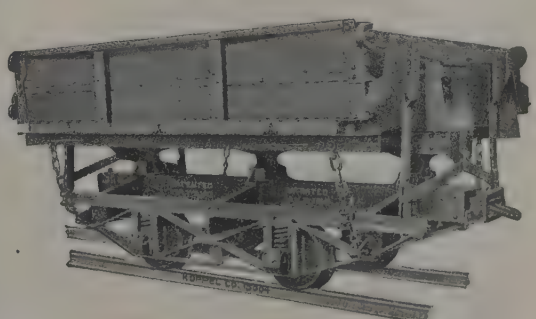


Fig. 3018—Square Box Dump Car. Builder, Koppel Industrial Car and Equipment Company.

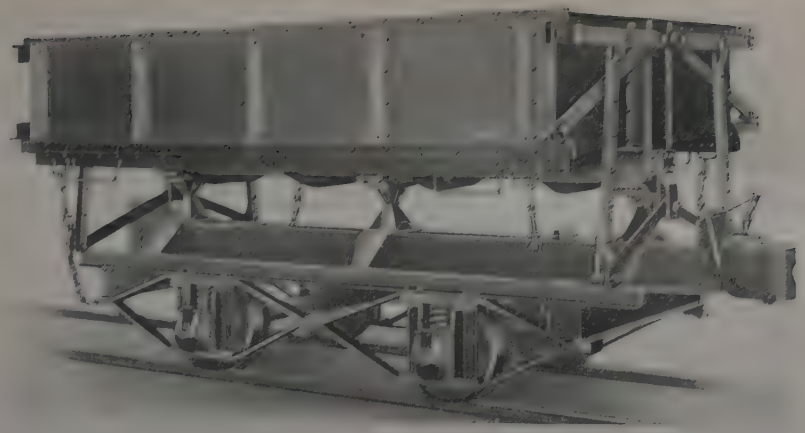


Fig. 3019—All-Steel Two-Way Box-Body Dump Car. Capacity 4 cu. yd.; Gage, 1 Meter; for Regular Locomotive Traction, and Steam Shovel Work. Builder, The Gregg Company, Ltd.

Fig. 3020—6 yd. Dump Car with British Bumpers and Couplers. Builder, Western Wheeled Scraper Company.

Fig. 3021—Automatic End Dump Car.
Builder, The Atlas Car and Manufacturing Company.

Fig. 3022—Steel Frame Dump Car. Builder, Western Wheeled Scraper Company.

Fig. 3023—Small Platform Car for Hot Metals. The Gregg Company, Ltd.

Fig. 3025—Gregg Standard Small Platform Car. Builder, The Gregg Company, Ltd.

Fig. 3026—Concrete Block Car. The Atlas Car and Manufacturing Company.

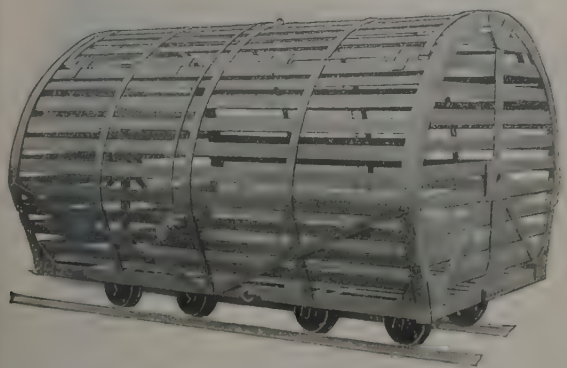


Fig. 3028—Block Car for Creosoting. Length, 9 ft. 5 in.; Width, 6 ft. 9¾ in.; Height of Floor, 12¼ in. Koppel Industrial Car and Equipment Company.

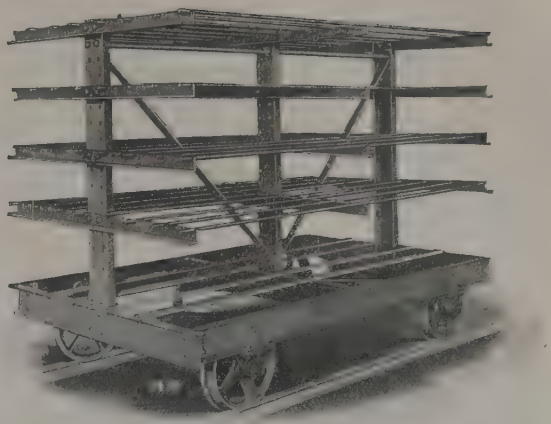


Fig. 3024—Structural Steel Frame Core Oven Car. Whiting Corporation.

Fig. 3027—Steel Rock Dryer Car for Core Oven or Other Similar Uses. The Gregg Company, Ltd.

Fig. 3029—A Seven-Tier Dryer Car with Pivoted Damper Between Wheels. The Gregg Company, Ltd.

"Car Foundry" Mine Cars

Varying conditions and the different methods employed in coal and metal mining require the use of a wide range of special railway equipment. Cars for this service manufactured by the American Car and Foundry Company include all types of wood, steel and composite construction. The cars illustrated are typical, but many other designs are furnished. Information concerning special types can be secured from the manufacturers.

A steel car for use with rotary dumping apparatus is shown in Fig. 3030. It has a capacity of 119 cu. ft. when level full; its weight is 3,600 lb.

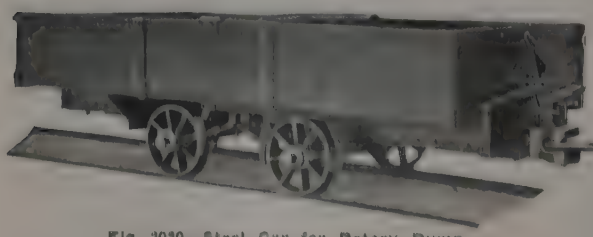


Fig. 3030—Steel Car for Rotary Dump

Roller bearings are used and the wheels are tight on the axles. The coupler head turns on the shank so that dumping can be accomplished without uncoupling.

Fig. 3031—Composite Mine Car

The Composite mine car illustrated in Fig. 3031, is used extensively in West Virginia operations. It has the strength and durability of a steel car, in addition to great flexibility, and can be repaired readily in any ordinary blacksmith shop.

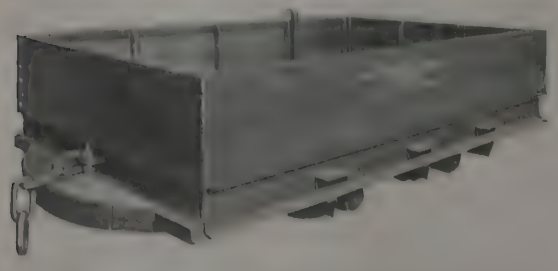


Fig. 3032—Mine Car with Bearings Outside the Wheels

Maximum cubic capacity with minimum height is obtained in the car illustrated in Fig. 3032 by placing the bearings outside of the wheels. Solid ends are also a feature, as these cars are designed for use with rotary dumping equipment.

End unloading composite cars—Fig. 3033—have a capacity when level full of 60 cu. ft. The

Fig. 3033—Composite Car Designed for End Unloading

weight is 3,040 lb. The wheels are self-oiling and the journal boxes are equipped with circular seats.

A wooden car for mine use is illustrated in Fig. 3034. The over-all length is 10 ft. 4 in.; width 4 ft. 1 in.; inside length, 8 ft. 3 in.; and height 3 ft. 2 in., from the top of the rail. The weight and capacity are 2,100 lb. and 4,500 lb. respectively.

Fig. 3034—Wooden Mine Car

Composite cars for anthracite mining—Fig. 3035 have oak underframes and steel bodies constructed from plates and standard rolled shapes. A spring type of drawbar distributes the pulling

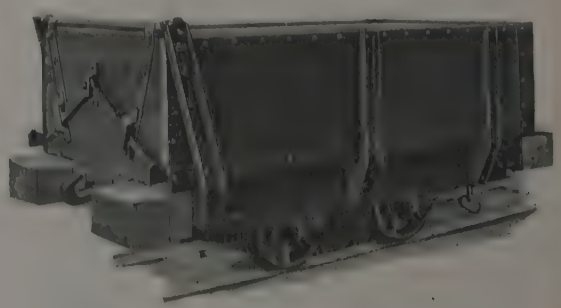


Fig. 3035—Composite Car for Anthracite Mining

strain over the entire underframe. These cars dump from the end through a swing or lift door. The capacity is 72 cu. ft. when the car is level full.

"Car Foundry" Mine Cars *(Cont'd.)*

An example of a lighter type of mine car used in the bituminous fields, made by the American Car and Foundry Company, is shown in Fig. 3036. This car weighs 1,800 lb. It is dumped from the end through a swing door . The drawbar is continuous and the metal brakes have spring blocks and guides. Either a standard channel or an angle bar truck can be used with either steel or wood body. Chilled cast wheels fitted with patented self-contained spring oilers are also part of the equipment.

Fig. 3036—Steel Car for Bituminous Fields. Capacity, 2,500 Pounds

A heavy steel car weighing 3,400 lb. and having a capacity of 5,000 lb., used in bituminous mining, is shown in Fig. 3037. These cars either dump from the end through a lift or swing door or the ends can be furnished solid for use with rotary dumping apparatus. A continuous drawbar with an auxiliary bar and stirrup is used. Brakes are metal and have spring blocks and guides.

Fig. 3037—Steel Car for Bituminous Fields. Capacity, 5,000 Pounds

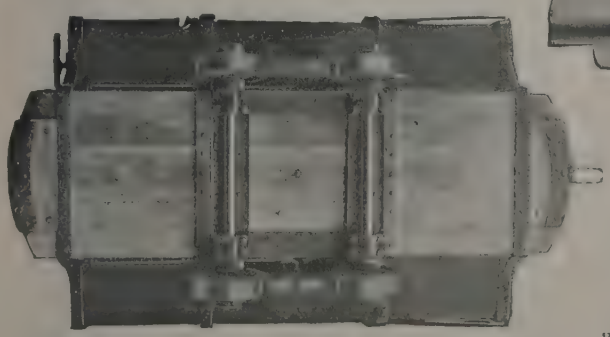


Fig. 3038—Channel Truck, Applicable to Wood or Steel Car

A patented mine car truck known as the "channel truck" can be furnished ready for the application of the car body. Equipment which may be specified for this truck includes tight or loose wheels with open or closed hubs, or wheels pressed on axles with or without roller bearing journal boxes.

For mine motor cars, new wheels and axles complete can be supplied, or new wheels can be refitted on old axles. All patterns are in stock and the wheel mixture meets Pennsylvania Railroad specifications.

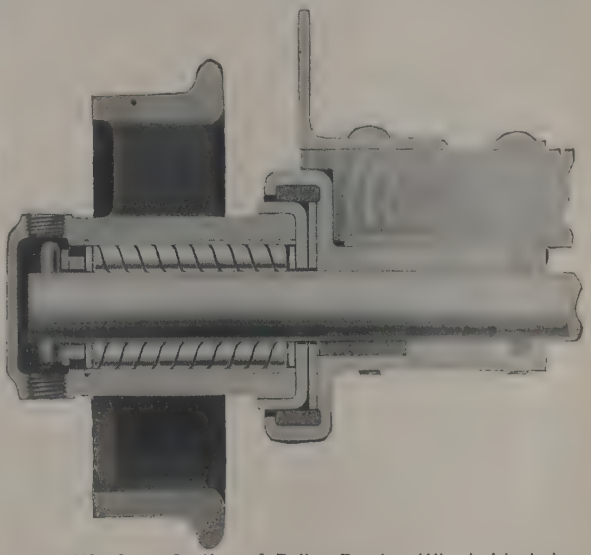


Fig. 3039—Cross-Section of Roller Bearing Wheel, Linchpin in the Axle

Roller bearing wheels in a variety of designs are available. Examples are shown as equipped with closed hubs and Hyatt roller bearings. Three different linchpin arrangements are also shown. An open hub with linchpin can be furnished if desired. Patents covering fully the various designs and their details, have been taken out.

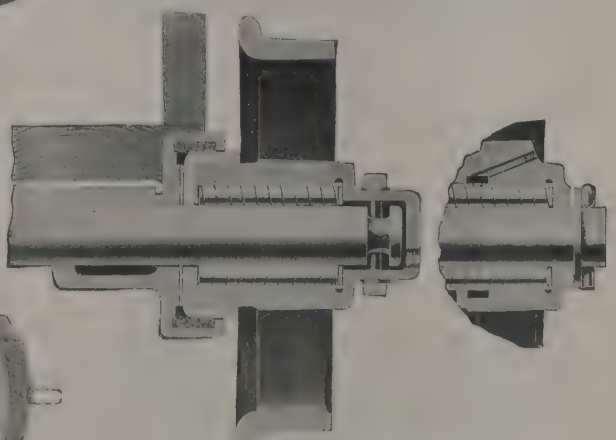


Fig. 3040—Arrangement of Roller Bearing Wheels with Linchpin in the Hub, Also with Open Hub and the Linchpin in the Axle

Standard Railroad and Industrial Freight Cars

The organization and facilities of The Gregg Company, Ltd., are complete for the manufacture of standard and special purpose freight cars of any size, dimensions or capacity for use on any gage of track. From the many types, a few are here illustrated partially indicating the range of the products of their manufacture. Their works are only eight miles from New York.

Cane cars which dump from the side are usually

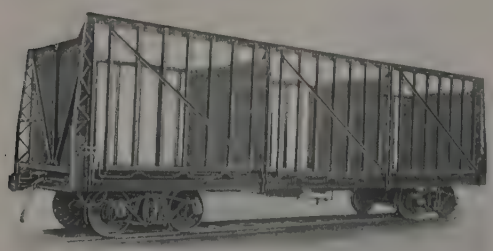


Fig. 3041—Side Dump Cane Car

built in capacities from 10 to 40 tons. The floor or superstructure may be either steel or wood, as desired. This type of car is illustrated in Fig. 3041.

A hoist discharge cane car having three compartments is illustrated in Fig. 3042. These cars are

Fig. 3042—Hoist Discharge Cane Car

usually built with capacities ranging from 10 to 25 tons, and ordinarily have either one, two, or three compartments. The floor may be either steel or wood. The partitions consist of steel plates or wooden planks. Any type of standard or special draft gear can be supplied.

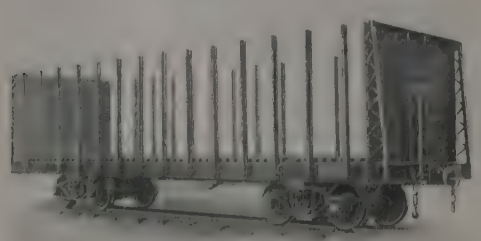


Fig. 3043—Cane Car Equipped for Hoist or Hand Discharge

One of the smaller types of cane cars is illustrated in Fig. 3043. This design of car discharges either by hand or by the hoist method. Capacities as low as 5 tons can be provided and 20 tons is usually the high limit. All-steel construction is generally advised.

Steel gondola cars—Fig. 3044—such as were built for the District of Columbia, are representative of a type of car which is built in capacities ranging

Fig. 3044—All-Steel Gondola Car

from 10 to 50 tons. It can be equipped with high, low, or drop sides, or with doors in the sides, ends, or floors. Wooden lining or floor can be furnished if desired.

A standard type of box car, constructed by The Gregg Company, Ltd., is illustrated in Fig. 3045. Cars of this type have capacities of 10 to 50 tons.

Fig. 3045—Modern Type of Box Car, Built in Capacities of 10 to 50 Tons

The sheathing may be steel and ventilators are part of the equipment.

Tank cars, adapted for carrying molasses, oil, and other liquids, are also built by The Gregg Company. The equipment of these cars may include

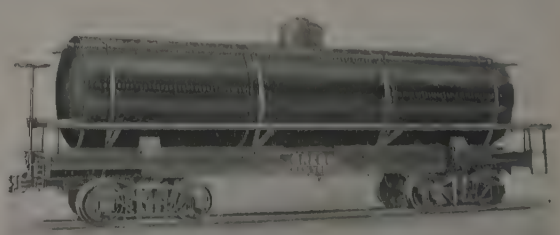


Fig. 3046—Tank Car, Capacities 1,000 to 8,000 Gallons

heater coils, special outlet valves, etc.; the capacities range from 1,000 gallons to 10,000 gallons.

For all cars constructed by The Gregg Company, the size and style of couplers, trucks, wheels, floor, brakes, and other details may be arranged to suit any practical requirements, either special or to conform to any type of existing equipment.

For other products and branch offices, see classified and alphabetical indexes.

THE GREGG COMPANY, LTD., NEW YORK, N. Y.

Car Repairs

CAR REPAIR SHOP PRACTICE must be based on the volume of work and the predominating class of cars, freight, or passenger, steel or composite. To determine the best layout and the type of tool equipment necessary, due consideration must be given to the needs of the railroad under consideration. A railroad having a large percentage of coal or ore traffic, requiring steel hopper and gondola cars and not very much passenger equipment, obviously will require a somewhat different car repair shop than a road having principally a general class of freight requiring mostly box cars and also a considerable passenger traffic. When the amount of repair work of each of the various classes of freight and passenger will exceed 50 cars per month, it is probable that a separate shop for each class would be an economy.

When this is done, however, the several shops must be so laid out that there will be a minimum of lost effort and duplication of equipment. Such work as may be required from a blacksmith shop or a machine for a particular class of repairs may be done in a shop conveniently located to all of the various departments.

The shop, yards, buildings, departments, and machinery should be arranged so that work will progress through the shop, the material entering at one end and passing out at the other end of the shop in the finished state. In the handling of general repair work, a car will enter the shop and be stripped. Both the car and the trimmings will then progress through the shop, each over a different route, finally meeting in the trimming house.

Generally light repair work on passenger cars can be handled to a large extent in the coach yard, but, if there are sufficient shop tracks to handle both general and light repair work, many experienced passenger car repair men consider it best to do light repair work under a roof.

Shop floors should be substantial and adapted to resist the wear and tear from handling of heavy material. Roller lift doors are best for the shop track doors.

The shop should be piped for compressed air, steam, water, and wired for electricity; if much oxy-acetylene welding is done, it should also be piped for acetylene gas.

Lavatories, locker rooms, shop offices and storerooms should be located in annexes, if possible, and not in the main shop, which should be kept clear for work.

In car repair work, the first step is to remove the trucks from under the car and place the car body in position for repair work. Usually this is done by jacking up the car so that the trucks can be removed. It may be done at some point before the car enters the repair shop and the trucks replaced at some point after the car leaves the paint shop. This permits time for truck repairs while the car itself is passing through the shop. If the jacking is done in yard and the car is placed on "dummy" or shop trucks, it facilitates movement from one point to another in the shops and, in case of fire, the car may readily be taken out of the shops, which would be impossible if it were set on horses.

At some railroad shops cars are jacked in the yard, at others in the shop; some use air jacks, other hand jacks. One large railroad shop has a jacking device in the yard two special overhead cranes equipped with hooks which raise the car from the trucks; in another shop the same method is employed, but the jacking is done inside the shop, an ordinary traveling crane being used and only one end of the car raised at one time.

Machine Shop and Blacksmith Shop

As the machine shop and blacksmith shop are required to serve both the passenger and freight departments, they should be located conveniently to both. The passenger car truck shop and repair shop give the blacksmith and machine shops practically all the work which is to be done for the passenger car department, therefore the blacksmith and machine shops should be conveniently located to these two shops.

Truck Shop

In many railroad shops the trucks are repaired on the same tracks with the cars, or on a few designated tracks in the car repair shop. Where the volume of work will warrant it, a separate truck shop would be desirable, as it permits a better and more extensive use of tools for doing steel truck work, better supervision and undoubtedly will result in a greater output.

The truck shop tracks should be transverse and open into the yards at both ends, so that trucks can enter and leave the shop in either direction. A traveling hoist running over each shop track, as well as a traveling crane running longitudinally the entire length of the shop, will expedite the movement of materials. The distance between centers of the shop tracks should be at least 25 ft. and there should be one or more longitudinal supply tracks, for wheels, etc., running the entire length of the shop, with turntables at their intersections with each shop track. An estimate based on the heavy truck work done at one large shop requires that there should be enough shop track room to allow one pair of trucks in the shop for three cars undergoing repairs.

At the larger railroad repair shops the truck shop, in conjunction with the wheel shop, generally is fully equipped to do all of the work pertaining to truck repairs including the turning of axles and wheels, wheel pressing, finishing of journal boxes, side frames, etc. At smaller shops it often is found advisable to do parts of the work in the general machine shop.

The truck shop should be located adjacent to the wheel shop, machine and blacksmith shops and have transfer table service for the movement of trucks to and from the cars.

Sufficient yard room for the storage of truck material should be provided, and, if dummy trucks or horses are used under cars, room also is needed for the storage of trucks awaiting shopping or awaiting placing under cars.

Floor space should be provided for drill presses, a spring press, a brass boring machine, etc. One shop doing a large amount of steel truck work has small drills; a radial drill

EDITOR'S NOTE.—A large part of the information included in this article was obtained from the report presented at the 1922 convention of the American Railway Engineering Association by a "Committee on Shops and Locomotive Terminals."

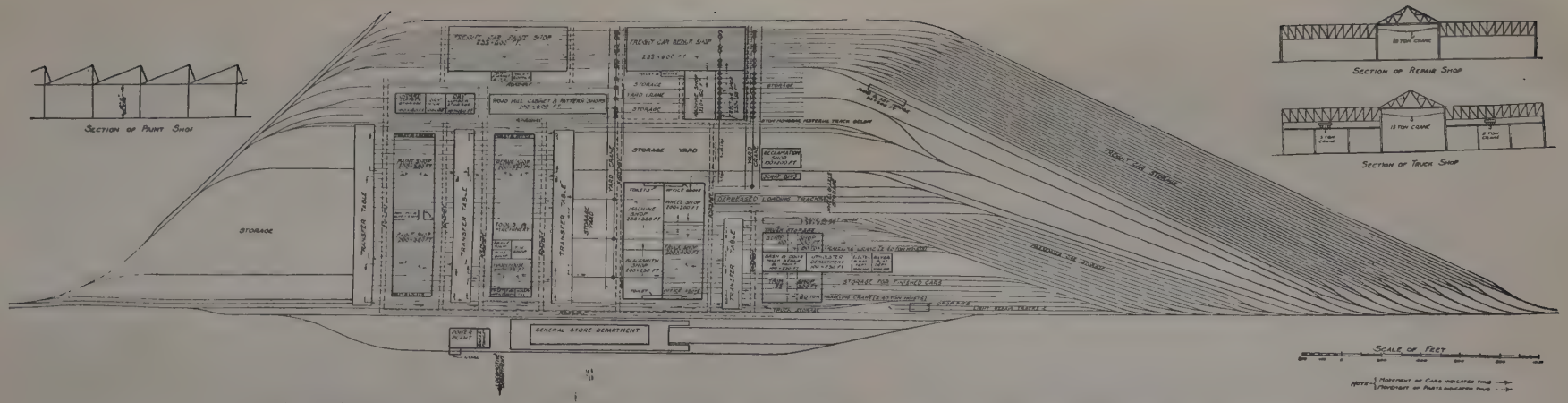


FIG. 3047—A. R. A. PRELIMINARY RECOMMENDATION FOR PASSENGER CAR REPAIR SHOP—LAYOUT OF TRACKS AND BUILDINGS.

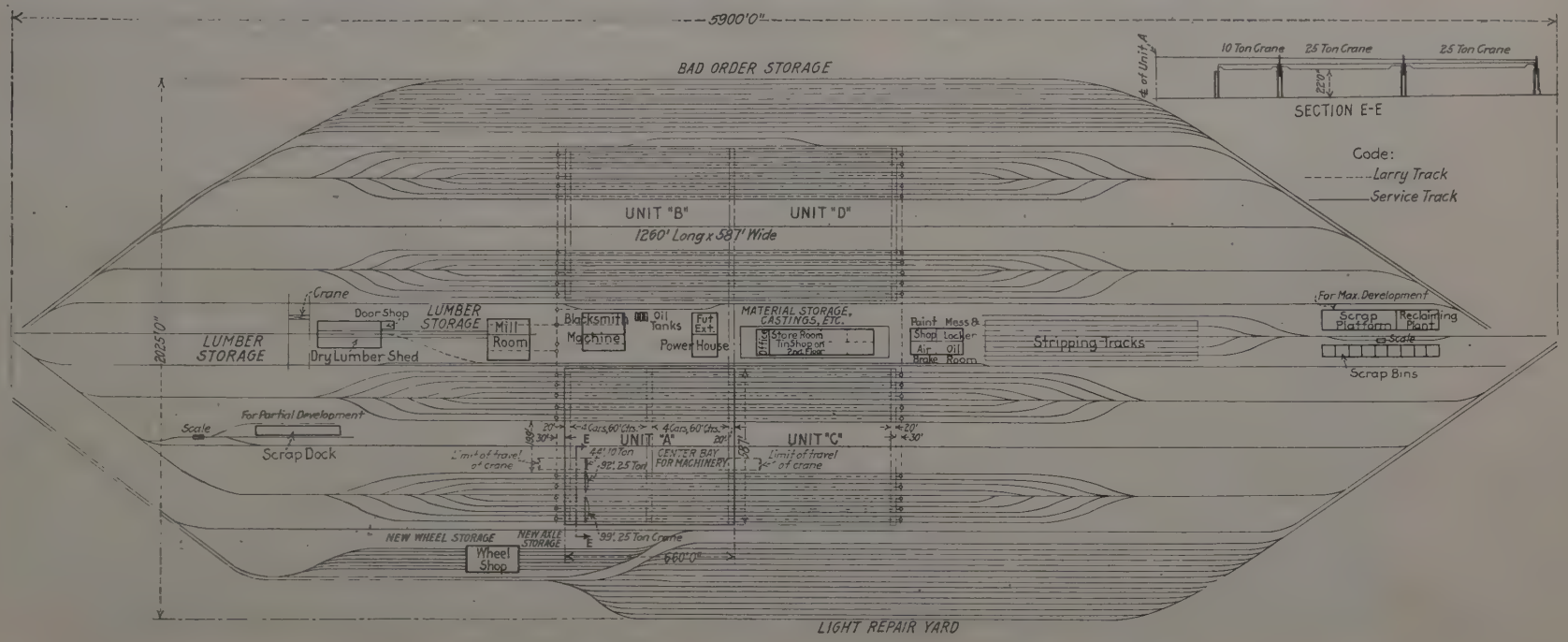


FIG. 3048—A. R. A. RECOMMENDED FREIGHT CAR REPAIR SHOP—LAYOUT OF BUILDINGS AND TRACKS.

on an arm swinging in a radius large enough to extend over an entire truck frame; punches; etc.

Wheel and Axle Shop

The wheel and axle shop should be conveniently located to both the freight repair tracks and to the passenger department truck shop. Some railroads have the wheel and truck shop under one roof, thus reducing the cost of moving wheels between the two departments. It is debatable, however, whether this is an economical arrangement, as both shops, particularly the wheel shop, need a large storage space. A cramped yard or long haulage to a remote storage will probably more than offset any labor saving due to the wheel and truck shops being in close proximity.

On one large railroad the wheel shop has storage space provided on all four sides and is arranged so that wheels are unloaded and stored in the yard at one end of the shop, while mounted wheels which have passed through the shop are stored and loaded in the yard on the opposite end of the shop. At both sides and ends of the shop storage space is afforded for new and scrap wheels and axles, wheels with manufacturers' defects and other special wheels and axles, all assorted as to size, make, etc. Thus no time and labor is lost searching for and "digging" out wheels, as there is plenty of yard room to allow a place for everything.

At another large shop the layout includes a wheel loading and unloading platform served by an electric hoist traveling on a monorail track which runs along one side of the platform, passes into and out of the wheel shop, and runs along the other side of the platform. Depressed tracks at each side of this loading platform facilitate loading and unloading the wheels. The wheel shop machinery is arranged so that work enters one end of the shop and progresses through and out at the other end. As a considerable part of a wheel shop's work is for outside points, service trucks should be provided to allow for loading and unloading of cars.

Planing Mill

The planing mill is required to finish wood work for both freight and passenger car repairs and therefore should be located convenient to both the freight car repair track and the passenger car repair shop. It should be easily accessible to the lumber yard, dry kiln and boiler room. The building should be fireproof, well ventilated and lighted and the floor should be capable of supporting and resisting wear.

At least two supply tracks from the yard should run longitudinally through the planing mill and the various wood working machines should be arranged so that lumber will enter at one end of the shop, progress through the mill and when finished, leave at the other end.

Shavings from the mill may be disposed of in several ways: burned in the boiler room; pressed into bales and sent to round-houses to be used in starting fires in engine boilers; or hauled away in freight cars. An overhead shaving pipe connecting the mill and the boiler room or baling shed, will facilitate disposal.

Pattern and Cabinet Shops

The planing mill requirements have already been described; closely related to the planing mill, are the pattern shop and cabinet shop—all doing wood work—and in many shops they are under the same roof. The planing mill usually on the ground floor; the second floor divided between the pattern and cabinet shops, with elevator service to the ground floor.

In a shop handling all-steel cars a separate steel cabinet shop for handling steel trimmings; etc., will also be required.

The pattern storage should be in a separate, fireproof building located convenient to the pattern shop.

The sash and door department is required chiefly for passenger car work and should be located convenient to the passenger car stripping and trimming shop. This shop may occupy two floors; there should be ample working room and storage space and at shops where storm sash is to be stored during summer, a separate shed for this purpose is desirable.

The glazing department should be located near the sash and door department and possess facilities for handling and storing a sufficient stock of glass.

The wash room, and paint or varnish room are usually located in separate rooms.

Electrical Department

The electrical department should be in a separate building with the battery room separate from the electrical room. The battery room should be located on the ground level and it should have a ventilating system, a cement floor, and good drainage because of the acids, etc., used in the work. The electrical shop should have a small material storage space inside the shop. Some shops have electrical connections in the coach shop and in the yard for charging the car lighting batteries. On some railroads still operating gas-lighted cars, the gas lighting system work is also handled in the electrical shop.

Other Departments

Other departments which make up the complete passenger car repair shop are the tool room; tinshop; air brake shop; steamfitters' shop; silverplaters; upholstering shop; and paint mixing room. Generally, these miscellaneous departments are located with regard to the convenient handling of work—usually near the coach shops—but they should be concentrated so that if possible one line of shafting and one motor may serve all, and thus eliminate the need for several lines of shafting and motors.

The tool room should be located conveniently to the various departments; in most shops it is situated in a corner of one of the larger shop buildings.

Generally the tin and sheet metal shop is required to take care of freight, passenger, and road work. It should be equipped with the necessary machinery, benches, etc., have plenty of working space, and a material storage space inside of the shop.

In many railroad shops the passenger car air brake department consists of only a few benches in the passenger car repair shop. However, where the volume of this class of work is large a separate air brake shop equipped with test racks, benches, etc., for doing both freight and passenger work will be an advantage.

The steamfitters also often have only benches along the wall of the passenger car repair shop; a separate shop equipped with the necessary machinery, benches and a large storage space for pipe, etc., is desirable.

The silverplating and brass shop should be located on the ground floor of a separate building, preferably situated near the passenger car stripping and trimming shop. The building should be divided into four or five rooms, so that each process—buffing, electro-plating, etc., may be done in a separate room. Freedom from dust and dirt is necessary for good work and because of the unavoidable leakage of acids used in the work, the floor should be of cement.

The upholstering shop usually requires two floors; it should be located near the passenger stripping and trimming shop. There should be a large carpet room; the moss pulling room should be fireproof, many are metal lined; the

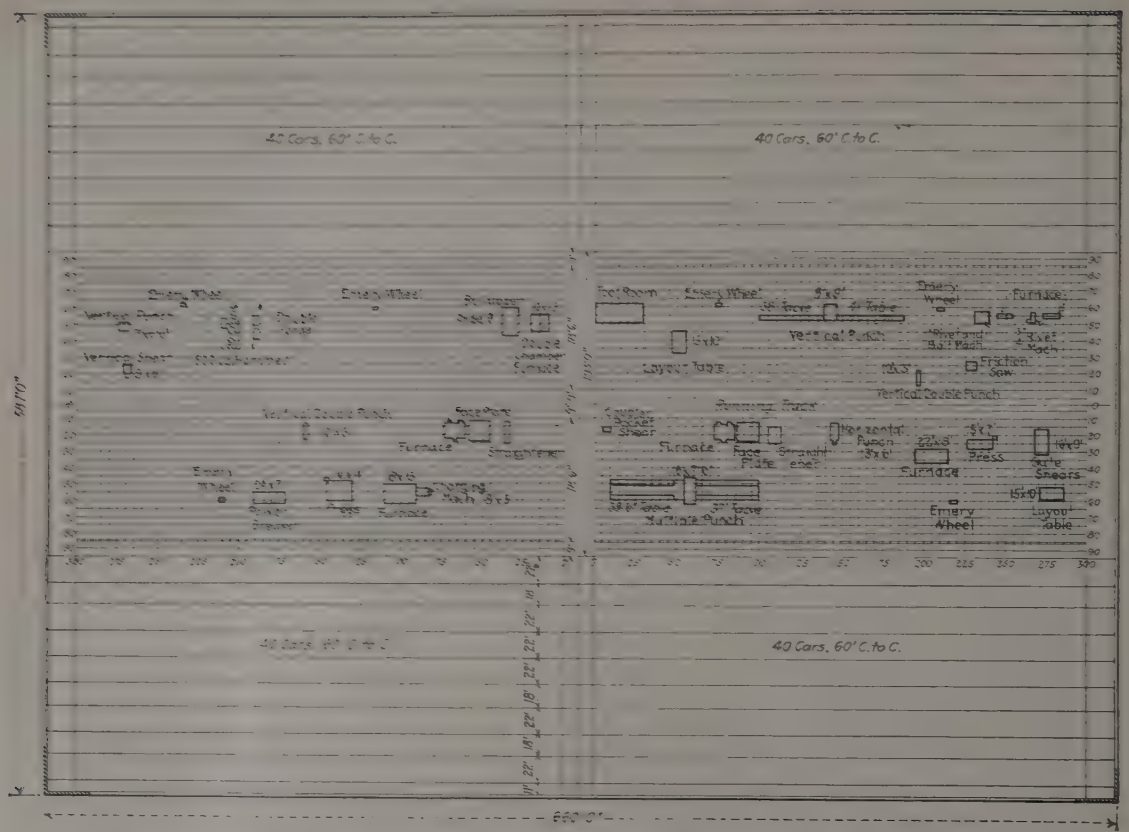


FIG. 3049—A. R. A. RECOMMENDED FREIGHT CAR REPAIR SHOP—MAIN SHOP TOOL LAYOUT.

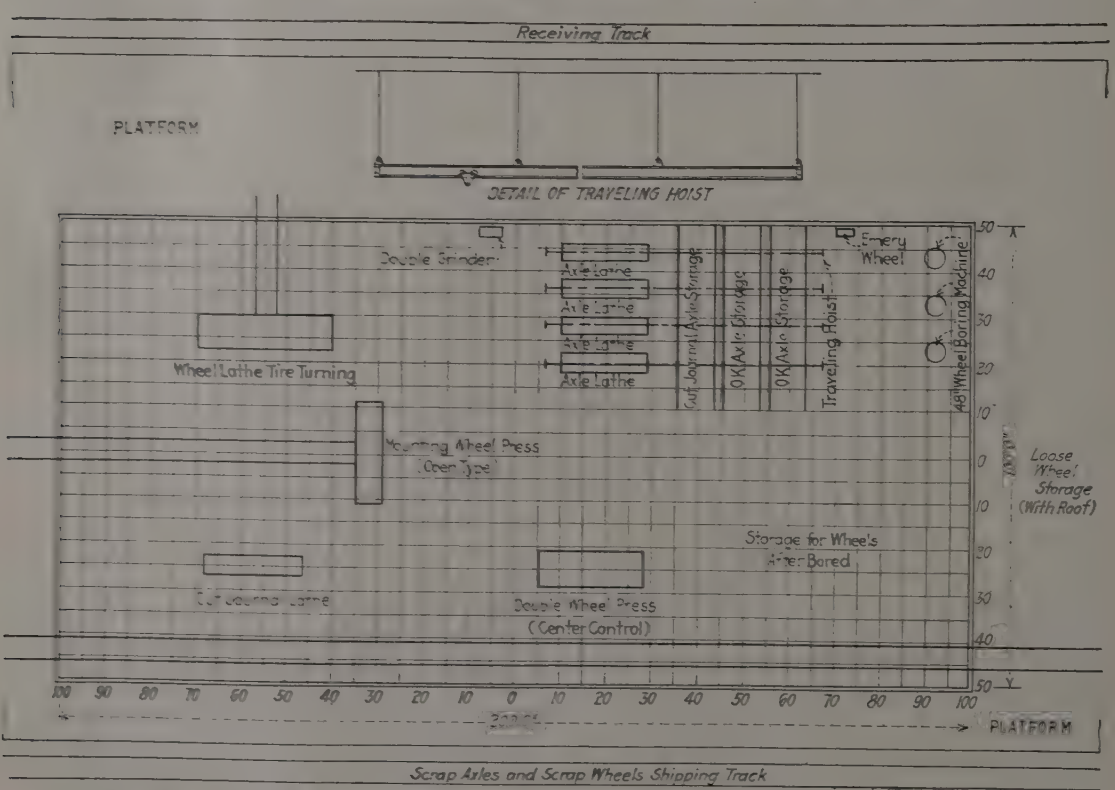


FIG. 3050—A. R. A. RECOMMENDED FREIGHT CAR REPAIR SHOP—WHEEL SHOP TOOL LAYOUT.

shop should be piped with compressed air to renovate or clean seat cushions, etc.—there should be a separate room or shed for blowing the dust from cushions. A large storage space is desirable in this department.

Stripping and Trimming Shop

The stripping of the cars preparatory to cleaning and painting is often done in the wash house; many railroads remove the upholstering in the shop yards and strip the balance in the wash house.

In most shops the cars are washed on certain tracks in the passenger car paint shop, but as the washing of cars causes dampness in the shop and as good painting requires a dry atmosphere, it would be more desirable to have a wash house separate from the paint shop. The burning off of paint from the cars should also be done in the wash house. The house should be well lighted, heated and ventilated, so that the cars will dry quickly. The floor should be of cement, with good drainage and sewage facilities; gutters running parallel to the shop tracks, at a distance outside the

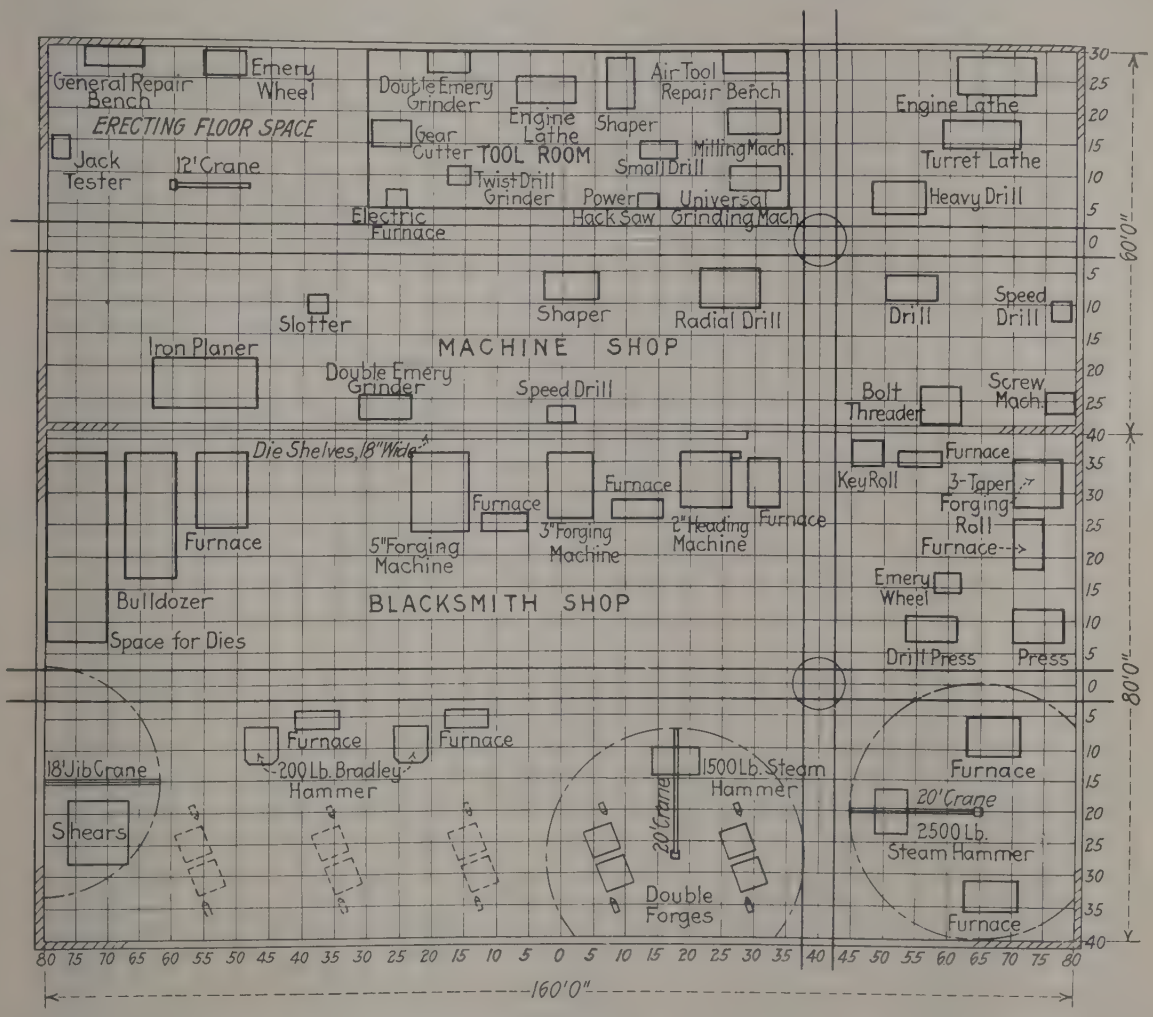


Fig. 3051—A. R. A. Proposed Freight Car Repair Shop—Blacksmith and Machine Shops. Tool Layout for 25-Car Output Per Day.

A plan followed by some roads is to have a stripping and trimming shop entirely separate from the other car shops. Cars are taken into this shop to be stripped, then moved to the wash house, repair shop and paint shop and then re-enter shop to be trimmed. The upholstering, lamps, sash and doors, etc., are there stripped from the cars and pass to the proper departments, to be repaired. The cars, after passing through the repair and paint shops, are returned to the trimming shop and the material replaced.

Wash House

To obtain the best results in passenger car painting it is necessary that cars be thoroughly cleaned before painting. rails so that water will drip off the car sides directly into the gutters, and sloping from each end toward the center, where a sewer is located, makes the most efficient drainage. Water and gas connections are essential, and a soap preparation room should be located in the shop or in an annex.

Sand Blasting

The sand blast provides a quick and efficient method for removing paint from steel cars and trimmings and is used by many railroads. The sand blasting shed should be located in the yard at a convenient distance from the coach shops. The shed should consist of two rooms, one for sand blasting of steel cars and the other for priming the cars after

they are sand blasted. A small sand blasting shed located near the sash and door shop will be useful for cleaning steel trimmings.

Lumber Yard and Dry Kiln

The lumber yard should possess an adequate number of tracks, proper facilities for loading and unloading cars of lumber, and plenty of room for lumber storage. There should be direct supply track connection between the lumber yard and the planing mill.

tion of steam for power and for heating purposes. The boiler room should be well ventilated; the engine room should have a high roof and good light. Because of the fire hazard, it would be best to have the power plant at some distance from the planing mill.

Track Arrangement

Transverse shop tracks with wide aisles running the entire length of the shop, one through the center and one parallel to each side wall, have been found preferable to

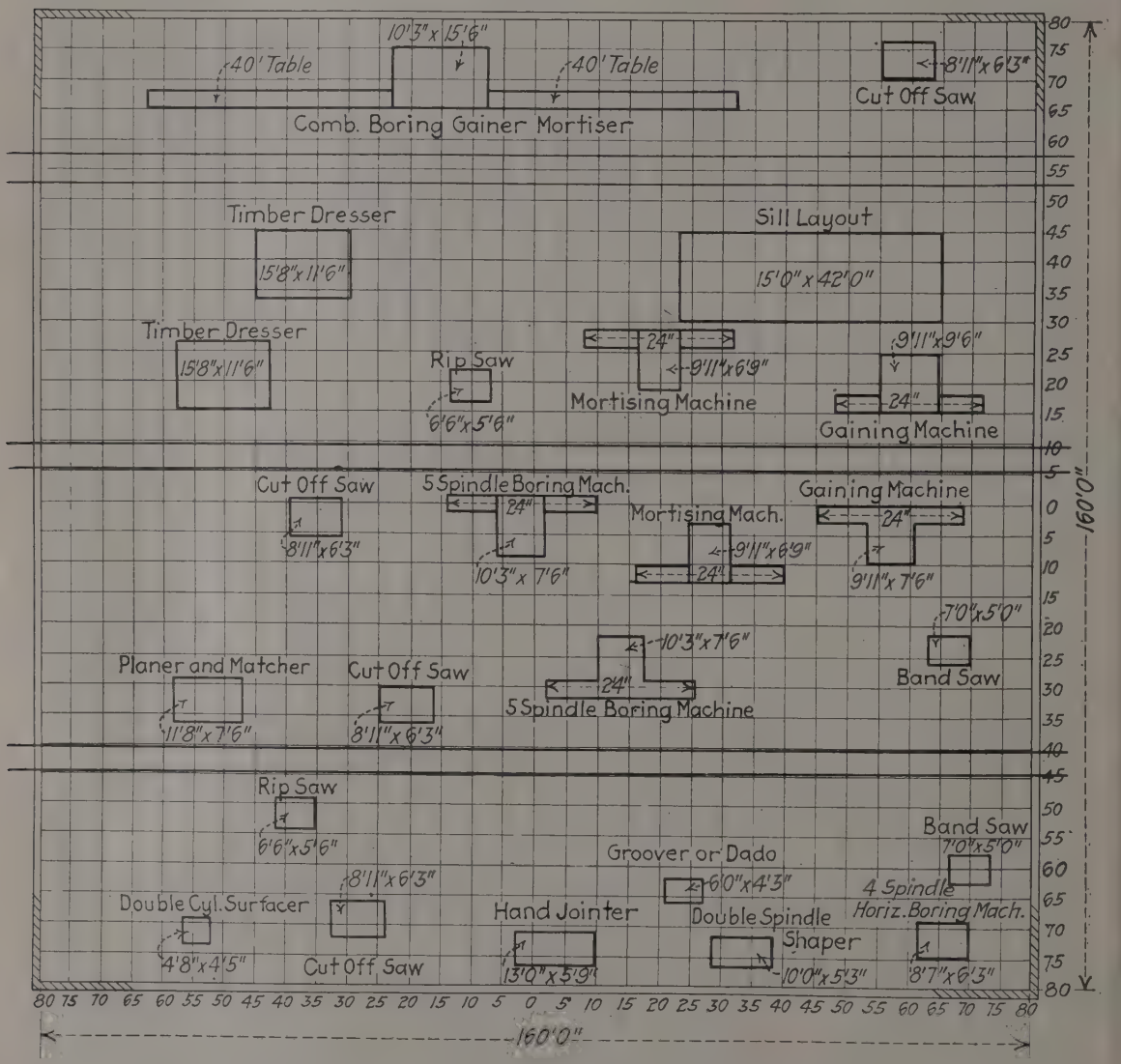


Fig. 3052—A. R. A. Recommended Freight Car Repair Shop—Wood Mill Tool Layout for 25-Car Output Per Day.

The dry kiln should be adjacent to the lumber yard; a large shop of one of the largest railroads has an undried lumber shed with a dry kiln at one end and after being dried the lumber passes out into a dried lumber shed at the other end.

Power House and Boiler Room

The power house should be designed with reference to the economical handling of fuel and ashes; and should be located so as to provide an easy and economical distribu-

the longitudinal tracks as cars can be handled easier. Each track should be long enough to hold two 75-ft. cars; three cars per track are too many because the center car offers a problem to move out of the shop if it is completed before the end cars. There should be openings through each side wall so that cars can enter and leave the shop on either side.

When there is likely to be enough work to keep three cranes busy, a traveling crane—about 30-ton capacity—should run the entire length of each shop aisle; the crane

should be arranged to operate from the floor. When the trucks are removed and cars leveled and jacked in the yard or in another shop, it is probable that one crane in the center aisle will care of all necessary work.

A standard gage supply track from the yard should run the entire length of the shop through the center aisle, under the crane, with turntables placed at each intersection of the transverse shop tracks. This supply track should open into the yard.

Shop scaffolds should be built-in near the tracks and movable up and down; one railroad has a type of scaffold which is suspended from the roof trusses and extends to the floor. When the scaffold is not in use it is pushed up off the floor out of the way.

Repair Shop Layouts

The general characteristics and a preliminary layout of a freight car repair shop, designed to have an ultimate capacity of 100 cars a day, have been worked out by a committee of the American Railway Association. The plans submitted provide for units having a capacity of 25 cars a day, and an expansion program is so mapped out that the layout can be expanded in units of 25 cars a day until the ultimate capacity of 100 cars is reached.

Investigation of existing conditions developed the fact that for a steel car repair plant space should be proportioned from the following data:

(1) Twenty-five "spots" for heavy repairs will turn out from each spot, one steel car every six eight-hour days, or a total of approximately four cars per day.

(2) Twenty-five spots for medium-heavy or heavy-light repairs will turn out from each spot one car every three eight-hour days—approximately eight cars per day.

(3) Fifty spots for light repairs will turn out one steel car from each spot every eight-hour day, or fifty cars per day.

In the general plan of the 100-car shop, consideration has been given chiefly to steel cars but space is also provided for wooden cars, as it is recognized that for a great many years, there will be wooden cars to consider and also composite cars—steel and wood construction. The general arrangement of the repair plant and layouts of the various shops are shown in Figs. 3047-3052.

"The question of machine tools was a matter given considerable discussion and the committee report includes a tool layout. The number of tools shown is given more as a suggestion than as a concrete recommendation as the number and type of tools depends on the output required. In this connection it should be recognized that, up to the present time, the steel car repair work is carried on largely with machine tools primarily designed for locomotive work and that, no doubt, great economies can be effected by the design of machine tools specifically adapted to car repair work."

"The location of cranes and their installation, as shown by the plans are facilities which need not be installed to the maximum point at the time of initial construction of the shop, but they should be provided for and installed as conditions indicate their need. Where cranes are used, a clearance of 22 ft. from bottom of the crane girder to the top of the shop track rails should be provided.

"The distribution of compressed air is largely one of local preference and conditions, but, with the ultimate capacity of the plant considered, it is deemed advisable to provide several electrically driven air compressors located near points of consumption in preference to two or more large units located at a central point, both on account of economy of distribution and continuity of service."

Welding

IN RAILROAD SHOPS the repair of parts by the means of autogenous welding has become very extensive and has aided materially in reclaiming broken parts and also in reduction of repair costs. Electric, gas, and thermit or molding methods are used.

In electric welding two methods have been used—carbon arc and metallic arc, the latter being now in more general use.

In carbon arc welding the part on which metal is to be added generally forms the positive pole of a direct current circuit, and an arc is drawn between this and a carbon rod manipulated by the operator. At the point of arc contact on the work the metal becomes molten; the metal, which it is necessary to add to the weld, is supplied by melting a filler rod in the arc, the molten metal of the rod fusing with the molten metal of the parts to be welded.

In metallic arc welding, an arc is drawn between the part to be welded and a metallic electrode—a wire, or small rod which may or may not be of similar composition to the metal in the parts to be welded. The arc is established by striking the metallic electrode on the work with a dragging touch and withdrawing it a slight distance thus forming what is commonly called the metallic arc. This form of arc welding differs from the carbon arc in the fact that the filler rod or wire forms one terminal of the arc, which is melted and is conveyed in liquid form across the arc and deposited on the work which forms the other terminal of the arc.

There are a variety of electric welding equipments used for this form of autogenous welding, some of which employ a direct current and others an alternating current at the arc.

Gas welding equipment consists of a torch for burning a mixture of oxygen and acetylene gas and for directing the flame, together with the apparatus necessary for supplying the gases. In some cases the supply of oxygen and acetylene is compressed and stored in tanks from which it passes through a reducing valve to the torch. A generator is sometimes used for supplying the acetylene gas. This form of equipment is also used for cutting metals such as steel plates in car structures.

Another process of welding is by pouring molten thermit steel in a mold enclosing the parts to be welded. Thermit steel is a mixture of finely divided aluminum and iron oxide placed in a crucible and ignited, thus converting it into a molten state. This process is used for welding very large sections and for emergency repairs, as generally the part can be welded without removing it from the structure of which it forms a part.

A report on welding cast steel truck side frames and bolsters will be found in the M. C. B. Proceedings, 1916, page 497.

Autogenous Welding—Limits and Regulations.

Recommended Practice—ADOPTED, 1919.

I. General.—In welding, either by the use of gas or

electricity, care and good judgment on the part of the operator are of prime importance. The operator's ability as to the desired proficiency should be certified by the mechanical officers in charge or by an instructor qualified by experience in general railroad welding with the method involved.

The metal added is liable to be porus and relatively brittle.

The heat at the surfaces welded affects other sections near the weld, tending to reduce strength and toughness.

The following general rules must, therefore, be carefully observed:

II. Welding cracks or fractures will not be permitted on the following:

Axles.
Arch bars.
Car wheels or tires.
Truck equalizers.
Spring or bolster hangers.
Brake staffs.
Brake wheels.
Coupler bodies, knuckles, knuckle pins, locks, lifters and throwers.
Parts made of alloy steel or heat treated carbon steel.
Top chord angles of open top all steel cars if the fracture is located at a point between bolsters more than 5 ft. from the center line of either body bolster.

III. Building up worn surfaces will be permissible on the following:

Parts subject to compression only.
*Spring or bolster hangers.
*Holes in levers.
†Center plates.
†Truck sides, bolsters and column castings.
Journal boxes.
Coupler bodies, knuckles, locks, lifters and throwers. After building up the original section, the same must be dressed and then checked with proper gages to insure interchangeability and proper operation.
Flat spots on rolled steel wheels and tires, if thickness of tread is 1 in. or more above limit of wear groove.

*Provided that the material remaining in part is equal to at least 80 per cent of the original section.

*Provided that the material remaining in part is equal to 60 per cent of the original section.

IV. Welding cracks or fractures will be permitted on the following:

Car and roof sheets.
*Cast steel truck sides.
(*) Pressed and structural steel truck sides, bolsters and transoms.
*Cast steel bolsters.
Draft castings.
Brake beams.
*Cast steel coupler yokes.
Car sills, posts, braces, stakes, carlines, side plates and end plates.
Other car parts subject to compression only, and those not subject to high tension strains, except as otherwise prohibited.

*Welding is permitted only when the area of the crack is less than 2-5, or 40 per cent, of the total area through the section at the point of fracture, but it is not permissible to weld any crack located within 6 in. of an old weld.

V. Regulations for Welding

(a) All parts marked * in section IV. except truck transoms, must not be welded unless removed from car or truck. Truck transoms may be welded in place by removing the truck from under car body.

(b) The edges of pieces for welding must be prepared as in Figs. 1 and 2, page 1153. If both sides of the fractured member can be worked upon, the fracture should be prepared as per Fig. 1, and where only one side of the fractured member is accessible, Fig. 2 should be followed. The entire crack should be burned or chipped out far enough back so that there will be no portion of the crack in the metal. Failure to do this permits the check or crack to work its way across the metal to the farther side, due to the constant vibration, even after the weld has been made. A hole may be drilled at the end of crack or check and chip or burn towards the hole. The surfaces where new material is to be deposited must be clean and bright and reasonably smooth and, therefore, if the surfaces are prepared by the burning process the surfaces must be finished by chipping before welding.

(c) The portion of the part adjacent to the fracture should be heated before the welding is begun. In welding, the operator should begin to weld at the point farthest

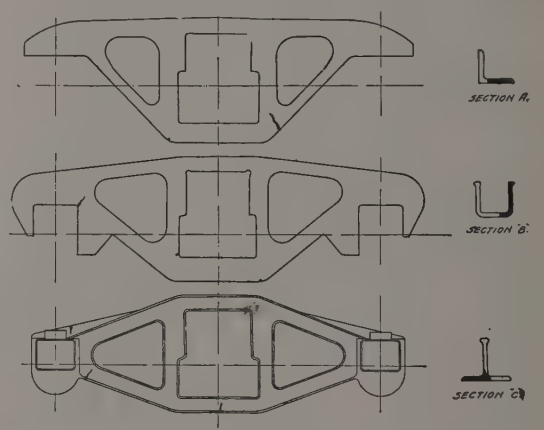


Fig. 3053-A—Diagram Showing Cracks in Truck Side Frames Which May Be Welded.

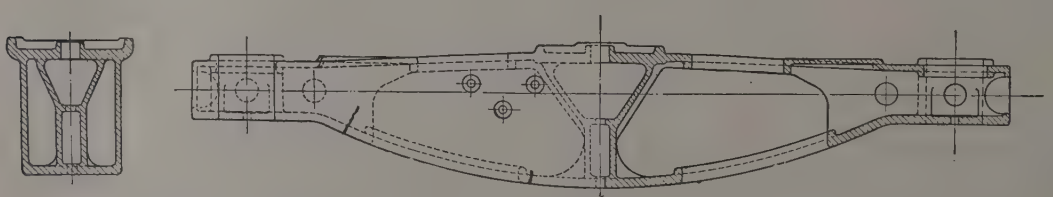


Fig. 3053—Diagram Showing Cracks in Truck Bolster Which May be Welded.

away from the outside edge and work the weld towards the edge. All efforts must be made to prevent oxidizations,

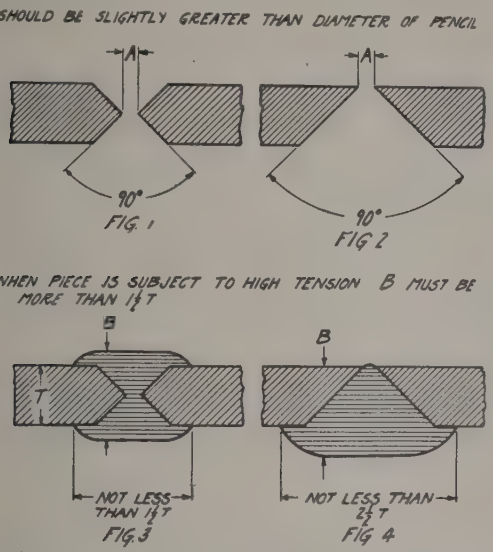


FIG. 3054—DIAGRAM SHOWING METHOD OF PREPARATION OF PIECES FOR WELDING.

and to accomplish this the work should be placed at angle that will allow the blowing out of all slag or impurities in the fused metal, and by giving the torch a rotary movement it will assist in their removal.

(d) The new material must be deposited to the form shown in Figs. 3 or 4 in order to properly reinforce the weld, and "B" should be somewhat greater than "T." For the important items marked * and (*) in Section IV, as well as for car sills, posts, braces, stakes, car lines, side plates and end plates, "B" must be at least 1½ times "T."

(e) The parts marked * in Sections III. and IV., with the exception of truck transoms welded in place, must be carefully annealed by uniformly heating to approximately 1400 or 1500 degrees Fahrenheit and allowed to cool slowly in the atmosphere.

(f) Worn surfaces permitted to be built up to the original section by depositing of new metal thereon must first be made clean, bright and fairly smooth, and after the metal is deposited must be dressed to the required dimensions and gaged where necessary.

(g) When truck side frames and bolsters are welded the weld must be made smooth and the following record legibly stamped on the weld by at least ⅜-in. steel stencils, in the following form:

(Mo. — Day — Yr.)	(Railroad)
0 —00— 00	A. B. C.
XY	(X)
(Shop Abbreviation Mark)	(Welder's identification number or mark)

Wood Working Machine Operation Study*

THE DEVELOPMENT OF MODERN wood working machine tools, the changes in design and the increase in the size of railway car parts makes it necessary to carefully consider the design of each new shop, keeping in mind the service that may be required of it. A study of each individual machine tool operation is necessary so that the tool requirements may be definitely based upon the average time required for each operation and the average number of such operations in a given time.

In preparing for the layout of a new shop a study of a large shop already in operation was made and the information thus obtained was tabulated to permit a ready determination of the number and kind of tools that would be required for the output desired. By segregating the repairs under various headings and into unit operations—either by an arbitrary selection based on a knowledge of the subject or by records obtainable at any shop operating under similar conditions—accurate information on the size and type of tools that will be required, as well as the number of each type can be made available. If tools of greater or less capacity are desired, the data can easily be pro-rated to give correct results.

The study presented was made in the Fitchburg shop of the Boston & Maine which at the time—1912—was working under a complete piece work system and at an efficiency probably as good as the average railway shop of similar size. This shop furnishes material for repairs made at the shop as well as considerable material which is shipped to outside points. Due to the preponderance of wooden cars at that time the study deals with wood working machines, but it may also be applied to metal working machines.

The method employed in determining the machine tool time as shown in the tables, was on the basis of the actual piece work prices and in the number of pieces and operation. The latter was taken at the average of conditions and schedules, covering six months' operation, checked by a careful analysis of three years' output. The time was then determined in the following manner:

Average time = Piece work price × Number pieces per month ÷ Average hourly rate.

In many cases the piece work price in the schedule covered the complete operation, which included many different tool operations. In such cases the price was segregated into the component machine movements participating in and forming a part of the completed portion, aggregate or lump sum rate, on a percentage basis, the proper percentage being determined by observation and time study tests.

The data given in Tables I-V shows the tools required in a car repair shop for general repairs to 70 passenger and 714 freight cars per month, and the time required for each operation.

Table I represents material operations where the repairs were made and the material applied directly at the shop, in the nature of heavy repairs. The names of the different tools and number of each kind are given at the head of the columns while the articles or pieces shaped and machined are given in the first column at the left. The time required for each tool operation, determined on the basis described, is then given in the columns under each tool heading. In some classes of work operations on but one

* EDITORS' NOTE.—This study, published in the October, 1912, issue of the American Engineer, was made by L. R. Pomeroy, at the Fitchburg shops, of the Boston & Maine, at a time when piece work was extensively used and it was possible to readily find the average time required for each individual operation. These tables form an excellent basis for making such an analysis with respect to more recent developments in machine tools and shop methods.

TABLE I—DETAILED DISTRIBUTION OF WORK ON A TIME BASIS.

ITEM AND QUANTITY.	15" Rip Saw.	24" Rip Saw.	22" Rip Saw.	Self-feed Rip Saw.	Combination Rip and C. O. Saw.	Edging Saw.	Swng. C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Tenoner and Gainer.	Shaper.	Outside Moulder.	Inside Moulder.	Gray & Wood Planer.	3-Spindle Vertical Borer.	1-Spindle Horizontal Borer.	Vertical H. C. Mortiser.	Horizontal H. C. Mortiser.	Rotary Bed Planer.	Single Surfacer.	Sash Tenoner.	Panel Machine.	Sash Mortiser.	Berlin 4-Side Timber Planer.
Number of tools	1	1	1		1	2	2	2	3	2	4	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Arms, canopy passenger.....25			1.33		1.08		0.04		2.63	1.18		2.00									1.00				
Arms, canopy, caboose.....12			1.03		1.03		0.10			0.40	0.60										0.44				
Canopy arch finish.....30			1.00				1.00			1.00		2.50									1.08				
Bars, pulp cars.....10							0.15																		
Battens.....15 sets and 575 pcs.			12.34				5.59		0.62	8.10		1.50	0.53			0.33	0.71				6.30				
Belt rail.....600′			7.00							4.00			1.00								2.40				
Beads—																									
Sash .....2,500′																									
Door .....600′			6.24		6.24					1.03			0.33								7.60				
Screens .....2,500′																									
W. box (pcs.).....170			1.31				0.78			1.56		1.20				2.60					1.86				
Brake beams 10			0.25					0.17							0.33	0.17					0.67				
Boxes, emergency 24			4.92		6.45		1.53			1.02		1.38									0.67				
Boxes, equipment, etc. 108			6.13		8.15		5.45			7.11	3.54	3.10				0.52					3.30				
Blocks, various 2,716			59.86						0.71	1.35	0.35					6.00	0.10			58.56	4.20				
Boards—																									
Roof .....7½ M′																									
Lining .....35 M′																									
Floor .....15 M′																									
Running .....10 M′				28.30		0.54	57.63			5.70		5.20		0.17				1.82			4.70				34.20
Letter .....500′																									
Finish .....50 M′																									
Miscellaneous .....110′																									
Body bolsters 65								3.34			7.00				7.07	12.65		8.75							
Bracing, passenger and baggage..65				1.23			1.33			0.84						0.07									0.78
Bracing, caboose and freight.....50				0.83			1.66																		1.20
Bumper beams 285		0.90						8.50								12.60		1.20			12.00				
Bars, horse cars 7		0.70				0.28	0.45					0.13								0.20	0.02				
Bridging sill 200		2.00					3.33				6.67									2.00					
Carlines 178							0.64		12.46	3.57	8.18	6.82			1.67	0.09	3.79	0.21			6.90				
Cases, drawers, etc., mail car.....28			4.44		21.71				0.15	5.62		2.93					1.66				4.20	4.03		4.48	
Closets, baggage and caboose car..5			0.16		0.97		0.49			0.39		0.25									0.09	0.12		0.12	
Casing edg., pass. and caboose....55			1.90		2.89		1.00			1.43		1.84					1.83				1.85				
Cleats 15			0.10		0.12		0.01			0.13											0.12				
Door frames, sash, battens, rails.140			17.80		24.64		10.65			22.93		7.54	1.00			1.52	0.03			1.08	16.00	23.67		24.55	0.96
Desks, drawers, caboose.....13			1.17		4.71		0.82			2.40		0.75									1.39	0.75		0.75	
Dowels (dowel mch. 6.23).....1,500			3.12																		2.76				
Finish, P. M. B. & H.			2.32			1.55	2.26		1.60	1.82		1.43		1.86							3.00				
Frames, door 20			2.40		2.39		2.15		0.53	3.15	3.37	0.86		0.03			1.33			1.00	0.70			2.94	
Filling .....2,800′																				7.47					
Furring 75			0.80				0.53		2.77											1.40					
Guards, dust 250			1.06		1.75		0.68			1.66											0.91				
Gates, horse cars.....2			1.08		2.59		1.50		1.13	1.50	0.67	1.83					0.84				1.57				0.46
Girths—																									
Freight 75																									
Platform 25	1.01							0.87	2.76	0.40	2.01							0.58	0.44						
Trans. 20																									
Hopper, cov. lids, etc.....4			4.18					1.67		0.96		0.87					0.25				0.89				
Headers, baggage door.....4			2.87					1.73	1.13	1.05							1.43				0.52			2.02	
Ladders 300			2.50					5.00								10.00				7.50					
Lintels 360			0.61		1.04		0.43			0.94		0.77					1.01				0.56				
Moulding .....7,120′			7.48			4.10				3.21		3.20	4.80	8.47							3.00				
Moulding, pcs. 210			0.15				4.84		4.63	3.89		9.65									2.90				
Moulding, from stock.....3,500′			8.00		8.00	7.00															11.70				
Panels, monitor and sides.....435			3.86		10.35		6.51			5.52		0.15					0.13				5.10				
Panels, canopy 15																									
Partitions 3			2.80		11.13		5.83		3.95	3.90		6.08					1.33				4.60	3.24		1.82	
Pilasters 40			1.85		2.35		0.49			0.66	0.04	0.17					0.08				0.40				
Plates—																									
Freight 110																									
Passenger 10																									
Caboose 4			0.17					5.61	12.92	0.37	22.40	0.17			13.80	18.80		29.00			0.30				6.30
Splice 107																									
Posts—																									
Passenger, C. and D.....50																									
Caboose 2			39.49				9.74		1.88	1.41	13.12			1.85	0.27	9.10		0.61	2.49	26.17	2.44	3.13			1.50
Freight, C. & D.....455																									
Purlines 25																									

(*Continued on Page 1155.*)

TABLE I (CONTINUED).

ITEM AND QUANTITY.	18" Rip Saw.	24" Rip Saw.	22" Rip Saw.	Self-feed Rip Saw.	Combination Rip and C. O. Saw.	Edging Saw.	Swng. C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Tenoner and Gainer.	Shaper.	Outside Moulder.	Inside Moulder.	Gray & Wood Planer.	3 Spindle Vertical Borer.	1 Spindle Horizontal Borer.	Vertical H. C. Mortiser.	Horizontal H. C. Mortiser.	Rotary Bed Planer.	Single Surfacer.	Sash Tenoner.	Panel Machine.	Sash Mortiser.	Berlin 4-Side Timber Planer.
Number of tools.....	2	1	1		1	2	2	2	3	2	4	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Platform arms 75	.....	.....	.....	.....	.....	.....	.....	.....	6.25	.....	.....	.....	.....	10.00	10.00	3.90	.....	.....	.....	.....	.....	.....	.....	.....	1.50
Platform truss beam.....15																									
Platform T. B. blocks.....15																									
Platform furring blocks.....30																									
Platform B. S. blocks.....15	.....	.....	.....	.....	.....	.....	.....	2.56	1.00	5.60	2.56	6.50	.....	.....	.....	3.86	.....	2.00	.....	.....	5.25	.....	.....	.....	2.00
Platform cross blocks.....15																									
Platform C. I. blocks.....15																									
Platform cover blocks.....60																									
Planks .....25,000'	.....	.....	.....	.....	.....	.....	3.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18.85
Planks, floor, side, splices 425	.....	.....	.....	3.00	.....	.....	11.83	.....	1.50	.....	.....	.....	.....	.....	.....	6.60	.....	.....	.....	.....	5.00	.....	.....	.....	.....
Rafters 41	.....	.....	.....	1.16	.....	.....	1.66	.....	3.51	1.36	.....	0.32	.....	.....	.....	.....	.....	.....	.....	.....	2.26	.....	.....	.....	.....
Refrigerator sinks, caboose.....2	.....	.....	0.42	.....	1.62	.....	0.71	.....	.....	0.99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.61	1.00	.....	0.75	.....
Racks, milk cars.....24	.....	.....	1.20	.....	.....	3.60	1.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.40	.....	.....	.....	.....
Sash—																									
Sides, ends 45																									
Monitor 200	.....	.....	4.35	.....	5.51	.....	14.22	.....	.....	6.75	0.17	10.76	5.22	.....	.....	.....	1.00	.....	.....	.....	6.40	12.18	.....	14.32	.....
Caboose 25																									
Sheathing, P. B. M.....35,800'	.....	.....	31.70	.....	.....	23.33	17.66	.....	.....	.....	.....	.....	.....	46.66	.....	.....	.....	.....	.....	.....	19.20	.....	.....	.....	.....
Shields, door, baggage car stove...8	.....	.....	1.13	.....	1.70	.....	0.58	.....	.....	0.60	.....	0.60	.....	.....	.....	.....	0.50	.....	.....	.....	0.93	2.64	.....	1.30	.....
Shelving, baggage car.....12	.....	.....	0.68	.....	1.30	.....	0.71	.....	.....	0.94	.....	0.30	.....	.....	.....	.....	.....	.....	.....	.....	0.96	.....	.....	.....	.....
Sills—																									
Side 324																									
End 373																									
Interior 12																									
Draft 35	.....	.....	.....	8.06	.....	.....	....	73.26	.....	8.06	109.27	.....	.....	.....	61.65	200.00	.....	131.00	.....	.....	.....	.....	.....	.....	63.50
Splices 410																									
Sub 20																									
Buffer 99																									
Stakes 160	.....	.....	.....	3.00	.....	.....	.....	2.67	.....	.....	.....	.....	.....	.....	.....	3.45	.....	.....	.....	5.18	.....	.....	.....	.....	.....
Step—																									
Treads 350																									
Risers 50																									
Sides 33	.....	.....	3.36	.....	7.56	.....	5.10	.....	1.91	9.91	.....	2.92	.....	.....	.....	3.45	4.62	.....	.....	0.75	5.00	.....	4.13	.....	.....
Brake 90																									
Stools, window 220	.....	.....	0.71	.....	0.71	.....	0.25	.....	.....	0.93	.....	0.11	.....	1.33	.....	.....	0.08	.....	.....	.....	0.61	0.17	.....	.....	.....
Steps: door, 160, dft. tumbl..150..250	.....	.....	1.75	.....	0.58	.....	2.58	.....	1.25	0.34	.....	0.66	.....	.....	.....	6.50	.....	.....	.....	4.10	0.38	.....	.....	.....	.....
Studding—																									
Passenger B. H. C.....70																									
Monitor 40	.....	.....	.....	12.50	.....	.....	5.83	.....	.....	2.35	23.16	.....	.....	.....	.....	0.11	.....	.....	.....	.....	.....	0.67	.....	.....	11.90
Caboose 50																									
Freight car 500																									
Spacing strips, roof. 2,800	.....	.....	2.33	.....	2.33	.....	1.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.80
Seat frames 32	.....	.....	1.20	.....	1.20	.....	0.80	.....	1.60	1.60	2.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.80	2.40	.....	2.40	.....
Saddles, thresh.....200', 664 pcs.	.....	.....	3.30	.....	2.39	.....	161.59	.....	128.25	3.79	1.19	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.92	1.19	.....	1.19	.....
Seat ends, mahogany.....10	.....	.....	0.68	.....	1.05	.....	0.37	.....	.....	1.34	.....	0.94	.....	.....	.....	.....	2.00	.....	.....	.....	1.00	.....	.....	.....	.....
Sheathing, roof, 1800 780	.....	.....	13.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.10	.....	.....	.....	1.50
Roof pole space, strips.....215	.....	.....	.....	1.71	.....	.....	1.57	.....	0.96	1.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ties 80	.....	.....	.....	.....	.....	.....	.....	2.65	.....	.....	10.03	.....	.....	.....	.....	5.30	10.00	.....	.....	.....	.....	.....	.....	.....	.....
Timbers, dft., stop...620', 1,060 pcs.	.....	.....	1.33	.....	.....	.....	.....	14.61	23.03	.....	68.05	.....	.....	.....	.....	55.60	62.00	.....	1.20	44.01	11.30	.....	.....	.....	.....
Truck—																									
Wh. pce. 14																									
Transom 52																									
S. beam 36																									
Bolster 4																									
Sp. plank 4	.....	.....	1.08	.....	.....	.....	.....	10.40	4.06	.....	18.65	.....	.....	.....	19.75	43.60	.....	11.60	.....	0.26	.....	.....	.....	.....	1.53
C. pin block 4																									
End sill 14																									
Freight bolster 47																									
Freight transom 10																									
Freight sp. plank.....7																									
Shelving, milk cars.....45	.....	.....	7.27	.....	.....	.....	2.07	.....	.....	3.12	.....	.....	.....	.....	.....	.....	3.10	.....	.....	5.16	.....	.....	.....	.....	.....
Total	1.01	11.70	279.97	60.09	145.84	40.40	373.98	153.70	223.83	148.07	303.08	84.93	33.94	60.37	175.77	424.50	27.12	187.99	46.94	137.13	174.39	55.19	4.13	56.64	151.98

tool is required while in others many different tools are required for completion of the work.

Table II gives similar information in connection with material furnished to outside repair points for light or running repairs, such as are made in terminal or junction yards. In connection with this table it should be mentioned that the number of cars in the total credited to the shop for this outside operation is based on general repairs determined by an average time per car, obtained from the shop operation for the heavy home repairs. As a matter of fact, this material for outside repair or inspection points represents light repairs on 430 cars, while the equivalent number of cars equated on a heavy repair basis represents only 80 cars.

Table III gives the time for sharpening, changing, and adjusting knives and rolls on the various tools, this being a necessary part of the operation which must be included in the total time but is not included in Table I or II.

Table IV gives the machine tool time spent on various operations on material other than for car repairs furnished on order for various departments of the road.

TABLE II—CAR MATERIAL FURNISHED OUTSIDE POINTS.

ITEM AND QUANTITY.	Rip Saw, 18", 22", 24".	Self-feed Rip Saw.	Comb'n Rip and C. O. Saw.	Edging Saw.	S'w C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Single Surfacer.	Shaper.	3-S. V. Borer.	1-S. H. Borer.	Rotary Bed Planer.	4-S. Timber Planer.	Matcher.	Lathe.	Tongue and Groove.	Inside Moulder.	G. & W. Planer.	Jig Saw.	Vert. H. C. Mortiser.	Panel Machine.
Battens, standard...250	6.25	....	2.98	.....	.....	.....	.....	2.08	3.50	4.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Beads, glass.....1,200	3.60	.....	0.17	0.40	.....	.....	.....	.....	3.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brake beams 10	.....	.....	.....	.....	.....	.....	0.50	.....	.....	.....	.....	0.50	4.17	.....	.....	.....	.....	.....	.....	.....	.....	.....
Blocks, truss.....250	2.08	....	.....	.....	.....	2.09	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boards—																						
Lining .....3,500'																						
Finish .....4,000'																						
Running .....15,000'	.....	5.67	....	....	11.66	.....	.....	.	.....	.....	.....	....	3.33	2.90	13.33	.....	.....	.....	.....	.....	....	....
Floor .....2,500'																						
Pratt door.....50'																						
Bolsters 290	6.83	....	.....	.....	.....	7.99	.....	.....	.....	.....	8.33	.....	.....	.....	.....	.....	.....	.....	23.00	.....	.....	.....
Dust guards 200	0.67	....	0.66	.....	0.50	.....	....	1.33	0.84	.....	.....	0.33	.....	.....	.....	0.50	.....	.....	.....	1.00	.....	.....
Ladder sides 250	2.08	....	.....	.....	.....	0.50	.....	.....	.....	.....	.....	4.28	6.25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Plates and planks..275	2.50	.....	.....	.....	.....	7.92	.....	.....	.....	.....	1.58	....	2.50	3.00	.....	.....	.....	.....	3.71	.....	.....	.....
Sills, various 500	.....	.....	.....	2.50	.....	11.64	2.50	1.66	.....	.....	18.80	....	.....	6.50	.....	.....	5.00	.....	24.16	.....	13.20	.....
Sheathing, pass..5,000'	6.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.00	.....	.....	.....	.....	8.30	.....	.....	.....	.....
1,600'	...	....	.....	3.73	3.67	.....	.....	.....	.....	.....	0.53	.....	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stakes 250	.....	.....	.....	.....	.....	4.16	1.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Step treads 250	3.42	....	1.91	0.42	....	....	.....	2.33	1.82	2.07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Step brake.....30																						
Step pass. side.....25	.....	....	.....	.....	.....	.....	1.25	0.83	0.70	1.86	.....	.....	.....	.....	.....	.....	.....	.....	2.66	.....	3.70	.....
Stops, frt. car door.150	1.25	.....	1.25	.....	.....	.....	0.41	.....	.....	.....	1.05	.....	3.00	.....	.....	.....	.....	.....	.....	.....	.....	3.33
Studding, frt. car..100	.....	....	.....	...	0.49	.....	6.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Saddles, frt. & cab. c.675	.....	.....	.....	.....	1.70	.....	6.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tie & dft. timbers..150	.....	.....	.....	.....	.....	12.50	1.25	.....	.....	.....	3.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Truck sills 20	.....	.....	.....	.....	.....	1.27	0.83	.....	.....	.....	3.35	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.10	.....
Total	35.38	5.67	6.97	7.05	18.02	48.07	21.21	8.23	10.26	8.10	37.29	9.28	40.91	12.40	13.33	0.50	5.00	8.30	53.53	1.00	21.00	3.33

TABLE III—TIME CHARGED MACHINES FOR CHANGING, ADJUSTING, SHARPENING, ETC.

	Times per Mo.	Shaper.	Sash Tenoner.	Sash Mortiser.	Gainer and Tenoner.	Saws.	Dowel Machine.	4-Side Planer.	Matcher.	Inside Moulder.	Rotary Bed Planer.	Single Surfacer.	Buzz Planer.
For chamfer, bead and round	150	25.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For sash	20	13.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For tongue and groove	5	1.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For O. G. ¼ and ½ round	100	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For square work, small head	50	5.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For square work, large head	100	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For crown moulding	20	13.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set tenoner for sash and sharpen	25	.....	20.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set tenoner plane	50	.....	13.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set for gaining	25	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set gainer plane	25	.....	.....	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....
Set gainer with form	20	.....	.....	.....	6.65	.....	.....	.....	.....	.....	.....	.....	.....
Set for grooving	100	.....	.....	.....	.....	16.65	.....	.....	.....	.....	.....	.....	.....
Set for marquetry	10	.....	.....	.....	.....	6.65	.....	.....	.....	.....	.....	.....	.....
Set when rolls changed	5	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....
Set when rolls not changed	15	.....	.....	.....	.....	.....	5.00	.....	.....	.....	.....	.....	.....
Removing knives and sharpening	35	.....	.....	.....	.....	.....	5.83	.....	.....	.....	.....	.....	.....
Set for square edge from dimensions	100	.....	.....	.....	.....	.....	.....	16.65	.....	.....	.....	.....	.....
From T. and G. to dimension	20	.....	.....	.....	.....	.....	.....	10.	.....	.....	.....	.....	.....
Set for Murphy roof strips	1	.....	.....	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....
Set for ash corners	2	.....	.....	.....	.....	.....	.....	.....	.....	2.31	.....	.....	.....
Set and sharpen	25	.....	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....	.....
Change knives and spurs, large G	2	.....	.....	.....	2.31	.....	.....	.....	.....	.....	.....	.....	.....
Change knives and spurs, sill G	2	.....	.....	.....	2.31	.....	.....	.....	.....	.....	.....	.....	.....
Changing knives (3)	5	2.5*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changing knives (3)	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changing knives (2)	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.50	.....	.....
Changing knives	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.50	.....
Change and sharpen sidehead	2	.....	.....	.....	.....	.....	.....	.....	2.66	.....	.....	.....	.....
Change and sharpen sidehead	3	.....	.....	.....	.....	.....	.....	.....	1.00	.....	.....	.....	.....
Change knives (2)	5	.....	.....	.....	.....	.....	.....	.....	.....	2.00	.....	.....	.....
Set knives for fluted roofing	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.83
Set for window belt strips	10	.....	.....	.....	.....	.....	.....	.....	0.40	.....	.....	.....	.....
Set for sideheads	3	.....	.....	.....	.....	.....	.....	.....	.....	8.32	.....	.....	.....
Set top and bottom cylinders	8	.....	.....	.....	.....	.....	.....	1.86	.....	.....	.....	.....	.....
Sharpen with file and stone, sideheads	8	.....	.....	.....	.....	.....	.....	5.83	.....	.....	.....	.....	.....
Sharpen with file and stone, top cylinder	8	.....	.....	.....	.....	.....	.....	2.13	.....	.....	.....	.....	.....
Sharpen with file and stone, bottom cylinder	8	.....	.....	.....	.....	.....	.....	2.64	.....	.....	.....	.....	.....
Total	...	90.99	38.25	4.15	15.42	23.30	13.33	25.10	6.56	12.63	2.50	2.50	5.83
Sharpen and set for T. & G. dimensioner	...	.....	...	....	....	.....	...	16.65	.....	.....	.....	.....	.....
Sharpen and set for G. & W. planer	...	2.5	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....

* G. & W. planer.

Table V, columns 1 to 4, gives a summary of all the operations shown in Tables I to IV inclusive; these are brought together as a grand total in column 5. Column 6 gives the load factor which was determined as follows:

Load Factor = Total machine time ÷ (Number of tools × 26 days of 9 hours).

Columns 5 and 6 are equated to an equivalent number of

freight cars on the basis of 5 hours per car, which was found to be the average obtained from segregating the time consumed on freight cars, as given in Table I and divided by the number of freight cars included in that table.

This study was made some years ago and for that reason some of the figures given are not entirely accurate for present day operations but the principles involved still obtain. A study of tables of this character prepared for any shop now in operation, will readily show which tools are being used to full capacity and which are lying idle part of the time. With such information available, it will often be possible to rearrange the work so that a single tool can be made to do the duty of two or three, or on the other hand it will show just what new equipment will be necessary to increase the capacity of the shop.

The ideal load factor is very greatly influenced by certain machines and operations that are, from the nature of t work, intermittent and infrequent. A particular type of machine may be required if only 50 cars are repaired and yet the one machine may be capable of handling work of the same character for 500 or more cars, just as in a locomotive shop, a driving wheel lathe that could handle the tire turning for 500 locomotives per year would be required in a smaller shop handling only 50 locomotives—and therefore remain idle a large part of the time. Consequently considerable judgment and experience is necessary in pro-rating the results of such an analysis as the foregoing and to apply it to the requirements of shops of varying capacities.

Tools for Steel Car Repair Work

The large number of steel cars now in service requires a large amount of heavy steel car repair work and the problem of providing for this work has received consideration by many railroads. A study of the requirements of the heavy car repair shop and the tools adapted to the special conditions encountered in the fabrication of steel car repair parts is necessary in order to determine the advisability of the smaller railroads equipping a special shop for such work or to make light repairs in the railroad shop and to send cars needing heavy repairs to the shops of car builders and other companies operating car repair plants. In every case the subject requires careful study.

TABLE V—SUMMARY.

Column Number.....	1	2	3	4	5	6
No. of Tools.	General repairs.	Material furnished outside points.	Material other than car repairs.	Time changing, adjusting, and sharpening tools.	Total machine time.	*Load factor.
4 Rip saws { 2—18" 1—22" 1—24" }	292.68	35.38	67.97	23.30	419.33	0.45
1 Self-feed rip saw	60.09	5.67	.....	.....	65.76	0.28
1 Comb. Rip & C. O. saw	145.84	6.97	10.32	.....	163.13	0.70
2 Edging saws	40.40	7.05	13.34	.....	60.79	0.13
2 Swing C. O. saws	373.98	18.02	21.49	.....	413.49	0.88
2 R'y C. O. saws	153.70	48.07	142.51	.....	344.28	0.74
3 36" band saws	223.83	21.21	3.63	.....	248.67	0.36
2 Buzz planers, 16"—12"	148.07	8.23	28.47	5.83	190.60	0.41
Gainers and tenoners—						
1 Horz. car gainer						
1 Comb. G. & T., double	303.08	5.00	5.33	15.42	328.83	0.35
1 End tenoner						
1 Small overhead gainer.						
1 Double head shaper	84.93	8.10	6.46	90.99	190.48	0.81
1 Inside moulder, 5"	60.37	8.30	9.15	12.63	90.45	0.39
1 Outside moulder, 8"	33.94	.....	.....	.....	33.94	0.15
1 Gray & Woods planer, 36"	175.77	53.53	0.72	2.50	232.52	1.00
2 3-spindle vertical borers	424.50	37.29	.....	.....	461.79	0.98
1 1-spindle horizontal borer	27.12	9.28	19.63	.....	56.03	0.24
1 Horizontal H. C. mortiser	46.94	.....	.....	.....	46.94	0.20
1 Vertical H. C. mortiser	187.99	21.00	.....	.....	208.99	0.90
1 Rotary bed planer	137.13	40.91	17.90	2.50	198.44	0.85
1 Single surfacer, 24"	174.39	10.26	33.06	2.50	220.21	0.94
1 Sash and blind tenoner	55.19	.....	.....	38.25	93.44	0.40
1 Panel machine	4.13	3.33	.....	.....	7.46	0.03
1 Sash and door mortiser	56 64	.....	.....	4.15	60.79	0.26
1 Berlin 4-side tim. planer	151.98	12.40	.....	58.40	222.78	0.95
1 Jig saw	7.16	1.00	.....	.....	8.16	0.03
1 Dowel machine	6.23	.....	10.80	13.33	30.36	0.13
1 Lathe	0.93	.....	20.52	.....	21.45	0.09
1 Daniels planer, 24"	2.40	.....	.....	.....	2.40	0.01
1 Saw mill (resaw)	11.83	.....	.....	.....	11.83	0.05
1 Matcher	54.17	13.33	.....	6.56	74.06	0.31
Total machine hours...	3,445.41	374.33	411.30	276.36	4,507.40	0.46 Avg.
Equivalent cars—						
Freight	550	80	84	.....	714	.....
Passenger	70	.....	.....	.....	70	.....

* Load factor = Total machine hours (Col. 5). / Number tools × 26 days × 9 hours.

Approximate hours per month..... Passenger car ..... 5.84; Freight car 6.00

TABLE IV—MATERIAL OTHER THAN CAR REPAIRS

ITEM AND QUANTITY.	18", 22", 24" Rip Saw.	Self-feed Rip Saw.	Comb. Rip and C. O. Saw.	Edging Saw.	Sw. C. O. Saw.	Ry. C. O. Saw.	Band Saw.	Buzz Planer.	Single Surfacer.	Shaper.	1-S. H. Borer.	Rotary Bed Planer.	Dowel Machine.	Lathe.	G. & W. Planer.	Gainer and Tenoner.	Inside Moulder.
Closet stand 1	1.28	.....	.....	.....	1.70	.....	.....	0.21	0.18	0.09	.....	.....	.....	.....	.....	.....	.....
Bridges, gangplanks for freight houses 70	4.80	.....	.....	8.40	8.60	.....	.....	.....	.....	.....	4.80	11.40	.....	.....	.....	.....	.....
Blocking carriage 50	2.50	.....	.....	.....	.....	0.50	.....	.....	.....	.....	1.50	0.50	.....	.....	.....	.....	.....
Blocking, wreck trains.....4,000'	....	.....	.....	.....	.....	108.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barrel heads 25	0.08	.....	.....	.....	0.05	.....	0.20	.....	.....	.....	.....	0.17	.....	.....	.....	.....	.....
Boards, playing card.....36	3.00	.....	3.00	.....	.....	.....	.....	.....	.....	0.60	4.80	.....	.....	.....	.....	.....	.....
Carpenters' tool boxes.....36	3.00	.....	2.40	.....	.....	.....	0.90	2.10	1.80	1.80	.....	.....	.....	.....	.....	.....	.....
Desks stand. office.....½	0.83	.....	0.16	.....	.....	.....	.....	0.35	0.35	0.08	.....	.....	.....	.....	.....	.....	.....
Folder racks (pass. stations)....3	0.24	.....	.....	.....	1.41	0.24	.....	0.17	1.00	0.30	.....	.....	.....	.....	.....	.....	.....
Handles, brush and lant. hook.197	8.96	.....	4.76	.....	.....	.....	.....	.....	2.40	.....	.....	.....	.....	.....	.....	.....	.....
Horses, carpenter 48	7.32	.....	.....	.....	.....	14.72	.....	3.33	2.25	.....	.....	.....	.....	.....	.....	5.33	.....
Gages, car insp.....2	1.65	.....	.....	.....	2.15	0.90	.....	2.20	2.30	.....	1.35	.....	.....	.....	.....	.....	.....
Keg heads 36	0.14	.....	.....	.....	0.14	.....	0.70	.....	.....	.....	.....	0.42	.....	.....	.....	.....	.....
Ladders—																	
8' 36																	
8'—15' 10																	
15'—20' 5	1.11	.....	.....	.....	.....	2.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20'—30' 3																	
Step 12	6.55	.....	.....	.....	.....	3.70	.....	1.80	1.50	0.40	0.72	.....	1.50	0.53	.....	.....	.....
Push car sills.....40	0.53	.....	.....	0.27	.....	0.26	.....	.....	.....	.....	0.68	0.93	.....	.....	.....	.....	.....
Pail bottoms for canvas colp. pails 24	.....	.....	.....	.....	0.11	.....	0.33	0.34	0.28	0.56	.....	.....	.....	.....	.....	.....	.....
Pickets, fence 50	0.14	.....	.....	.....	0.14	.....	.....	.....	.....	.....	.....	0.67	.....	.....	.....	.....	.....
Rollers, freight house.....125'	.....	.....	.....	.....	.....	4.17	.....	1.57	.....	.....	.....	1.56	.....	10.40	.....	.....	.....
Signs, cinder 25	0.35	.....	.....	.....	0.17	.....	.....	0.52	.....	0.83	0.18	0.51	.....	.....	.....	.....	.....
Stretchers, cab. and bag. car...25	4.50	.....	.....	.....	.....	6.00	.....	3.00	2.50	.....	3.00	.....	3.00	6.50	.....	.....	.....
Window lifts 5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.14	.....	.....	.....	.....	.....
Wheel clubs 3	.....	.....	.....	.....	.....	0.18	0.90	.....	.....	.....	.....	.....	.....	.....	0.72	.....	.....
Wheel levers 12	0.40	.....	.....	.....	.....	0.40	0.60	.....	.....	0.80	.....	1.60	.....	.....	.....	.....	.....
Wedges 700	.....	.....	.....	4.67	.....	0.85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flagsticks 1,660	20.59	.....	.....	.....	7.02	.....	.....	12.88	18.50	1.00	2.60	.....	6.30	3.09	.....	.....	9.15
Totals	69.97	.....	10.32	13.34	21.49	142.51	3.63	28.47	33.06	6.46	19.63	17.90	10.80	20.52	0.72	5.33	9.15

Machine tools used in steel car repair shops are, in many respects, similar to those used for boiler shop work, but special equipment has been developed for this class of work and these tools are available when required.

The types of tools and the number required for a desired output may be determined by means of a time study conducted as described for wood working tools.

PASSENGER CAR SCHEDULE CONSTANTS

(WORKING DAY ON WHICH OPERATIONS ARE DUE)

No. of Days in Shop	8	10	12	14	15	17	19	22	24	17	19	22	22	24
Paint Work										Burn	Burn	Burn	SB	SB
Schedule / Operation	A	C	D	E	F	G	H	I	J	K	L	M	N	O
PAINTERS														
Wash Outside	•1	•1	•1	•2	•2	•2	•2	•3	•3					
Wash Inside	•1	•1	•1	•2	•2	•2	•2	•4	•4	•2	•2	•3	•6	•6
Sandblast Start													•3	•3
Sandblast Finish (By Noon)													5	5
Burn Start										•2	•2	•3		
Burn Finish										3	4	5		
Lead Color													8	8
Sand Start										4	5	6	11	11
Sand Finish										4	5	6	12	12
Prime No. 1										5	6	7	6	6
Putty Start										6	7	8	9	9
Putty Finish										6	7	8	10	10
Sand Putty											8	9		
Prime No. 2										7	9	10		
Prepare Start	•3	•4	•5	•5	•5	•6	•6	•8	•9					
Prepare Finish	3	4	6	7	7	8	9	12	13					
Color No. 1										9	11	12	13	13
Color No. 2		5	7	8	8	9	10	13	14	10	12	13	14	14
Color Varnish	4	6	8	9	9	10	11	14	15	11	13	14	15	15
Ornament	5	7	9	10	10	11	12	15	16	12	14	15	16	16
Varnish No. 1	6	8	10	11	11	12	13	16	17	13	15	16	17	17
Varnish No. 2	•7A	•9A	•11A	•12	•13	•14	•15	•18	•19	•15	•17	•18	•19	•19
Paint Bottom				12	11	14	16	19	21	13	15	19	19	21
Paint Roof				13	14	16	18	21	23	16	18	21	21	23
Inside Start				•5	•5	•6	•6	•9	•9	•6	•6	•8	•10	•11
Inside Finish				•10	•11	•13	•15	•18	•20	•13	•15	•18	•18	•20
Touch Up	•3	•4	•5	13A	14A	16A	18A	21A	23A	16A	18A	21A	21A	23A
Clean (By Noon)	8	10	12	14	15	17	19	22	24	17	19	22	22	24
CARPENTERS														
Strip				1	1	1	1	1	1	1	1	1	1	1
Start Body	•2	•2	•2	•3	•3	•3	•3	•5	•5	•3	•3	•4	•7	•7
Start Platform	•2	•2	•2	•3	•3	•3	•3	•5	•5	•3	•3	•4	•7	•7
Finish Body	•2	•3	•4	•5	•5	•5	•6	•8	•8	•5	•6	•7	•10	•10
Finish Platform	•3	•4	•5	•7	•7	•7	•8	•10	•10	•7	•8	•9	•12	•12
CABINET MAKERS														
Strip Start				•1	•1	•1	•1	•1	•1	•1	•1	•1	•1	•1
Strip Finish				•1	•1	•1	•1	•2	•2	•1	•1	•2	•2	•2
Work Start	•2	•2	•2	•3	•2	•3	•3	•5	•5	•3	•3	•4	•7	•7
Work Finish	•2	•3	•4	•4	•4	•5	•5	•8	•8	•5	•5	•7	•10	•10
Trim Start				11	12	14	16	19	21	14	16	19	19	21
Trim Finish (By Noon)				13	14	16	18	21	23	16	18	21	21	23
TINSMITHS														
Roof Start	•2	•2	•2	•3	•3	•3	•3	•5	•5	•3	•3	•4	•7	•7
Roof Finish	•5	•7	•9	•10	•10	•10	•10	•12	•12	•10	•10	•11	•14	•14
Trim Finish (By Noon)	7	9	11	13	14	16	18	21	23	16	18	21	21	23
STEAMFITTERS														
Pipes Finish, Cover and Test	•5	•7	•9	•10	•10	•13	•16	•19	•21	•13	•15	•19	•18	•21
TRUCKS														
Off	•1	•1	•1	•1	•1	•1	•1	•1	•1	•1	•1	•1	•5A	•5A
On and Level	•7N	•9N	•11N	•13TN	•12W	•15W	•17W	•20W	•22W	•14W	•16W	•20W	•20W	•22W
AIR BRAKES														
Finish and Test	•7	•9	•11	•13	•13	•16	•18	•21	•23	•15	•17	•21	•21	•23
ELECTRICIANS														
Work Finish				•4	•4	•5	•5	•8	•8	•5	•5	•7	•10	•10
Dyn. Set Up and Elect. Board				9	11	14	16	19	21	13	15	19	19	21
Batteries O. K., Dyn. Finish Test				13	14	16	18	21	23	16	18	21	21	23
Tested By Noon				14	15	17	19	22	24	17	19	22	22	24
UPHOLSTERERS														
Stock Received				2	2	2	2	3	3	2	2	3	3	3
Roof Finish	•4	•5	•6	•7	•7	•7	•7	•9	•9	•7	•7	•9	•11	•11
Trim Finish (By Noon)	8	10	12	14	15	17	19	22	24	17	19	22	22	24
SILVERPLATERS														
Stock Received				2	2	2	2	3	3	2	2	3	3	3
Stock Finish				•10	•11	•13	•15	•18	•20	•13	•15	•18	•18	•20
MACHINISTS														
Dynamo Set Up				•9	•11	•14	•16	•19	•21	•13	•15	•19	•19	•21
Dyn. Finish Test				13	14	16	18	21	23	16	18	21	21	23

KEY TO SYMBOLS USED IN CHART. •—Guide days; these days will be marked on shop blackboards. A—Operation to be performed during afternoon period. N—Operation to be completed by noon. T—On dynamo cars trucks are to be under by noon of 10th day. Steamfitters and Bottom Painters' finishing day will be on 9th and Air Brake on 10th day.

NOTE—This chart is a summary of the passenger car schedules of January 11, 1921, and is put in this form for the convenience of the supervisors.

C. M. & St. P. Ry. Co., Milwaukee Shops. Approved: L. B. JENSEN, Shop Supt. Car Dept.

FIG. 3055—MASTER SCHEDULE FOR PASSENGER CAR REPAIR SHOP, SHOWING ESTIMATES OF TIME.

Scheduling Systems for Car Shops

THE ROUTING AND SCHEDULING OF WORK in a car repair shop has been found to aid materially in expediting the work and assuring that the various parts needed to complete the repairs will be ready at the proper time so that the equipment can be finished on a predetermined date. Where heavy repairs are to be made to a number of different types of cars the routing and scheduling of the work saves time and thus reduces the cost of repairs. For light repair work, however, where most of the parts used are made in quantities in advance and carried in stock, or where diversified heavy repairs are handled it has not proved advisable to establish the scheduling system.

The American Railway Association committee on "Car Repair Shops" has made an extensive investigation of the scheduling and routing of car repair work and offer some general recommendations for establishing the systems in railway shops. The recommendations of the committee and an outline of some of the methods followed in shops now using such a system are given in pages following.

Passenger Car Schedule

A scheduling system as applied to passenger car work is shown in Figs. 3055-3060. The forms shown indicate what work is to be done and how it is to be followed; the work on each particular car is scheduled.

When cars come into the shop they are inspected, and the work necessary to be done is laid out on a Master Schedule—Fig. 3055—indicating the number of days that it is estimated the car will be in the shop undergoing repairs. A car schedule—Fig. 3056—is placed at the head end of the track on which the car is located.

First the car strippers and the washers work on the car to be repaired and these are followed by the carpenters, the cabinet makers, the tinsmiths, and then the painters. These in turn are followed by the steamfitters and electricians, etc., as shown on the car schedule. The different crafts work separately; thus the work is carried on satisfactorily and no one craft interferes with the other.

Each supervisor who has charge of the work—forgings, or any other class of work on the car—has a schedule which he is expected to follow, and if there is time lost on any operation, the supervisor in charge of the operation receives a "Daily Delay Sheet"—Fig. 3059. Each morning these sheets are checked and any trouble usually can be corrected.

The status of the work is recorded in the following manner:

Near the top of the board an x marked in the space underneath a row of numbers—1 to 24—indicates the days a car is in the shop; the marks, 1, 1 and 2, 2, etc., in the columns under "Start" and "Finish" and on the line giving the class of work indicates the day or days on which each particular class of work was done.

The car is stripped the first day—started and finished, and is marked "1" on the board in both "Start" and "Finish" columns. On the second day the car is washed—started and finished and likewise marked "2" in the "Start" and "Finish" columns. Similarly the carpenters start on the third day and finish on the sixth; the platform work is started on the third day and finished on the eighth. In the same manner each successive step in the work is recorded on the board.

Master schedule and planning boards may be used to advantage in the office of the schedule supervisor and the foreman. Shop sheets, blackboards, or bulletins, should be used for conveying dates from master schedules to department foreman. Fig. 3056 illustrates a shop bulletin sheet which is displayed on or near the end of the car under repair. Daily delay sheets—Fig. 3059—should preferably be made from colored paper to distinguish them from other

PASSENGER CAR REPAIR SCHEDULE

CAR COACH 4161

Schedule H — Date In 3/10. — Date Out 3/31

DAYS IN SHOP

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
x	x	x																					

		Start	Finish	Note
Strip		1	1	OK 1
Wash		2	2	Out OK—In OK
Carpenters	Body	3	6	
	Plat.	3	8	
Cabt. Maker		3	5	
Tinsmith		3	10	
Painter	Out	6	15	
	In	6	15	
Steamfitter		–	16	
Electrician		–	5	
Trucks		1	17	
Air Brake		–	18	
Upholsterer		–	19	
Machinist		–	–	
Plater		–	15	
Remarks				

FIG. 3056—REPAIR SCHEDULE FOR INDIVIDUAL PASSENGER CARS.

forms. Departments recommended to be supplied separate shop and delay sheets are as follows: Erecting and paint shop, tin and pipe shop, cabinet shop, smith shop, truck shop, upholstering and plating shops and electrical department.

Separate master schedules should be prepared for coaches, mail, baggage, express, combination, dining, parlor and sleeping cars; these schedules should be further subdivided for wood or steel construction. All schedules should show exterior, interior, and paint work separately, also work in all other participating departments, such as the tin and pipe shop, electrical department, air brake shop, etc.

Any convenient combination of figures and letters may be used to designate the individual schedules. For example, the designation "1-A-2" on a repair schedule would serve to indicate a Class 1 heavy exterior repair, Class A heavy paint repair and a Class 2 medium interior repair.

Freight Car Schedule

In freight car scheduling, the A. R. A. committee recommends that only heavy repairs such as require 20 man-hours and over should be considered. Separate master

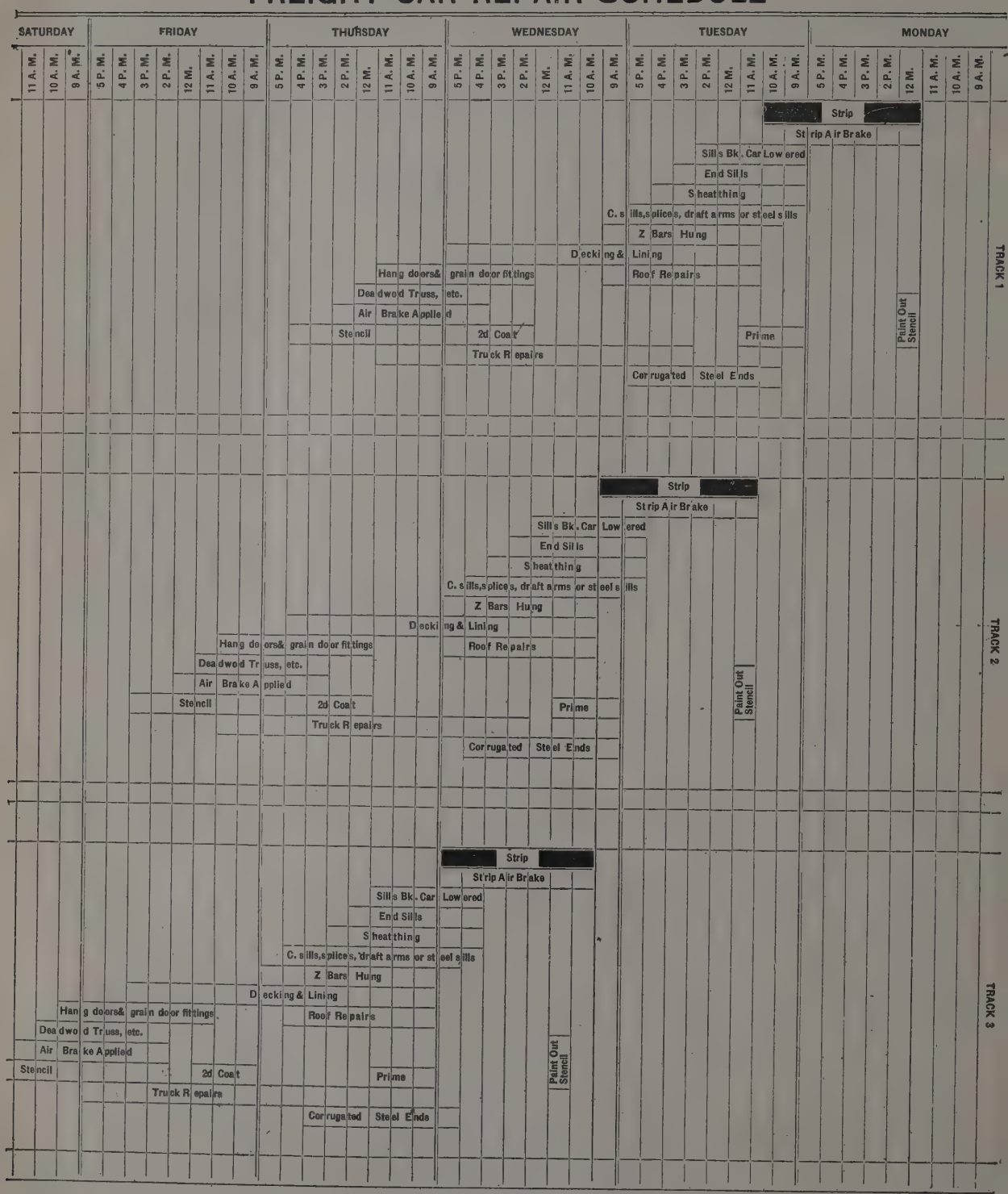


FIG. 3057—INDIVIDUAL CAR SCHEDULE FOR FREIGHT CAR REPAIR SHOP, SHOWING SEQUENCE OF OPERATIONS.

schedules should be prepared for flat, coal, box and refrigerator cars and these sub-divided for wood or steel construction. The subdivisions may be varied to some extent when cars are repaired under a group system with specialized gangs.

It is not possible to give definite rules for scheduling freight equipment as shop tracks and buildings are lacking in uniformity and many shops and tracks are at present so arranged that practices giving excellent results in one shop may not be suitable in another. In general, however, a workable system can be adapted to any shop, large or small, which turns out heavy repairs. It is generally conceded that individual cars should not be scheduled as the cost would be prohibitive even if it were thought advisable, but groups of cars of the same type and class of repairs may be scheduled successfully. Close attention should be paid to segregation of incoming cars if best results are to be obtained.

FREIGHT CAR REPAIR SCHEDULE

DATE IN SHOPS .....

TRACK No..... DATE DUE OUT.....

OPERATIONS.	TIME A. M.					TIME P. M.				
	8	9	10	11	12	1	2	3	4	5
Stripping Underframe and Air Brake										
Paint Out Old Stencil										
First Paint Commenced										
End Sills Commenced										
Side Sheathing Commenced										
Center and Side Sill Splices										
Draft Arms or Steel Sills Commenced										
Z Bars Hung Commenced										
Roof Repairs Commenced										
Corrugated Steel Ends Applied Commenced										
Decking and Lining Commenced										
First Paint Completed										
Truck Repairs Started										
End Sill Completed										
Side Sheathing Completed										
Draft Arms Applied Completed										
Corrugated Ends Completed										
Second Paint Started										
Roof Repairs Completed										
Side Doors and Grain Doors Commenced										
Dead Wood and Truss Rods Commenced										
2nd Paint Completed										
Application of Air Brake Commenced										
Application of Stencil Commenced										
Decking and Lining Completed										
Dead Wood and Truss Rods Completed										
Truck Repairs Completed										
Stencil Completed										
Track O. K. to Pull										

Fig. 3058—Repair Schedule for Individual Freight Cars.

In the method of using the schedule system as followed on one large road, the general foreman inspects the car on its arrival at the shop. The class of repairs required is discussed at that time with the car inspector and then the general foreman writes out the schedule. Each foreman and gang boss in charge of the parts of the work under the respective headings, receives a copy of a notice of the repairs necessary. This notice is also placed on the end of the car, and each foreman, as the work proceeds, keeps in mind the date when the repairs are scheduled to be completed and the car ready to leave the shop. The general foreman, carrying with him a schedule of dates showing when the car is to be completed, passes through the shop and, by consulting the order issued for the repair of the car, can see how the work is progressing. This procedure is followed each morning and no trouble is experienced in following a pre-arranged schedule. If one department is behind in their allotted work, assistance is obtained from other departments doing work of similar character and in this way congestion on any part of the work is avoided.

DAILY DELAY SHEET Feb. 24-1922

Work to Start Saturday Feb. 25th

2-25	M. & E.	1528	Med.	Sch. E	3-13	NS
2-25	Slpr.	Spokane	Hy.	Sch. I	3-28	OS
2-25	Coach	4150	Hy.	Sch. H	3-18	NS

Operations Lost Friday Feb. 24th

OLD SHOP

1838-Plat Carp. Compl. XX-No. 2½" Draw Bar Bolts.
5001-Color Varnish-X-Held up by Carp.
3738-Trucks Compl. XXX-No Oil Boxes-Truck & Level XX-Air Brake Compl.-X
3604-Plat. Carp. Compl. X-Rotted End Timber.
Yakima-Inside Wash-X-Held by Strippers

Gains

1010-Varnish #2-0

NEW SHOP

5720-Varnish #2-XXX-Varnish #1-XX-Ornament-X-Held by Carpenters
346-Body Carp.-X-Entire New Sheathing on One Side
3814-Trucks off-X-10 Cars to Raise
Zenda. Cabt. Mkrs. Strip-X-Excess Stripping-4 Cars.

Gains

3123-Body Carp. Compl.-O

Fig. 3059—Form for Recording Delays in Repair Work.

Each foreman in the respective shops, having received a schedule notice of the car which is undergoing repairs in the shop, and being notified that the part of the work to be done in the particular department is required at a certain time, is required to see that a proper supply of material is ready when the car reaches his department.

By this method it is a relatively simple operation to carry out a system of scheduling if the details are properly worked out and there is adequate supervision of the work being done. The status of the work may be ascertained each morning and the plan thus made very effective.

In one large shop incoming cars are switched to three or four parallel tracks, having regard for the type of car and nature of repairs required. Work is started on track No. 1—see "Freight Car Repair Schedule" in Fig. 0000—and as fast as each gang completes the work assigned to them they pass to track No. 2, proceeding in turn to Track No. 3. As indicated by the entries on this schedule, sixteen separate gangs of men are used at this shop and the time in hours each gang is expected to start and finish their special class of work is also indicated at the top of each column. The stripping operation is shown shaded in order to make the gang movement more easily understood.

Fig. 3057 shows graphically the information condensed on Fig. 3058. A daily delay sheet, similar to Fig. 3059, which is used for passenger cars, should also be provided.

By this method 10 or 15 cars in a group on one track are scheduled as a unit; the time allotted each gang is predetermined and stated on the schedule. This schedule, with hours, dates and duties inserted, hangs in a conspicuous place near the head of each working track where foreman and inspectors may check the progress of the work and quickly locate each gang, or each man, at any hour of the day and record it on the form shows in Fig. 3058. Under this shifting gang plan, when one gang loses time and anything repairs. This list is written up on a special form or order—Fig. 3060—which is taken up by the supply men at frequent intervals. The material routing clerk receives copies of these orders and periodically checks all departments visited by the supply men and also checks material arriving at destination in the main repair shop. Records of delays by departments and delays for which supply men are responsible are tabulated by the routing clerk and subsequently forwarded to the general foreman or a higher shop officer. The material clerk co-operates closely with the local storekeeper.

A B C RAILROAD

MATERIAL ORDER AND ROUTING SLIP

SHOP.....CAR No.....INITIALS.....TRACK No.....LOCATION.....

Quantity	DESCRIPTION OF MATERIAL	Patt. No.	No. Feet or Weight	MATERIAL Price	Amount	

Ordered—Date.....Time.....Required—Date.....Time.....

Cause of Delay

Completed in.....Dept—Date.....Time.....

Delivered to ..... " " ..... " .....

Completed in..... " " ..... " .....

Delivered to ..... " " ..... " .....

Completed in..... " " ..... " .....

Date Delivered to Car.....

.....

Charge to.....Asst. Foreman.....

FIG. 3060—ORDER FORM FOR CAR REPAIR MATERIAL.

other gains, those ahead may be used temporarily to help those behind their schedule.

Material may be handled under a separate system controlled by the schedule supervisor. One large freight car repair shop has a material routing plan operating as follows: An assistant foreman in the main repair shop inspects incoming cars and lists all material required for making repairs. This list is written up on a special form or order—Fig. 3060—which is taken up by the supply men at frequent intervals. The material routing clerk receives copies of these orders and periodically checks all departments visited by the supply men and also checks material arriving at destination in the main repair shop. Records of delays by departments and delays for which supply men are responsible are tabulated by the routing clerk and subsequently forwarded to the general foreman or a higher shop officer. The material clerk co-operates closely with the local storekeeper.

In shops where one foreman supervises all men on two or more parallel tracks, and cars are switched in or out as fast as needed or finished, the arrangement should be studied carefully, and it will be apparent that a good system for expediting repairs may also be fitted into this situation, although the forces may not admit of specialization and track room may be insufficient for the more elaborate methods. More experience is necessary before a system can be definitely outlined and recommended for shops operating on the single foreman plan.

Time Required

The following tabulation of time will give some idea of the average time required for repair work, the distribution of work, and the comparative number of shop tracks required.

TIME SCHEDULE IN DAYS FOR CARS IN SHOP UNDERGOING CLASS REPAIRS—BASED ON EXTERIOR WORK

	Strip	Wash	Days Repair	Paint	Trim	Total of Items	Total Days in Shop
C. M. & St. P...	1.00	1.22	3.00	8.44	1.66	15.32	15.66
P. R. R.....	1.00	1.27	4.64	7.00	1.36	15.27	15.27
C. P. R.....	....	1.00	2.50	10.00	3.20	16.70	17.80
			Percentage				
C. M. & St. P...	6½	8	20	55	10½	100	.....
P. R. R.....	6½	8	30½	46	9	100	.....
C. P. R.....	...	6	15	60	19	100	.....
			Average				
Days	1.00	1.16	3.38	9.48	2.07	15.76	16.24
Per cent	6.5	7.3	21.8	53.7	12.8	102.1	100.0

The figures given are approximately correct; the difference in "Total of Items" and "Total Days in Shop" is due to overlapping of paint repair and trimming work, or to days not assigned to above classified work.

The P. R. R. figures are based on averages obtained from 22 schedules; the C. P. R. on 10 schedules; and the C. M. & St. P. on 9 schedules. In the C. P. R. schedules, of the 17.80 days in shop, the cars are actually under the shop roof only 12.70 days and 5.10 days in the yard on stub tracks.

Apprentices—Inspectors

The development of men qualified to supervise the operation of railroad shops has led to the adoption, by the American Railway Association, of certain rules for the selection and instruction of apprentices.

Rules for the examination of car inspectors have also been adopted.

Basic Principles Relating to the Handling of Apprentices.

Recommended Practice—ADOPTED, 1908.

1. To develop from the ranks in the shortest possible time carefully selected young men for the purpose of supplying leading workmen for future needs, with the expectation that those capable of advancement will reveal their ability and take the places in the organization for which they are qualified.

2. A competent person must be given the responsibility of the apprenticeship scheme. He must be given adequate authority, and he must have sufficient attention from the head of the department. He should conduct thorough shop training of the apprentices, and in close connection therewith should develop a scheme of mental training, having necessary assistance in both. The mental training should be compulsory, and conducted during working hours at the expense of the company.

3. Apprentices should be accepted after careful examination by the apprentice instructor.

4. There should be a probationary period before apprentices are finally accepted; this period to apply to the apprentice term if the candidate is accepted. The scheme should provide for those candidates for apprenticeship who may be better prepared as to education and experience than is expected of the usual candidate.

5. Suitable records should be kept of the work and standing of apprentices.

6. Certificates or diplomas should be awarded to those successfully completing the apprentice course. The entire scheme should be planned and administered to give these diplomas the highest possible value.

7. Rewards in the form of additional education, both manual and mental, should be given apprentices of the highest standing.

8. It is of the greatest importance that those in charge of apprentices should be most carefully selected. They have the responsibility of preparing the men on whom the roads are to rely in the future. They must be men possessing the necessary ability, coupled with appreciation of their responsibility.

9. Interest in the scheme must begin at the top, and it must be enthusiastically supported by the management.

10. Apprenticeship should be considered as a recruiting system, and greatest care should be taken to retain graduated apprentices in the service of the company.

Rules for Examination of Car Inpectors.

Recommended Practice—ADOPTED, 1902.

REQUIREMENTS.

One year at oiling cars.

Two years at car repairing.

Age limit for new men, thirty years.

Age limit for promoted men, forty years.

Vision, 20-20 in one eye and not less than 20-40 in the other, without glasses.

Method of Testing

Acuity of Vision.—The test card should be hung in a good light and the party to be examined should, if possible, be seated with his back to the window. Each eye should be examined separately, using, for the purpose of excluding one eye, a folded handkerchief. The lowest line that can be read should be determined by exposing only one letter at a time through a hole cut in a strip of cardboard. In making out the report in each case, the visual acuity of each eye should be denoted by a fraction of which the numerator represents the number of feet at which the applicant is seated from the card, while the denominator represents the number of feet at which the lowest line which he can read should be read. Thus, if at 20 ft. he reads the line marked 20 ft., his vision—20-20 or 1, which is the normal standard. If at the same distance he only can read the line marked 70 ft., his vision—20-70. If at 20 ft. he reads the 15-ft. line, the vision—20-15, or more than normal. If a room 20 ft. long can not be used, a testing distance of 15 or 10 ft. should be employed, in which case normal vision would be represented by 15-15 or 10-10 respectively, and lower grades of vision by such fractions as 15-20, 10-70, and so on.

Field of Vision.—Test should be made by having the applicant and examiner stand about 3 ft. apart, each with one eye shut, looking each other steadily in the eye. The examiner should then bring his hand in from the edge of the field toward the center of the space between them, until the applicant sees it coming. This should be done from different directions, up, down and from each side. The applicant should see the hand coming about as soon as the examiner does. If not, this should be noted on the report.

Hearing.—Test should be made in a quiet room. First, the examiner should hold the watch opposite the ear to be examined not less than 48 in. distant, then gradually approach the ear until the applicant hears the tick, the stop being used to satisfy the examiner that the applicant is not deceiving. The distance at which the applicant hears the watch should be noted in inches. The normal ear should hear the tick of the watch at 48 in. Then the hearing power will be denoted by a fraction whose numerator represents the number of inches at which the watch is heard. Thus, if he hears the watch at 48 in., his hearing—48-48, or normal. If he hears it only at 10 inches distant, his hearing—10-48, and so on.

Color.—The committee does not think it essential that inspectors should be rejected on account of imperfect color sense. It is, however, believed that inspectors should be tested as to their color sense so that they, as well as their employer, may know their condition in this respect.

Education.—The applicant should be able to write a legible hand in English, and also to read manuscript matter as well as printed matter.

Car Knowledge.—The inspectors should be able to name each part of the cars in general use, in preference using Car Builders' dictionary terms.

A. R. A. Rules.—Inspectors must pass a satisfactory examination on A. R. A. Interchange and Loading Rules, answering 75 per cent of the questions submitted. These questions should be of about the following character:

1. What are the A. R. A. Interchange Rules?
2. What is the object of the A. R. A. Interchange Rules?
3. What is the underlying idea or principle of these rules?
4. When is a company, operating the cars of another company, responsible for defects of such cars?
5. When a company is thus responsible, what should it do?
6. What care should be given to foreign cars by the company hauling them?
7. What cars must be accepted in interchange?
8. What is a defect card and how is it used?
9. Under what conditions is a road obliged to accept a car which is carded for defects for which the owner is not responsible?
10. What are the defects of wheels and axles for which owners and delivering companies are responsible?
11. Describe the form and use of the A. R. A. wheel gage?
12. What are the rules which apply to the cleaning of triple valves and cylinders?
13. What does the limit of height of drawbars mean?
14. When a company is obliged to make improper repairs, what must it do to call attention to such repairs?
15. What does the term unfair usage mean?
16. What are the rules regarding splicing sills?
17. What is the purpose of the repair card?
18. How do these rules apply to switching roads?
19. Are switching roads allowed to render bills against owners direct for repairs of any other than those named in Section 23 of Rule 5?

A topical discussion on "Cannot the General Work of Car Inspectors Be Improved by Giving Some Attention to the Eyesight, Hearing, Etc., of the Men?" will be found in the M. C. B. Proceedings, 1901.

Freight and Passenger Car Repairs

With sixteen plants in nine states, the American Car and Foundry Company is always prepared to handle a large volume of freight and passenger car repair work. The locations of these plants are strategic points, chosen with regard to ready accessibility and traffic requirements, with a view to avoiding delays in returning repaired cars to service.

In Pennsylvania there are three plants, located at Berwick, Bloomsburg, and Milton. In New

Fig. 3061—Plant of the American Car and Foundry Company at Wilmington, Delaware

York State, plants are located at Buffalo and Depew. Indiana has three "Car Foundry" plants, located at Terre Haute, Indianapolis, and Jeffersonville. Illinois and Missouri have two plants each. In the former state, they are at Chicago and Madison; in the latter, at St. Louis and St. Charles. Michigan, Tennessee, West

Fig. 3062—Detroit Plant of the American Car and Foundry Company

Virginia and Delaware each have one plant, located respectively at Detroit, Memphis, Huntington, and Wilmington.

The plants at Berwick, Pa., St. Charles, Mo., Jeffersonville, Ind., and Wilmington, Del., are equipped primarily for handling passenger car repairs, although ample facilities in the form of additional tools, installed in all four plants, permit the handling of freight car repairs also.

Unusual care is devoted to the work, which includes rebuilding, remodeling, modernizing,

Fig. 3063—American Car and Foundry Plant at Madison, Ill.

and repainting. The facilities permit the reception of cars in any condition, which may range from the results of various degrees of ordinary wear and tear in service to that resulting from serious wrecks.

Excellent steel shop facilities in all departments permit strengthening of old wooden equipment

Fig. 3064—Plant of the American Car and Foundry Company at Berwick, Pa.

by the substitution of steel center sills with metal draft arms and bolsters, or complete steel underframes comprising center and side sills together with bolsters and other cross members, when desired. Wheel foundries located at Berwick, Pa., Buffalo, N. Y., Chicago, Ill., Madison, Ill., St. Louis, Mo., and Huntington, W. Va., permit the ready replacement of all defective or worn wheels under such cars. Rolling mills at Berwick, Pa., and St. Louis, Mo., provide for quick rolling of the bar iron requirements for prompt replacement of all forged parts.

Fifty years of building and repairing experience, and a highly trained organization which keeps closely in touch with changing conditions, place the American Car and Foundry Company in an exceptionally advantageous position for handling the repair of freight and passenger cars, efficiently, economically, and quickly.

For other products and branch offices, see classified and alphabetical indexes.

AMERICAN CAR AND FOUNDRY COMPANY, NEW YORK, N. Y.

Greenville Steel Car Company

The Greenville Steel Car Company specializes in the repair and rebuilding of steel freight cars. Since its organization in 1910, this company has developed a car repair plant of experienced personnel and complete facilities, adequate for the production of very high grade car repairs.

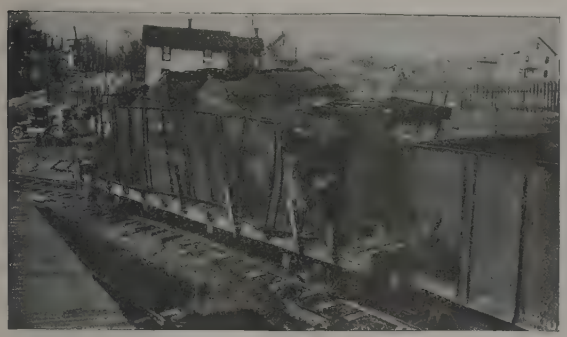


Fig. 3065—View Showing Wrecked Car Arriving at Plant

With the approach of every business revival there is an immediate demand for cars able to carry the heavy traffic, do it economically at a reasonable cost and with profit to the railroad and public. On many railroads a large amount of rolling stock is relegated to cinder service or stored on sidings under Nos. 1 or 2 heavy repair classification; a comparatively small expenditure for repairs would be sufficient to put the great majority of these cars in good condition and enable them to haul their full rated tonnage.

Fig. 3066—Shipment of Steel Underframes Leaving Plant

When a car enters the plant of the Greenville Steel Car Company, frequently too badly damaged to travel on its own wheels, it is carefully inspected by the company's experts together with representatives from the owning railroad. This preliminary inspection is intended to determine the extent of repairs necessary, the number and character of new parts required, and just how much of the existing structure can be salvaged.

Reclamation of damaged parts is an important feature of steel car repair work at the Greenville plant. Every possible means, such as straightening, autogenous welding, reforging, etc., are employed to salvage and return to service all usable material.

When the car has been dismantled another inspection is made, and in the majority of cases, it is found possible to save the old center sill construction by the use of proper reinforcement. After a new floor has been applied, new hoppers and a partial renewal of sides and ends together

Fig. 3067—Car Repaired, Ready for Service

with complete repairs to air brakes and safety appliances, the car is ready to enter revenue service and to handle as much traffic as a new car costing two or three times the expense involved in the above overhauling. An example of this class of repairs is illustrated in Fig. 3067.

The Greenville Steel Car Company also manufactures steel underframes for all types of freight cars, and furnish steel car parts for application by the railroads at their own shops.

This company's car repair plant is located adjacent to America's greatest steel producing community and has the advantage of low freight rates combined with quick delivery on practically

Fig. 3068—Car Storage Yard

all varieties of car parts, such as plates, axles, castings, rivets and similar material required in the rebuilding of steel car equipment. Its convenient location as regards availibility of both material and labor, together with unexcelled railroad connections, greatly facilitate the rapid and satisfactory handling of car repair contracts.

In consideration of these facts the Greenville Steel Car Company has made a consistent annual increase in its facilities. At the present time it extends to the railroads, accommodation for rebuilding 500 cars per month, with ample storage room and with the assurance that the work will be handled in accordance with the most modern car repair practices.

For other products, see classified index.

GREENVILLE STEEL CAR COMPANY, GREENVILLE, PA.

Freight Car Repairs

The Buffalo Steel Car Company which began operations in 1920 as railway freight car repair contractors, operate at a distinct advantage in that it has a newly equipped plant designed especially for freight car repairs and particularly for handling steel freight cars of all sorts and descriptions.

The plant is conveniently located just east of the city limits of Buffalo with rail connections to the New York Central and the West Shore. It occupies an area of 83 acres, and has two steel freight car repair tracks and two wooden freight car repair tracks, each about ¼ of a mile long with a capacity of 40 repaired steel cars and 20 repaired wooden cars per day.

Fig. 3069—View Showing Details of Steel Car Repairs at the Buffalo Steel Car Company

The arrangement of the plant is such that the work can be performed in progressive sequence with no back hauls nor unnecessary movements. Careful study was given to the layout of the plant to permit economical handling with the accompanying decrease in operating costs. The steel fabrication shop, a building 82 ft. x 460 ft., is located conveniently to the steel car repair tracks; the wood mill, a building 50 ft. by 150 ft., is conveniently located to the wooden car repair tracks, while the forge shop and the storehouse are convenient to both the steel car and wooden car repair tracks.

The equipment of the plant is modern in every respect and meets fully the requirements. Two 10-ton gantry cranes of 100-ft. span serve the steel car repair tracks and travel over a distance of nearly a half a mile. Two saddle tank switching locomotives, two locomotive cranes and numerous jib cranes located at advantageous points throughout the yard complete the outside handling machinery.

The equipment in the shops is of latest design for handling the work. The steel fabrication shop is equipped with two 10-ton traveling cranes and hydraulic forming presses of 225-ton, 500-ton, and 750-ton capacities, besides the necessary punches, shears, etc., required for the work.

Fig. 3070—General View of Repair Facilities of the Buffalo Steel Car Company

The method of handling the steel car repairs has been carefully developed. The cars to be repaired are switched to a track located at about

Freight Car Repairs *(Cont'd)*

the middle of the span of the gantry cranes. The bodies of the cars are then removed and placed on horses at one side of this track for stripping while the trucks are taken by the gantry cranes, to the truck gang for repairs. As the trucks are repaired they are brought back to the head of the repair tracks which are at the middle of the ½-

Fig. 3071—All-Steel Hopper Car Repaired at the Buffalo Steel Car Company

mile run of the gantry cranes and on the side of the receiving track opposite to the stripping position. There the car bodies, which have been previously stripped, are placed on their trucks and the car is ready for the necessary repairs and assembling.

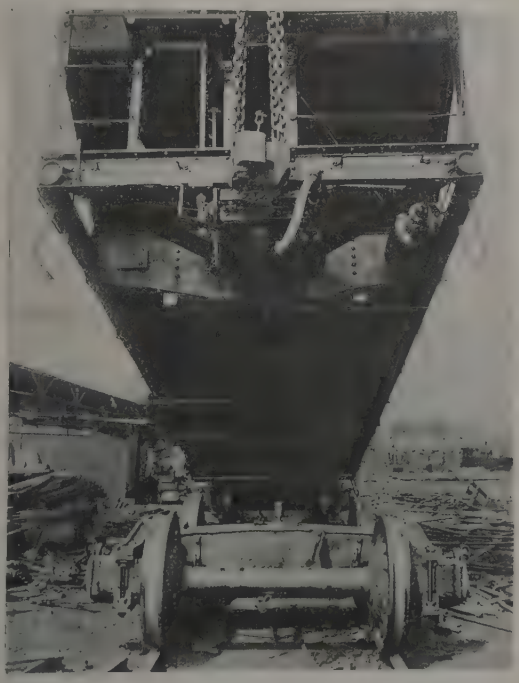


Fig. 3072—Bottom and Trucks of Repaired Steel Car

The two ¼-mile repair tracks mentioned above are in reality one track ½ mile long divided in the middle, which is the point at which the work begins, cars of one series or railroad going in one direction, and cars of another series or railroad in the opposite direction on their progressive system of repairs. The cars pass down the tracks from gang to gang, each gang specializing on one specific detail in the repairs until they pass off the repair track painted, ready for stenciling, and

Fig. 3073—Interior of Wooden Box Car Repaired by the Buffalo Steel Car Company

for service. There is a slight down grade in both repair tracks in the direction of progression to assist in moving the cars forward after passing through the various stages of repairs. The repair track is also covered by a steel shed where the use of the overhead crane is not required.

Fig. 3074—Wooden Box Car After Repairs by the Buffalo Steel Car Company

During the first year and a half of its operation the Buffalo Steel Car Company has repaired 2,850 cars for the Lehigh Valley, 1,900 cars for the Buffalo, Rochester & Pittsburgh, 1,000 cars

Fig. 3075—Composite Gondola Car Repaired by the Buffalo Steel Car Company

for the New York Central, and 850 cars for the Delaware, Lackawanna & Western.

Ralston Steel Car Repairs

While the Ralston Steel Car Company is primarily a builder of steel and composite freight cars, it has developed in addition, an extensive car repair business. Car repairs made by the Ralston Company are thorough and include a complete restoration from all deterioration or damage accrued during operation, so that insofar as utility and further revenue production are concerned, any repaired car from this company's plant is in a condition substantially equal to a new car.

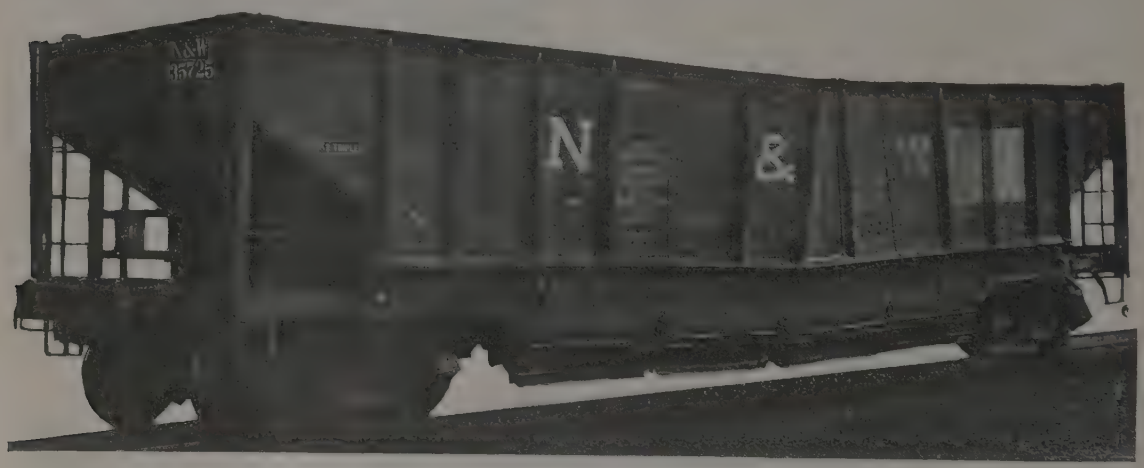


Fig. 3076—Steel Hopper Car as Received for General Repairs

The accompanying illustrations show a badly damaged car before and after being overhauled. All work has been performed in strict accordance with the owner's standard practice, the A.R.A. requirements and in full conformity with the Safety Appliance Laws of the United States.

When comparing the relative cost of car repairs made in railroad shops, with similar work handled under contract, it should always be remembered that the repair of equipment on a railroad is merely incidental to the business of conducting transportation.

An analysis of railroad and contract shop expenses will show conclusively that a contract shop operated with reasonable efficiency can repair cars at less cost than is possible in the average railroad yard.

In the Ralston plant a close and efficient control is exercised by a management whose entire interest is concentrated upon the problem of reducing costs and keeping up production. A system of accounting has been provided which affords a clear insight into the various phases of the business, and serves as an immediate check upon any tendency toward unwarranted expenditure.

Special attention is given to the reclamation of damaged car parts by straightening, reforging and the use of electric or autogenous welding processes. Facilities of the most modern type have been installed to handle this work and every effort is made to avoid the waste of good and usable material.

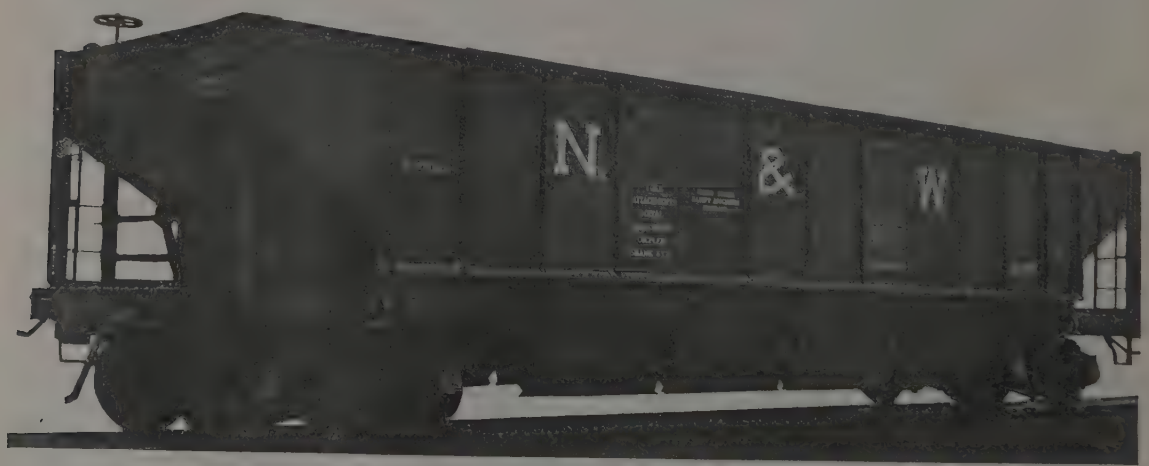


Fig. 3077—Steel Hopper Car After Completion of General Repairs

For other products and branch offices, see classified and alphabetical indexes.

THE RALSTON STEEL CAR COMPANY, COLUMBUS, OHIO

Rebuilding Freight Cars

Rebuilding and re-inforcement of all kinds of freight car equipment, both steel and wood, has been brought to a state of highly organized efficiency and mechanical perfection at The Ryan Car Company's plants which were established in 1906, at Hegewisch, a suburb of Chicago.

Steel re-inforcements of the type shown in the illustration and manufactured in large quantities and applied by this company or shipped to railroads for application at their own repair shops.

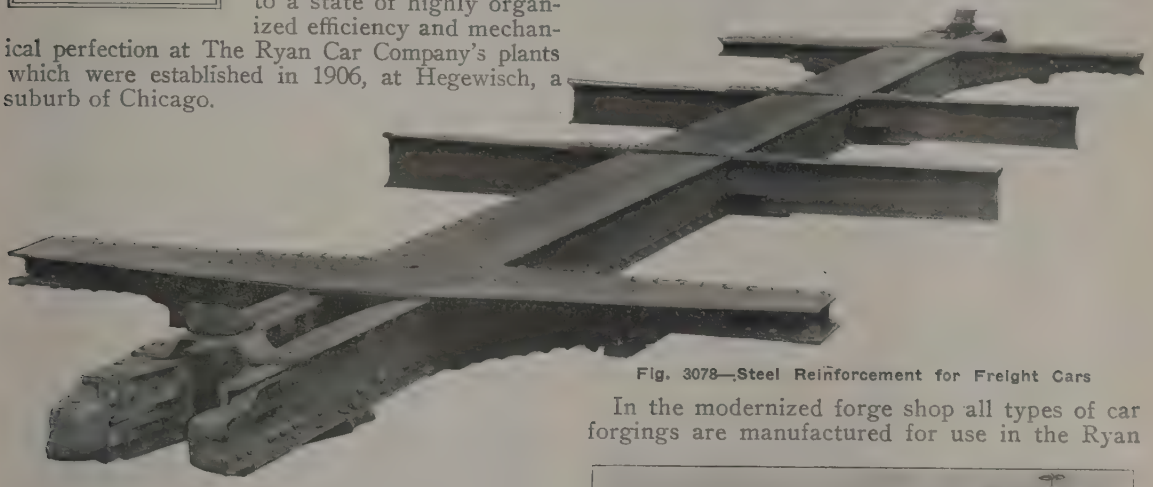


Fig. 3078—Steel Reinforcement for Freight Cars

Repairing, rebuilding and re-inforcing existing freight car equipment follows closely the paths of improvement suggested by the ever-changing conditions of service on American railways so that definite programs governing this work are carried out by nearly all owners of freight car equipment.

The engineering department of The Ryan Car Company specializes in the subject of car re-inforcement, working out the ideas of its customers and submits complete programs for the rebuilding of equipment to meet modern service conditions.

Great economies are effected as the result of this work and much equipment that would otherwise be relegated to light service or abandoned entirely is put in condition to withstand the heaviest traffic, thereby becoming an important factor in the earnings of its owners.

In the modernized forge shop all types of car forgings are manufactured for use in the Ryan shops as well as shipment to customers for application at their own shops.

Fig. 3079—A Rebuilt Box Car with Steel Ends

The capacity of The Ryan Car Company's plants is 40 heavy rebuilt cars per day; 30 steel center sills per day and a large tonnage of car forgings.

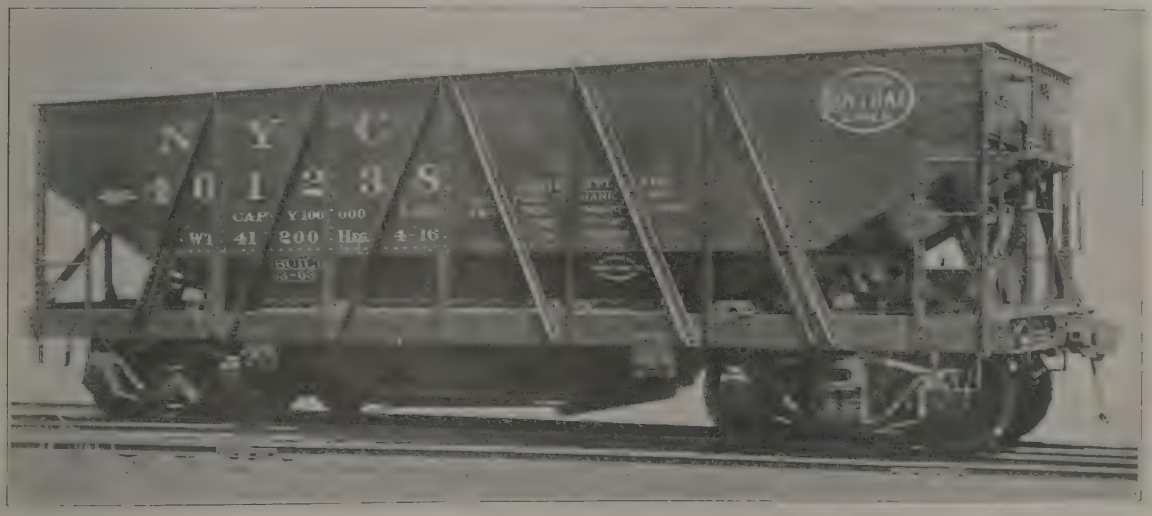


Fig. 3080—Hopper Car Rebuilt by The Ryan Car Company

THE RYAN CAR COMPANY, CHICAGO, ILL.

"Youngstown" Car Repairs

Freight car repairs to both wooden and steel equipment have been the business of the Youngstown Steel Car Company for over 15 years. With experience gained in this class of work for over such a long period this company has so perfected its organization and methods that it is in a position to handle repairs to all classes of freight equipment, regardless of the type of car, expeditiously, satisfactorily and at a reasonable cost.

As a result of the recent war, combined with the labor and financial difficulties experienced by all railroads during the past few years, the condition of freight car equipment throughout the entire country has deteriorated to a very considerable extent. How to get this equipment repaired with sufficient rapidity to meet the demands of reviving business, is unquestionably one of the most serious problems confronting railroad officials at the present time.

While a partial solution of this problem may be found in the speeding up of railway car repair operations and in the immediate enlargement of car repair facilities, it should be evident that the full utilization of all available car repair plants, in addition to those owned by railroad corporations, will will be of great assistance in this emergency, in reducing the number of bad order cars.

An entirely new freight car repair plant was placed in operation by this company at Niles, Ohio, in 1920. It is provided with ample rail facilities having connection with the Pennsylvania, the Erie and the Baltimore & Ohio. The equipment and arrangement of this plant was carefully planned to permit of handling freight car repairs in the most logical sequence. From the time the equipment is brought into the receiving yard, passed through the shops and out of the delivering yard there is no time wasted in lost motion or unnecessary movement of cars.

On the 110 acres of land covered by this plant there is ample storage capacity for bad order equipment awaiting repairs. All repairs are made under cover. The main shop is 400 ft. long by 166 ft. wide. It is divided into two bays each 83 ft. wide, one bay being the erecting shop and the other bay the fabricating shop. In addition there is a lean-to 30 ft. wide for the full length of the shop. There is also provided a machine shop, storeroom, power house, office and other smaller buildings necessary to the operation of the plant. A steel storage yard 400 ft. long is adjacent to the fabricating shop. It is served with a 10-ton traveling crane which runs for the full length of the yard and delivers material direct to the shop.

The Erecting Shop, in which all the rebuilding work is done, has four standard gage tracks over which the cars pass in their progress through the shop. This shop is served by two 10-ton traveling cranes. As the car enters the shop the trucks are removed when repairs to them are necessary, and the body is placed on shop trucks so that the car may be moved through the shop as repairs progress. The trucks are carried by the traveling cranes to the truck shop, which is under the same roof, and there repaired, being ready for the body of the car when all repairs to it have been made. The organization of the shop is such that special gangs of men handle each particular part of the work. These gangs are located in a prearranged sequence throughout the length of the shop so that as the car passes from gang to gang the construction work is logically made.

Fig. 3082—Material Storage Yard

Fig. 3081—The Car Repair Shops of the Youngstown Steel Car Company

The Fabricating Shop is thoroughly equipped with modern machinery among which are a 120-in. shear, 800-ton and 1,200-ton hydraulic presses, which are served by individual furnaces, large bull-dozers, steam hammers, etc. The equipment is sufficient to handle plates of any size and shape

For other products and branch offices, see classified and alphabetical indexes.

YOUNGSTOWN STEEL CAR COMPANY, NILES, OHIO

"Youngstown" Car Repairs *(Cont'd)*

required in general in the repair of steel freight equipment.

Equipment in any degree of dilapidation is handled by this company and will be repaired or scrapped as desired; in the latter case all usable material will be reclaimed and returned to the owner. Adequate facilities are provided for this work. Cutting is done by both the oxy-acetylene and electric methods, the latter being used particularly for rivet-cutting.

Three rigid inspections are given to all cars to be repaired—one on entering the plant when the extent of the repairs are determined, the second, after the car has been dismantled and stripped, when it is possible for a more detailed survey to be made, and the third after the car has been rebuilt and is ready for delivery. All work is open to the inspection of the railway companies' inspectors at any time before, during, or after the work has been finished.

Fig. 3083—A View of the Fabricating Shop of the Youngstown Steel Car Company

Under normal business conditions it is almost impossible to exaggerate the value of good serviceable cars, not alone from a railway revenue standpoint but also as a material addition to the resources of the country. Defective cars, on the other hand, are a liability, causing delayed train movement, added expense in transportation, claims for demurrage and the various indeterminate losses arising from a more or less disorganized service and a dissatisfied patronage.

It is, therefore, of great importance, in the efficient management of railroad properties, that full advantage should be taken of all available car repair facilities in addition to those under railway ownership, when conditions permit the release of cars for heavy repairs.

The Miscellaneous Department is a unique feature of the Youngstown Steel Car Company. As the name implies this department will, on orders from railroads, provide a variety of material entering into the construction of steel equipment. With its extended fabricating equipment this company is prepared to deliver, in any quantities and to the railway companies' drawings and specifications, material such as floor plates, drop doors, side stakes, end sills, draft sills, bolsters, cross hood sheets for hopper cars, etc., etc. This can be done at low cost because of the equipment and organization of the Youngstown Steel Car Company. It is, in fact, an important feature of the work of this company and is particularly attractive to those roads which do not have the proper or sufficiently large facilities for handling this class of work.

Owing to the alternate rise and fall in the volume of traffic movement, which seems to be an inevitable accompaniment of this country's industrial activity, there occurs at more or less regular intervals a vast accumulation of bad order cars on the various railroad systems.

As a rule the average railroad is not provided with sufficient facilities to adequately handle car repairs beyond a certain fixed maximum and in view of the fluctuating demand for such facilities, it would be an economic fallacy for railroads to make the comparatively great investment that would be required to handle the peak car repair situation, with the knowledge that a considerable percentage of such an investment must necessarily remain idle during a large portion of the time.

It is due to these circumstances that an independent car repair plant, such as the Youngstown Steel Car Company is in a position to render the greatest possible service to railroad corporations, as their facilities are immediately available when required, and repairs can be made without the necessity of an increased capital expenditure on the part of the railroads.

These facts, together with the further consideration that the efficiency of labor is usually susceptible to a more thorough control in the outside repair shop,

Fig. 3084—A Finished Car After Being Rebuilt by the Youngstown Steel Car Company

has established for these concerns a position of decided economic importance and value in the transportation industry.

Among the recent repair work done by this company may be mentioned 1,500 composite gondola cars which were given heavy repairs for the Pittsburgh & Lake Erie, and 600 all-steel 50-ton drop bottom gondola cars which were given heavy repairs for the Erie.

For other products and branch offices, see classified and alphabetical indexes.

YOUNGSTOWN STEEL CAR COMPANY, NILES, OHIO

Berwick Electric Rivet and Metal Heaters

Berwick Electric Rivet Heaters were first commercialized in November, 1919. During the following two years approximately 1,000 were built and placed in operation. About 600 are now used in the manufacture and repair of freight and passenger cars, 400 being used in the shops of the American Car and Foundry Company.

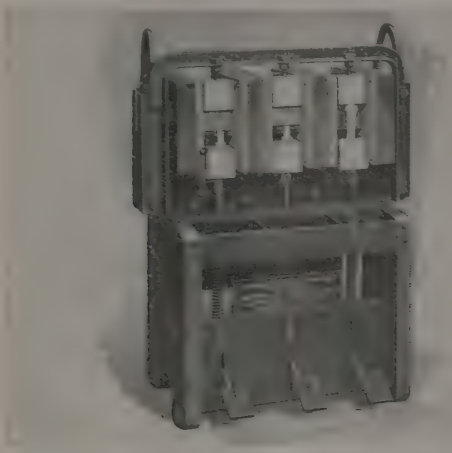


Fig. 3085—No. 3 Three-Electrode Heater

There are nine types and sizes of Berwick Heaters, with varying capacities from 75 to 600 hot rivets per hour, in sizes from ¼ in. by 1 in. up to 1½ in. by 10 in. or larger.

The advantages of heating rivets electrically, as compared with any type of fuel heater, are many. The possible saving in fuel ranges from 30 to 70 per cent. By the elimination of burning and scaling, approximately 10 per cent in the number of rivets used can be saved. From ⅛ in. to ¼ in. in length of rivets also can be saved by heating electrically, since there is no reduction in diameter or length, which occurs when rivets are heated with fuel. The elimination of dirt, gas, smoke and intense heat is an advantage having a value which cannot be definitely figured. The ability to heat any size rivet within 15 to 30 seconds avoids delaying the hammer gangs, not only at the beginning of each shift but also throughout the day when the operator may have neglected to put in the proper size of rivets. This represents an actual saving often as high as from 5 to 10 per cent of the total wages paid to the hammer gangs.

The elimination of fire hazard is a considerable advantage, as many fires have been traced to leakage in oil pipes or to explosions about the heater. The portability of the heater is also a valuable advantage.

An estimate of actual savings is difficult, without knowing conditions in the factory, but from two years' experience it has been determined that a saving of not less than $1.00 per hundred pounds of metal heated can be effected in practically any factory. In "Car Foundry" plants the saving is estimated to be not less than $5.00 per day per heater.

In combustion furnaces the heating begins at the outer surface and penetrates the rivet until it reaches the core. As a consequence, most hammer men and foremen insist that the rivet should have an appearance approximating a white heat before it is sufficiently heated to be driven. An analysis of such a rivet will show that deterioration of the metal has begun.

Uniform heating to the correct temperature is easily obtained with Berwick Heaters. The current passes equally through all portions of the rivet, and, as the atmosphere keeps the outer surfaces cool, the core becomes hot first and the heat radiates from the core to the outer surface. It is necessary, therefore, for foremen, hammermen and heaters to determine what appearance the electrically heated rivet should have, in order to produce the desired color in the heated rivet.

Two years of selling and demonstrating the Berwick Electric Rivet Heater indicate that the major objection to heating electrically is due to the fact that foremen and hammer-men, still retaining the idea that a rivet should show a white heat before driving, do not realize that exposure to light alters the appearance of a heated rivet. However, fifteen or twenty minutes of experimenting will determine the approximate color that a rivet should have in the Berwick Electric Heater when ready for use.

In addition to rivet heaters, the American Car and Foundry Company is also perfecting other electric devices for heating one end of a rod for bolt-heading or upset work; for heating one corner of a plate for scarfing; for heating 20 ft. or longer rods for automatic or bolt-making machines; and there are several experimental heaters now being developed for the heating of plates, angle irons, etc. Upon receipt of advice concerning any other special cases where the use of electricity for heating is practicable, the American Car and Foundry Company is in a position to develop a heater that will give satisfactory as well as economical results.

Fig. 3086—No. 3 Five-Electrode Heater

For other products and branch offices, see classified and alphabetical indexes.

Buckeye Jacks

All the essential qualities of a first-class jack are combined in the Buckeye. Its large rectangular base and column of ribbed construction provides for great lifting strength, with comparative light weight. This feature permits these jacks to be handled with ease, and allows them to be used in close quarters where jacks, having bulky standards, or with improperly designed columns, could not be operated. The matter of proper metal distribution in the design of Buckeye jacks has received careful attention as a study of the illustrations will clearly indicate.

These jacks are adapted to high or low set loads by using either the top of the rack or the projecting foot at the lower end. The working parts are all accurately machine finished and when worn out can be readily removed and replaced at slight expense.

Fig. 3087— Buckeye Automatic Lowering Jack No. 19

Fig. 3088—Buckeye Geared Automatic Lowering Jack No. 29

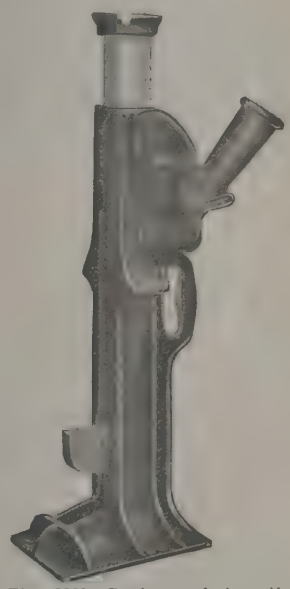


Fig. 3089—Buckeye Automatic Lowering Jack No. 219

Automatic Lowering Jack No. 19—Fig. 3087 has a capacity of 15 tons, and is especially designed for car repair work. Its height with the bar down is 28 in.; with the bar raised, 45½ in. This is a staunch, well built jack and weighs 102 lb. It lifts and lowers on the downward stroke of the lever only, the direction being reversed by a turn of the eccentric located at the side.

Geared Automatic Lowering Jack No. 29—Fig. 3088—has a capacity of 25 tons and weighs 190 lb. Its height with the bar down is 28 in.; the rise of the bar is 17 in. This is a geared jack which gives greater purchase power, the gears and pinions being from steel drop forgings, heat treated and machine cut.

Automatic Lowering Jack No. 219—Fig. 3089—has a capacity of 15 tons, and weighs 91 lb. Its height with the bar down is 28 in. while the bar has a raise of 17½ in. This jack is equipped with a very simple and durable reversing mechanism having six less working parts than are usually required for the purpose of reversing the action, or travel of the rack-bar. This materially reduces the up-keep—by eliminating the cost, replacement and liability to disarrangement of the superfluous mechanism. The few reversing parts essential to the operation of the No. 219 Jack, are so simply applied that any inexperienced operator can apply the parts, without the necessity of sending the jack to a base repair shop.

In the construction of this jack double-pointed pawls are used together with a fulcrum pin, instead of a trunnion integral with the socket lever. This construction with the use of a fulcrum pin made of high grade, 60 to 70 point carbon, machinery steel, makes it an easy and inexpensive matter to keep the jack in good working order. When the fulcrum pin wears to the extent of improperly setting the pawl points in the teeth of the rack, or interfering with the proper clearance of the pawls, it is only necessary to replace the pin while with the integral trunnion type of construction the entire steel socket lever must be renewed at an expense very much greater than that required to renew the fulcrum pin. Furthermore when it is necessary to replace a steel socket, it usually is necessary to send the jack to a base repair shop, while a fulcrum pin can be replaced by a handy man anywhere.

Racks, pawls and other steel forgings are of the highest class. They are made from grades of steel having the most suitable content in carbon, sulphur, manganese, etc., and all of the parts are especially heat treated. These features are embodied in the construction of all Buckeye Jacks.

For other products and branch offices, see classified and alphabetical indexes.

THE BUCKEYE JACK MANUFACTURING COMPANY, ALLIANCE, OHIO

Motor Drives and Electric Welding

The two principal classes of machinery employed in American railway carbuilding practice are known by the general terms of woodworking machinery and metal working machines, the application of G-E motor drives being particularly feasible for both classes. Either alternating or direct current can be used, and the designs available not only add to the efficiency of the shop as a whole, but also to the simplicity and efficiency of the individual machines.

A special design of G-E motor drive for woodworking machinery provides for the attachment

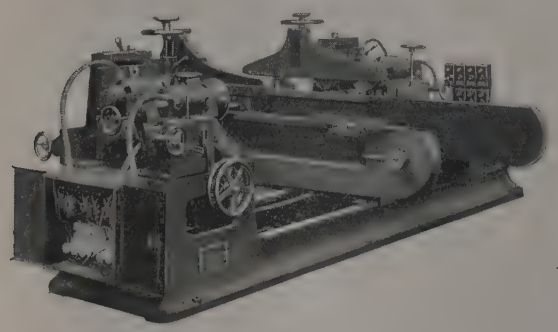


Fig. 3090—Ball Bearing Double End Tenoner—7 G-E Motors Directly Applied

of motors to the individual cutter spindles and thus permits the elimination of much of the gearing and all the belting ordinarily necessary. These motors operate at speeds as high as 25,000 r.p.m. and are suitable for driving cutter heads. As many as nine motors have been built into one machine, and successful applications have been made to shapers, saws, tenoners, drills, grinders, etc., requiring speeds up to 12,000 r.p.m. This drive is also suitable for metal working in drilling and grinding.

Hand or magnetic control apparatus is furnished. It is even possible to cut out individual motors without affecting the operation or efficiency of any of the others.

For the wheel lathe equipment used in finishing the treads and flanges of wheels while assembled

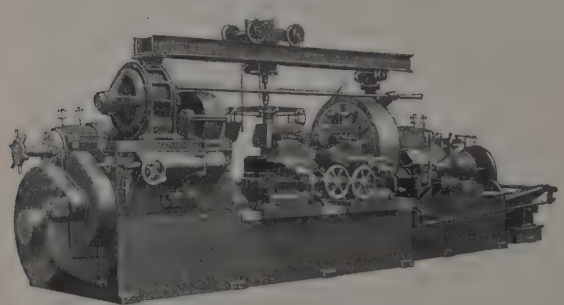


Fig. 3091—Heavy Wheel Lathe Driven by G-E Motor with Automatic Slow-down for Cutting Hard Spots

on axles, G-E motor drives include both a-c. and d-c. equipment. Both include control devices to provide great flexibility, as well as protection, and have provision for changing speed when hard spots are encountered. The a-c. equipments are made for reversing and non-reversing.

G-E Reversing Planer and Electric Feed Equipments for planers assure maximum production with a minimum of power consumption. The type RF, adjustable speed motor—direct current only—will accelerate and brake in the shortest practicable time; its control is positive in action and as near "fool proof" as practical design and construction can be made. The voltages are either 230 or 550, and sizes range from 2 h.p. to 50 h.p.; speed adjustments include 2 to 1, 3 to 1 or 4 to 1.

G-E general purpose motors include single-phase induction motors, ¼ to 15 h.p.; polyphase induction motors, 1 to 750 h.p.; and d-c. motors, open and semi-enclosed, ½ to 150 h.p.; all for constant speed service.

G-E electric arc welding equipments are available in three types for car work. They are known as manual equipment, automatic, and semi-automatic. For general use, both single and multi-operator motor generator sets are available primarily for metallic electrode welding. The manual equipments can be used with carbon electrodes for cutting, which affords a very fast and practicable way of cutting or trimming castings, or the plates of steel cars. The generators can be driven by any standard form of power.

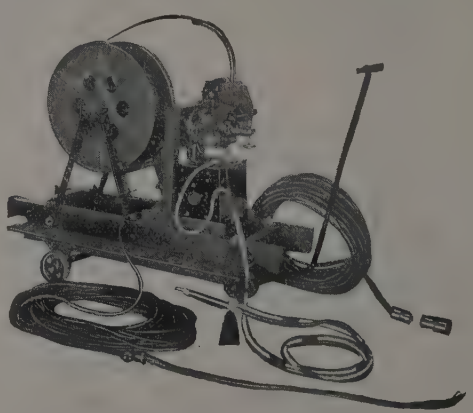


Fig. 3092—Semi-automatic G-E Arc Welding Equipment

The G-E automatic welder is especially applicable for routine duplicate welding of seams and worn or undercut shafts, axles and plates. It eliminates the unsteady conditions incident to manipulating the electrode by hand and makes a better weld in 20 to 50 per cent of the time required by hand.

A semi-automatic welding lead is also available for use with the G-E Automatic Welder. This type of equipment permits the operator to direct the arc as required, and thus weld seams of irregular contour readily; it also can be used for filling up blow holes in castings, or building up worn spots.

The use of G-E automatic and semi-automatic welders does not require highly skilled operators.

For other products and branch offices, see classified and alphabetical indexes.

Car Shop Machine Tools

The Niles-Bement-Pond Company can furnish practically every type of machine tool required for railroad car manufacturing and repair shops. It also builds steam forge and steam drop hammers, as well as electric traveling cranes, trolleys and hoists.

In addition to the special car shop tools illustrated below, the Niles-Bement-Pond line includes boring and turning mills, lathes, planers, slotters, boring and drilling machines, bending and straightening rolls, shears and punches, multiple drills, etc. The tool room equipment made at this company's Pratt and Whitney Works completes the list of "Niles" products.

Car wheel lathes are built in center-driven and end-driven types. The No. 3 end-driven machine —Fig. 3093—will take wheels from 26 in. up to

Fig. 3093—No. 3 Car Wheel Lathe

52 in. diameter on tread, and will accommodate axle journals as large as 8 in. diameter. This machine has power traverse and pneumatic clamp for right headstock and is equipped with pneumatic tool clamps or turret tool posts, together with a calipering device and with either electric or pneumatic wheel hoist and push button control.

The center-driven machine takes wheels from 26 in. up to 42 in. diameter on tread. Driving gear, double herringbone type with automatically

Fig. 3094—Double End Hydraulic Car Wheel Press

operating hinged segment. Tailstocks have pneumatic traverse and pneumatic clamping device. Face plates are equipped with patented semi-automatic equalizing drivers. Calipering device, pneumatic tool clamps and an electric wheel hoist are regularly supplied.

The Niles-Bement-Pond Company build single-end presses of 200, 300, 400 and 500 ton capacities to take wheels up to 42 in. diameter on tread. They also furnish double-end presses—Fig. 3094 —which will press both wheels on or off an axle simultaneously. This machine is especially serviceable in shops where a large number of wheels are handled daily. Two sizes of double-end

Fig. 3095—No. 3 Axle Lathe

presses are built, with capacities of 400 and 500 tons, to take wheels up to 42 in. diameter on tread.

Axle lathes built by the Niles-Bement-Pond Company are center-driven and will turn wheel seats and journals at both ends of the axle simultaneously. The No. 2 machine is intended for finishing wheel fits and journals and has a swing over the tool slide of 10 in.; maximum distance between centers, 8 ft. The No. 3 lathe—Fig. 3095 —is a high production machine, designed for machining axle forgings as well as rough machine axles. It has a 13 in. swing over the tool slide; maximum distance between centers 9 ft. 3 in. Both machines can be equipped with a crane and hoist for handling axles.

Car wheel boring machines—Fig. 3096—are built in two standard sizes, 42 in. and 48 in., and

Fig. 3096—Car Wheel Boring Machine

also an extra heavy 48 in. size. The 42 in. machine is designed for the requirements of small railroad shops and will take wheels up to 36 in. diameter on tread. The 48 in. standard machine is designed to meet the requirements of car builders and railroad repair shops on both cast iron and steel wheels. It will handle wheels up to 42 in. diameter on tread and is equipped with a self-centering universal chuck together with a quick acting crane for handling wheels. Hub facing attachment can be furnished to order. The 48 in. Heavy Borer is a manufacturing machine.

For other products and branch offices, see classified and alphabetical indexes.

NILES-BEMENT-POND COMPANY, NEW YORK, N. Y.

Pratt & Whitney Car Wheel Gages

Pratt & Whitney A. R. A. gages are made to cover the latest developments and conform to all changes in standard design authorized from time to time by the American Railroad Association.

These gages are produced in all standard types ordinarily used in the manufacture and maintenance of railway rolling stock. They are made of special steel, carefully heat treated and finished with unusual accuracy to insure the utmost reliability throughout a long period of service.

In addition to those illustrated, this company

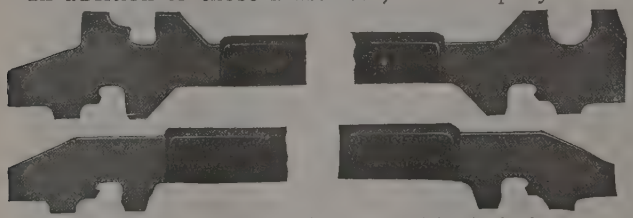


Fig. 3097—A. R. A. Standard Reference and Wheel Check Gages for Mounting and Inspecting Wheels

makes A. R. A. limit gages for rod iron, gages for automatic couplers and new knuckles, decimal measures as well as the regular line of snap gages, plug and template gages, all standard thread gages and pipe thread gages.

American Railroad Association standard reference and wheel check gages, shown in Fig. 3097, are made of steel having ample thickness and are provided with carefully hardened ends. The center is encased in wood, which makes the gage easier to manipulate and reduces to a minimum, expansion errors caused by temperate fluctuations, that would occur if the gage were handled without this protection. They are made only to order and prices will be quoted upon application.

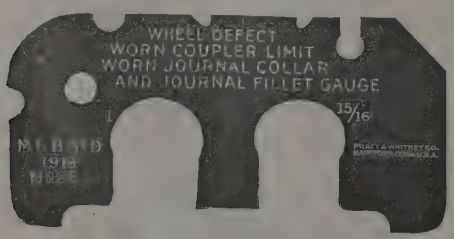


Fig. 3098—A. R. A. Wheel Defect, Worn Coupler Limit and Worn Journal Collar Gage

Car wheel circumference gages—Fig. 3099—are composed of flexible tempered steel and are provided with convenient adjustable handles. These are accurately graduated to conform with the A. R. A. standard for cast iron, solid steel and steel tired wheels.

The manufacture of small tools constitutes a further important addition to the Pratt & Whitney Company's output. These are produced in sufficient variety to meet the extensive requirements of this field, and include all styles of taps, dies, milling cutters, reamers, punches, drills and miscellaneous similar equipment.

In the manufacture of these tools, the Pratt & Whitney Company use every possible effort to maintain a uniform excellence in quality as the

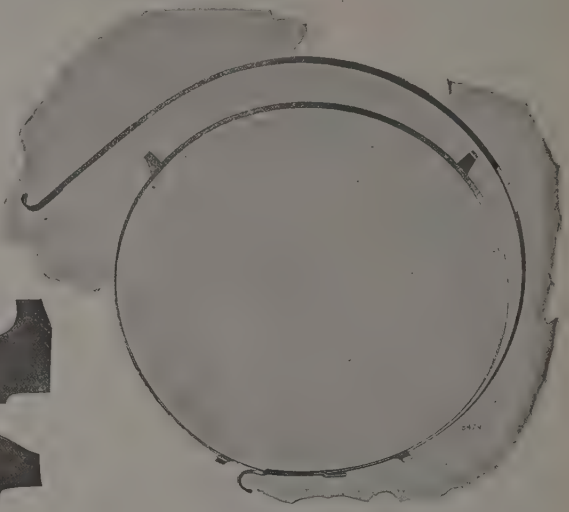


Fig. 3099—Car Wheel Circumference Gages

inherent characteristic of their product. With this end in view, the most complete modern tool-making facilities have been provided, including

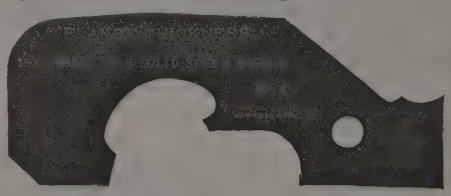


Fig. 3100—A. R. A. Standard Flange Thickness Gage

measuring and gaging equipment of the utmost precision.

This company has a world wide reputation for

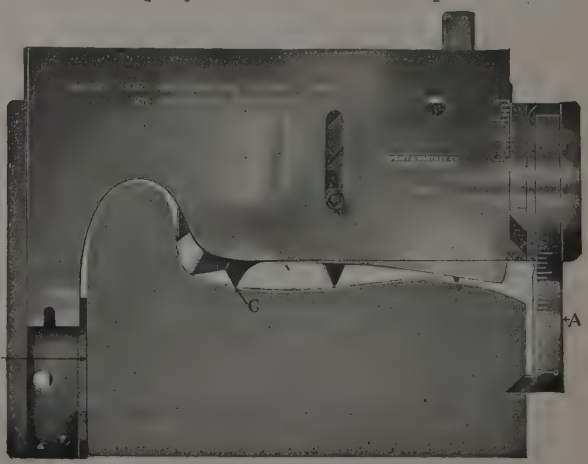


Fig. 3101—Gage for Measuring Steel Wheels to Restore Contour

careful, accurate workmanship in their various lines of manufacture and in railroad service Pratt & Whitney gages, small tools and other machinery have fully demonstrated their utility.

For other products and branch offices, see classified and alphabetical indexes.

NILES-BEMENT-POND COMPANY, NEW YORK, N. Y.

Directory of Products

For the convenience of users of this Cyclopedia, the products of all companies whose catalog or descriptive data appears in connection with editorial illustrations, have been classified on this and the following pages.

Where the product is illustrated or described, the figure number or page number is shown. In cases where no figure or page number appears, it may be assumed that the product is sold by the company listed.

In the alphabetical index on page 1188 will be found the addresses of the main offices, domestic and foreign branch offices of all companies whose products are classified.

A

AIR BRAKE CYLINDERS.
(See Cylinders, Air Brake.)

AIR BRAKE SYSTEMS.
General Electric Co.
Figs. 1990, 1993.
Westinghouse Air Brake Co.
Pages 783, 785, 791, 193, 812, 813; also Figs. 1888 to 1890, 1911 to 1913, 1947 to 1954.
Westinghouse Traction Brake Co.

AIR BRAKE VALVES.
(See Valves, Air Brake.)

AIR COMPRESSORS.
General Electric Co.
Figs. 1991, 1992.
Westinghouse Air Brake Co.
Page 818; also Figs. 1982 to 1984.
Westinghouse Traction Brake Co.

AIR SIGNAL APPARATUS.
Westinghouse Air Brake Co.
Figs. 2001 to 2003, 2005.
Westinghouse Traction Brake Co.

ANGLE COCK HOLDER.
National Car Equipment Co.
Page 961; also Fig. 2022.

A. R. A. STANDARD "D" COUPLER.
(See Couplers.)

ARCH BARS.
American Car & Foundry Co.
Pressed Steel Car Co.

ARRESTERS, LIGHTNING.
General Electric Co.

AXLES.
American Car & Foundry Co.
Johnson & Co., J. R.
Page 679.
Standard Forgings Co.
Standard Steel Works Co.
Page 680.
St. Louis Car Co.

B

BAGGAGE CARS.
(See Cars, Passenger: Baggage, Express, and Postal.)

BAGGAGE RACKS.
Adams & Westlake Co.
Page 954; also Figs. 991, 992.
Dayton Mfg. Co.
Page 957; also Figs. 980 to 986.
Howard & Co., Jas. L.
Page 958; also Figs. 987 to 990.

BATTERIES, STORAGE.
Edison Storage Battery Co.
Pages 912, 913; also Figs. 2303 to 2309.
Electric Storage Battery Co.
Page 911; also Figs. 2292 to 2294.
Safety Car Heating & Lighting Co.
Page 917.
U. S. Light & Heat Corp.
Page 925.

BATTERY CHARGING EQUIPMENTS.
General Electric Co.
Kerite Insulated Wire & Cable Co.
Page 943.

BEARINGS, JOURNAL.
(See Journal Bearings.)

BELL AND SIGNAL CORD AND ACCESSORIES.
Adams & Westlake Co.
Dayton Mfg. Co.
Howard & Co., Jas. L.

BELLS AND GONGS.
Dayton Mfg. Co.

BERTH FITTINGS.
Adams & Westlake Co.
Figs. 394, 397, 400, 401, 402.
Dayton Mfg. Co.
Figs. 390, 395, 396, 398, 401.

BERTHS, SLEEPING CAR.
Hale & Kilburn Corp.

BILLETS.
McConway & Torley Co.
Standard Steel Works Co.

BLOWERS, ELECTRIC.
General Electric Co.

BOLSTERS, CAR BODY AND TRUCK.
American Car & Foundry Co.
Fig. 1440.
American Steel Foundries.
Page 631; also Figs. 604 to 610, 1435 to 1438.
Bettendorf Co.
Figs. 1441, 1442.
Buckeye Steel Castings Co.
Page 632; also Fig. 611.
Canadian Car & Foundry Co., Ltd.
Page 1122.
Commonwealth Steel Co.
Pages 376, 377; also Figs. 612 to 616, 621, 1450.
Gould Coupler Co.
Page 955; also Figs. 602, 1439.
Magor Car Corp.
National Railway Appliance Co.
Page 962.
Pressed Steel Car Co.
Pullman Co.
Page 965.
Republic Railway Equipment Co., Inc.
Page 637; also Figs. 1444 to 1446, 1453.
St. Louis Car Co.
Symington Co., T. H.
Fig. 1443.

BOLTS.
American Car & Foundry Co.

BORING MILLS, CAR WHEEL.
Niles-Bement-Pond Co.
Page 1175.

BOX CARS.
(See Cars, Freight, Box.)

BOX CAR END REINFORCEMENTS.
(See End Reinforcements, Freight Car.)

BRAKE AND LOCK FOR SLIDING DOORS.
Howard & Co., Jas. L.
Page 958.

BRAKE BEAMS AND PARTS.
American Steel Foundries.
Page 776; also Figs. 1695 to 1708.
Buffalo Brake Beam Co.
Figs. 1709 to 1716.
Canadian Car & Foundry Co., Ltd.
Page 1122.
Chicago Railway Equipment Co.
Page 781; also Figs. 1717 to 1719, 1725 to 1740.
Damascus Brake Beam Co.
Page 748; also Figs. 1741 to 1748.
Magor Car Corp.
Pressed Steel Car Co.
Pullman Co.
Page 965.
Republic Railway Equipment Co., Inc.
Pages 743, 745; also Figs. 1758 to 1763, 1767 to 1769.

BRAKE BEAM GUIDES.
Republic Railway Equipment Co., Inc.

BRAKE BEAM STRUTS AND FULCRUMS.
Chicago Railway Equipment Co.
Buffalo Brake Beam Co.
Page 747; also Fig. 1775.
Damascus Brake Beam Co.
Page 748; also Figs. 1774 to 1776.
National Malleable Castings Co.
Fig. 1823.
Magor Car Corp.
Republic Railway Equipment Co., Inc.
Fig. 1773.

BRAKE BEAM SUPPORTS AND SAFETY DEVICE.
American Steel Foundries.
Chicago Railway Equipment Co.
Page 761; also Figs. 1845 to 1848, 1854, 1855, 1860.

BRAKE EQUIPMENT, AIR AND HAND.
(See also Specific Parts.)
American Brake Co.
American Brake Shoe & Foundry Co.
American Steel Foundries.
Buffalo Brake Beam Co.
Chicago Railway Equipment Co.
Damascus Brake Beam Co.
Dayton Mfg. Co.
Howard & Co., Jas. L.
Miner, W. H.
National Brake Co.
National Malleable Castings Co.
National Railway Appliance Co.
Pressed Steel Car Co.
Republic Railway Equipment Co., Inc.
Standard Car Truck Co.
Schaefer Equipment Co.
Talmage Mfg. Co.
Universal Draft Gear Attachment Co.
Westinghouse Air Brake Co.
Westinghouse Traction Brake Co.

BRAKE GEAR AND DETAILS.
(See also Names of Specific Parts.)
American Brake Co.
Chicago Railway Equipment Co.
Gregg Co., Ltd.
Magor Car Corp.
National Malleable Castings Co.
Republic Railway Equipment Co., Inc.
Schaefer Equipment Co.

BRAKE HANDLES, WHEELS AND STAFFS.
(See Brakes, Hand.)

BRAKE HANGERS.
Schaefer Equipment Co.
Page 757; also Figs. 1830, 1831, 1832.

BRAKE HEADS.
American Brake Shoe & Foundry Co.
American Steel Foundries.
Figs. 1777, 1780, 1780A.
Buffalo Brake Beam Co.
Fig. 1778.
Chicago Railway Equipment Co.
Figs. 1797, 1798, 1799, 1800.
Damascus Brake Beam Co.
Fig. 1779.
Magor Car Corp.
Republic Railway Equipment Co., Inc.
Page 743; also Fig. 1801.

BRAKE JAWS.
National Malleable Castings Co.
Figs. 1814, 1817, 1821.
National Railway Appliance Co.
Fig. 1811.
Schaefer Equipment Co.
Pages 756, 757; also Fig. 1820.

BRAKE LEVER CONNECTIONS, TRUCK.

National Malleable Castings Co.
Fig. 1818.
Schaefer Equipment Co.
Page 755; also Figs. 1826, 1827.

BRAKE LEVERS.

National Malleable Castings Co.
Figs. 1815, 1816.
Schaefer Equipment Co.
Page 756.

BRAKE MECHANISM, HAND.

(See Brakes, Hand.)

BRAKE PIPE ANCHOR.

National Car Equipment Co.
Page 961; also Figs. 2023, 2024.

BRAKE SHOE KEYS.

American Brake Shoe & Foundry Co.
Buffalo Brake Beam Co.
Page 747.
Magor Car Corp.
National Malleable Castings Co.
Fig. 1824.

BRAKE SHOES.

American Brake Shoe & Foundry Co.
Page 749.
American Car & Foundry Co.
Magor Car Corp.
Weierbach Brake Shoe Co.
Page 751.

BRAKE SLACK ADJUSTERS.

(See Slack Adjusters.)

BRAKE STEPS, FREIGHT CAR.

Morton Mfg. Co.
Fig. 2068.

BRAKES, CLASP.

American Brake Co.
American Steel Foundries.
Page 766; also Figs. 1698, 1699, 1861 to 1866.
Chicago Railway Equipment Co.
Figs. 1856, 1857.

BRAKES, ELECTRO-PNEUMATIC.

Westinghouse Air Brake Co.
Figs. 1948 to 1950, 1952.
Westinghouse Traction Brake Co.

BRAKES, HAND.

Adams & Westlake Co.
Fig. 266.
Dayton Mfg. Co.
Page 957.
Howard & Co., Jas. L.
Fig. 2079.
Miner, W. H.
Page 843; also Figs. 2034 to 2038.
National Brake Co.
Page 845; also Figs. 2041, 2042.
National Malleable Castings Co.
Figs. 2048 to 2059.
National Railway Appliance Co.
Page 962; also Fig. 2064.
Pressed Steel Car Co.
Fig. 2061.
Standard Car Truck Co.
Fig. 2063.
Talmage Mfg. Co.
Page 849.
Universal Draft Gear Attachment Co.
Page 970.

BRAKES, TRIPLE.

Chicago Railway Equipment Co.
Figs. 1858, 1859.

BRASSES, JOURNAL BOX.

(See Journal Bearings.)

BROILERS, GAS OPERATED.

Safety Car Heating & Lighting Co.
Figs. 377 to 379.

BUCKETS, POWER AND GRAB.

Brown Hoisting Machinery Co.
Pages 955, 987; also Figs. 2647, 2648, 2652, 2653, 2655.
Industrial Works.
McMyler Interstate Co.
Page 996.

BUFFERS.

Gould Coupler Co.
Page 955; also Figs. 1094, 1096.
Magor Car Corp.
McConway & Torley Co., The.
Fig. 1086.
Miner, W. H.
Page 501; also Figs. 1087, 1087A.
Standard Coupler Co.
Page 503; also Fig. 1091A.
Waugh Draft Gear Co.
Page 505; also Figs. 1093, 1097, 1156.
Westinghouse Air Brake Co.

BUFFING MECHANISM, FOR VESTIBULE DIAPHRAGM.

Morton Mfg. Co.
Fig. 790.

C

CABLES, ELECTRIC.

General Electric Co.
Kerite Insulated Wire & Cable Co.
Page 943.

CABOOSES.

(See Cars, Freight: Caboose.)

CAR BODY AND FRAMING DETAILS.

(See names of specific parts.)

CAR DETAILS, FOREIGN.

Middletown Car Co.
Pages 1130, 1131.
Standard Steel Car Co.
Pages 1130, 1131.
Standard Steel Works Co.
Page 1132.
(For other builders, see Cars, Foreign.)

CAR DUMPING MACHINES.

(See Dumping Machines.)

CAR HEATING APPARATUS.

(See Heating Apparatus, Passenger Train.)

CAR LIGHTING EQUIPMENTS.

(See Lighting Equipments, Passenger Train.)

CAR LIGHTING FIXTURES.

(See Lighting Fixtures.)

CAR LINING.

Hickman Lumber Co., W. R.
Page 1056.
Southern Pine Assn.

CAR SEATS.

American Car & Foundry Co.
Chase & Co., L. C.
Hale & Kilburn Corp.
Pages 452, 453; also Figs. 993 to 1009, 1027, 1028.
Heywood-Wakefield Co.
Page 485; also Figs. 1012 to 1018, 1025, 1026.
St. Louis Car Co.

CAR SILLS, WOODEN.

Hickman Lumber Co., W. R.
Page 1056.
Southern Pine Assn.

CAR TRIMMINGS.

(See names of specific parts.)

CARLINES.

American Car & Foundry Co.
Camel Co.
Fig. 758.
Chicago Cleveland Car Roofing Co.
Figs. 762 to 765.
Hutchins Car Roofing Co.
Pressed Steel Car Co.
Standard Railway Equipment Co.
Figs. 759 to 761.

CARRY IRONS, COUPLER.

Commonwealth Steel Co.
Figs. 1329 to 1334.
Gould Coupler Co.
Fig. 1327.

CARS, ASPHALT AND ASH.

(See Cars, Industrial.)

CARS, FOREIGN.

American Car & Foundry Co.
Pages 1142, 1143; also Figs. 2828, 2837 to 2840, 2845, 2870, 2884.
Bethlehem Shipbuilding Corp., Ltd.
Figs. 2825, 2829, 2835, 2841 to 2844.
Brill Co., The J. G.
Figs. 2832, 2833.
Canadian Car & Foundry Co., Ltd.
Pages 1122 to 1125; also Fig. 2858.
Gregg Company, Ltd.
Page 1144; also Figs. 2836, 2851, 2856, 2862, 2866, 2876, 2878, 2880, 2881, 2885, 2886, 2890, 2908, 2909.
Magor Car Corp.
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Middletown Car Co.
Pages 1127 to 1131; also Figs. 2826, 2827, 2834, 2854, 2857, 2859, 2860, 2863, 2871, 2877, 2883, 2906.
National Dump Car Co.
National Steel Car Corp., Ltd.
Page 1126; also Figs. 2848, 2855, 2869, 2889.

CARS, FOREIGN—Continued.

Pressed Steel Car Co.
Figs. 2846, 2867, 2868, 2873, 2874, 2879, 2888, 2899, 2902.
Pullman Co.
Fig. 2864.
Ralston Steel Car Co.
Rodger Ballast Car Co.
Standard Steel Car Co.
Pages 1127 to 1131.
Standard Steel Works Co.
Page 1132.

CARS, FREIGHT.

(See also different classes of freight cars.)

American Car & Foundry Co.
Bettendorf Company.
Brill Co., The J. G.
Canadian Car & Foundry Co., Ltd.
Clark Car Co.
Enterprise Railway Equipment Co.
Gregg Company, Ltd.
Greenville Steel Car Co.
Kilbourne & Jacobs Mfg. Co.
Magor Car Corp.
Middletown Car Co.
National Dump Car Co.
National Railway Appliance Co.
National Steel Car Corp., Ltd.
Pressed Steel Car Co.
Pullman Company.
Ralston Steel Car Co.
Rodger Ballast Car Co.
Ryan Car Co.
St. Louis Car Co.
Standard Steel Car Co.
Western Wheeled Scraper Co.
Youngstown Steel Car Co.

CARS, FREIGHT: BALLAST.

Clark Car Co.
Pages 188, 189.
Gregg Co., Ltd.
Kilbourne & Jacobs Mfg. Co.
Page 191.
Rodgers Ballast Car Co.
Page 149.
Western Wheeled Scraper Co.
Page 193.

CARS, FREIGHT: BOX.

American Car & Foundry Co.
Figs. 1, 2, 15, 23 to 25, 2845.
Bettendorf Company.
Page 276.
Canadian Car & Foundry Co., Ltd.
Pages 1122, 1123, 1124; also Figs. 3, 21, 22, 42, 43, 2858.
Enterprise Railway Equipment Co.
Page 127; also Figs. 31, 34.
Gregg Co., Ltd.
Page 1144; also Figs. 2850, 2851, 2856, 2862.
Magor Car Corporation.
Pages 960, 1126; also Figs. 2849, 2852, 2853.
Middletown Car Co.
Page 1127; also Figs. 2854, 2857, 2859, 2860.
National Steel Car Corp., Ltd.
Pages 960, 1126; also Figs. 30, 2848, 2855.
Pressed Steel Car Co.
Page 966; also Fig. 2846.
Pullman Company.
Page 965.
Ralston Steel Car Co.
Figs. 17 to 20.
St. Louis Car Co.
Page 967.
Standard Steel Car Co.
Pages 109, 1127; also Fig. 9.

CARS, FREIGHT: CABOOSE OR CABIN.

American Car & Foundry Co.
Fig. 322.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: COAL.

(See also Cars, Freight: Gondola and Hopper.)

CARS, FREIGHT: CONVERTIBLE.

Enterprise Railway Equipment Co.
Pages 121, 144, 145; also Figs. 31, 34, 68, 69, 71, 74, 76, 77, 82, 83, 175, 177.
Kilbourne & Jacobs Mfg. Co.
National Dump Car Co.
Page 153; also Figs. 191 to 193.
Pressed Steel Car Co.
Fig. 70.
Rodger Ballast Car Co.
Page 149; also Figs. 86, 87, 88, 93, 94.

CARS, FREIGHT: DUMP.

Clark Car Co.
Pages 188, 189; also Figs. 156 to 158.
Enterprise Railway Equipment Co.
Gregg Co., Ltd.
Fig. 163.
Kilbourne & Jacobs Mfg. Co.
Page 191; also Figs. 164, 165.
Magor Car Corp.
Fig. 169.

CARS, FREIGHT: DUMP—Continued.
National Dump Car Co.
Page 183.
Western Wheeled Scraper Co.
Page 193; also Fig. 171.

CARS, FREIGHT: FLAT.
American Car & Foundry Co.
Figs. 44, 54.
Canadian Car & Foundry Co.
Page 1124; also Figs. 42, 43.
Gregg Co., Ltd.
Fig. 2890.
National Steel Car Corp., Ltd.
Figs. 55, 2889.
Pressed Steel Car Co.
Figs. 45, 2888.
Pullman Company.
Fig. 2887.
Ralston Steel Car Co.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: GONDOLA.
American Car & Foundry Co.
Page 1121; also Figs. 2870, 2884.
Bettendorf Co.
Page 276; also Figs. 97, 98.
Canadian Car & Foundry Co., Ltd.
Pages 1123, 1124.
Enterprise Railway Equipment Co.
Pages 144, 145; also Figs. 68, 69, 71 to 74, 76, 77, 82, 83.
Gregg Co., Ltd.
Page 1144; also Figs. 2866, 2876, 2877, 2880, 2881, 2885, 2886.
Magor Car Corp., Ltd.
Fig. 2875.
Middletown Car Co.
Page 1129; also Figs. 2871, 2878, 2883.
National Dump Car Co.
Figs. 94, 96.
National Steel Car Corp., Ltd.
Fig. 2869.
Pullman Co.
Page 965; also Fig. 185.
Pressed Steel Car Co.
Page 966; also Figs. 56 to 59, 70, 2867, 2868, 2873, 2874, 2879.
Ralston Steel Car Co.
Page 277; also Fig. 99.
Rodger Ballast Car Co.
Page 149; also Figs. 86 to 88, 93.
St. Louis Car Co.
Page 967.
Standard Steel Car Co.
Pages 137, 1129; also Fig. 65.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: HOPPER.
American Car & Foundry Co.
Page 1121; also Fig. 154.
Bettendorf Co.
Fig. 139.
Clark Car Co.
Figs. 151, 153.
Enterprise Railway Equipment Co.
Figs. 123 to 127, 144.
Gregg Co., Ltd.
Figs. 2903, 2904.
Magor Car Corp.
Fig. 2900.
National Steel Car Corp., Ltd.
Figs. 2901, 2902.
National Dump Car Co.
Page 183; also Fig. 145.
Pressed Steel Car Co.
Figs. 102 to 104, 140 to 142, 149, 150, 2899.
Pullman Co.
Figs. 129, 155.
Ralston Steel Car Co.
Page 277.
Standard Steel Car Co.
Figs. 116, 131 and 135.
Youngstown Steel Car Co.
Fig. 2905.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: ORE.
American Car & Foundry Co.
Fig. 154.
Enterprise Railway Equipment Co.
Pages 166, 167.
Gregg Co., Ltd.
Fig. 2985.
Pullman Co.
Fig. 155.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: POULTRY.
American Car & Foundry Co.
Fig. 198.
(For other builders see Cars, Freight.)

CARS, FREIGHT: REFRIGERATOR.
American Car & Foundry Co.
Figs. 207, 208, 223 to 227.
Middletown Car Co.
Fig. 2863.
National Steel Car Corp., Ltd.
Figs. 214 to 216.

CARS, FREIGHT: REFRIGERATOR.—Cont.
Pressed Steel Car Co.
Figs. 233 to 235.
Pullman Co.
Page 964; also Figs. 207, 208, 2864.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: REFRIGERATION AND HEATING.
Gold Car Heating & Lighting Co.
Figs. 266, 267.

CARS, FREIGHT: STOCK.
American Car & Foundry Co.
Figs. 182 to 184, 189, 194, 196, 197.
Bettendorf Co.
Enterprise Railway Equipment Co.
Figs. 175, 177.
Middletown Car Co.
Page 1128; also Fig. 2863.
National Dump Car Co.
Figs. 191, 193.
National Steel Car Corp., Ltd.
Fig. 181.
Pressed Steel Car Co.
Fig. 190.
Pullman Co.
Figs. 174, 188.
Ralston Steel Car Co.
Figs. 178 to 180.
Standard Steel Car Co.
Page 1128; also Fig. 176.
(For other builders, see Cars, Freight.)

CARS, FREIGHT: STOCK AND COKE.
American Car & Foundry Co.
Fig. 2865.
Enterprise Railway Equipment Co.
Figs. 175, 177.
Pullman Co.
Fig. 174.

CARS, FREIGHT: TANK.
American Car & Foundry Co.
Pages 266, 267; also Figs. 286 to 288.
Canadian Car & Foundry Co.
Page 1125; also Figs. 293 to 295.
Enterprise Railway Equipment Co.
Figs. 296, 297.
Gregg Co., Ltd.
Page 1144; also Figs. 301, 2908, 2909.
Magor Car Corp
Fig. 2907.
Middletown Car Co.
Fig. 2906.
Pressed Steel Car Co.
Fig. 282.
Pullman Co.
Page 965.
(For other builders, see Cars: Freight.)

CARS, INDUSTRIAL.
American Car & Foundry Co.
Page 1121; also Figs. 2865, 2892, 2915, 3014 to 3016.
Brill Co., The J. G.
Canadian Car & Foundry Co., Ltd.
Gregg Company, Ltd.
Page 1144; also Figs. 2893, 2903, 2904, 2912, 2916, 2919, 2920, 2922 to 2931, 2985, 2990, 2999, 3003, 3004, 3006, 3008, 3019, 3023, 3025, 3027, 3029.
Magor Car Corp.
Page 1126; also Figs. 2852, 2853, 2894, 2900, 2907, 2917, 2918, 2921.
Middletown Car Co.
National Dump Car Co.
National Steel Car Corp., Ltd.
Page 1126.
Pressed Steel Car Co.
Fig. 2911.
Ralston Steel Car Co.
Rodger Ballast Car Co.
Standard Steel Car Co.
Figs. 2910, 2914.
Western Wheeled Scraper Co.
Fig. 3022.
Youngstown Steel Car Co.
Fig. 2905.

CARS, INDUSTRIAL: BANANA.
Magor Car Corp.
Fig. 2852.
(For other builders, see Cars, Industrial.)

CARS, INDUSTRIAL: CANE.
American Car & Foundry Co.
Fig. 2915.
Gregg Co., Ltd.
Page 1144; also Figs. 2912, 2916, 2919, 2920, 2922, 2923-2931.
Magor Car Corp.
Page 1126; also Figs. 2917, 2918, 2921.
National Steel Car Corp., Ltd.
Page 1126.
Pressed Steel Car Co.
Fig. 2911.
Standard Steel Car Co.
Figs. 2911, 2914.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: CONCRETE.
Gregg Co., Ltd.
Fig. 2990.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: CONTRACTORS, DUMP.
American Car & Foundry Co.
Fig. 3016.
Gregg Co., Ltd.
Figs. 2990, 3019.
Magor Car Corp.
Kilbourne & Jacobs Mfg. Co.
Western Wheeled Scraper Co.
Figs. 3020, 3022.

CARS, INDUSTRIAL: LOGGING.
American Car & Foundry Co.
Page 1121; also Fig. 2892.
Bettendorf Co.
Fig. 2898.
Gregg Co., Ltd.
Fig. 2893.
Magor Car Corp.
Page 1126; also Figs. 2894, 2897.
National Steel Car Corp., Ltd.
Page 1126.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: MINE.
American Car & Foundry Co.
Pages 1121, 1142, 1143; also Fig. 3015.
Gregg Co., Ltd.
Figs. 3006, 3008.
Magor Car Corp.
Pressed Steel Car Co.
Ralston Steel Car Co.
Youngstown Steel Car Co.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: OVEN.
Gregg Co., Ltd.
Figs. 3027, 3029.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: PHOSPHATE.
Standard Steel Car Co.
Figs. 133 to 135.
(For other builders see Cars, Industrial.)

CARS, INDUSTRIAL: PLATFORM.
Gregg Co., Ltd.
Figs. 3023, 3025.
(For other builders see Cars: Industrial.)

CARS, PASSENGER.
American Car & Foundry Co.
Brill Co., The J. G.
Canadian Car & Foundry Co., Ltd.
General Electric Co.
Gregg Co., Ltd.
Magor Car Corp.
National Steel Car Corp., Ltd.
Middletown Car Co.
Pressed Steel Car Co.
Pullman Company.
St. Louis Car Co.
Service Motor Truck Co.
Standard Steel Car Co.

CARS, PASSENGER: BAGGAGE, EXPRESS, POSTAL AND ANIMAL.
American Car & Foundry Co.
Figs. 408 to 412, 423, 428, 429, 430, 466 to 468.
Bethlehem Shipbuilding Corp., Ltd.
Page 314; also Figs. 469, 2842, 2843, 2844.
National Steel Car Corp., Ltd.
Fig. 419.
Pressed Steel Car Co.
Page 966.
Pullman Co.
Figs. 373, 420, 421.
St. Louis Car Co.
Standard Steel Car Co.
Fig. 415.
(For other builders, see Cars, Passenger.)

CARS, PASSENGER: BUFFET, CAFE, DINING.
American Car & Foundry Co.
Figs. 356, 364, 365, 370, 2839, 2840.
Bethlehem Shipbuilding Corp., Ltd.
Page 314; also Figs. 362, 363.
Canadian Car & Foundry Co., Ltd.
Fig. 368.
Pullman Co.
Figs. 366, 367, 373, 432, 433.
(For other builders see Cars, Passenger.)

CARS, PASSENGER: CHAIR, CLUB, PARLOR.
American Car & Foundry Co.
Figs. 351, 352.
Bethlehem Shipbuilding Corp., Ltd.
Page 314.
Pullman Co.
Figs. 349, 350, 353, 359, 432, 433.
(For other builders see Cars, Passenger.)

CARS, PASSENGER: COACHES.
American Car & Foundry Co.
Figs. 325, 326, 351, 352, 2828.
Bethlehem Shipbuilding Corp., Ltd.
Page 314; also Figs. 323, 324, 331, 2825, 2827, 2829, 2841, 2842.
Brill & Co., J. G.
Fig. 2833.
Gregg Co., Ltd.
Fig. 2836.

CARS, PASSENGER: COACHES—Continued.
Middletown Car Co.
Figs. 2826, 2834.
Pressed Steel Car Co.
Page 966; also Figs. 344 to 348.
Pullman Co.
Page 964; also Figs. 332 to 343, 353, 432, 433.
Standard Steel Car Co.
Figs. 327 to 330.
(For other builders see Cars: Passenger.)

CARS, PASSENGER: ELECTRIC.
American Car & Foundry Co.
Fig. 482.
Pressed Steel Car Co.
Figs. 478, 479.
St. Louis Car Co.
Figs. 481, 483 to 486.
Standard Steel Car Co.
Figs. 475 to 477, 480.

CARS, PASSENGER: GAS-ELECTRIC.
General Electric Co.
Fig. 541.

CARS, PASSENGER: GASOLINE.
Brill Co., The J. G.
Page 355; also Figs. 544 to 546, 549, 550.
St. Louis Car Co.
Page 967.
Service Motor Truck Co.
Page 359; also Figs. 555 to 557.

CARS, PASSENGER: OBSERVATION.
Canadian Car & Foundry Co.
Figs. 357, 358.
Pullman Co.
Figs. 360, 432, 433.
(For other builders see Cars: Passenger.)

CARS, PASSENGER: POSTAL.
(See Cars, Passenger: Baggage, Express, and Postal.)

CARS, PASSENGER: SLEEPING AND COMPARTMENT.
American Car & Foundry Co.
Figs. 2837, 2838.
Bethlehem Shipbuilding Corp., Ltd.
Fig. 2835.
Canadian Car & Foundry Co., Ltd.
Figs. 357, 358.
Magor Car Corp.
Page 960.
National Steel Car Corp., Ltd.
Page 960; also Figs. 380 to 385.
Pullman Co.
Page 964; also Figs. 354, 360, 386, 387, 391, 392.
St. Louis Car Co.
Page 967.
(For other builders see Cars: Passenger.)

CARS, PRIVATE.
American Car & Foundry Co.
Fig. 355.
(For other builders see Cars, Passenger.)

CARS, RAIL SAW.
Industrial Works.
Fig. 2679.

CARS, REPAIRED AND REBUILT.
American Car & Foundry Co.
Page 1164.
Bethlehem Shipbuilding Corp., Ltd.
Brill Co., The J. G.
Buffalo Steel Car Co.
Pages 1166, 1167.
Canadian Car and Foundry Co., Ltd.
Greenville Steel Car Co.
Page 1165.
Gregg Company, Ltd.
Pages 1195 to 1197.
Magor Car Corp.
Middletown Car Co.
National Steel Car Corp., Ltd.
Pressed Steel Car Co.
Pullman Co.
Pages 964, 965.
Ralston Steel Car Co.
Page 1168.
Ryan Car Co.
Page 1169.
St. Louis Car Co.
Standard Steel Car Co.
Youngstown Steel Car Co.
Pages 1170, 1171.

CARS, SPREADER.
Western Wheeled Scraper Co.

CARS, WEED BURNER.
Commonwealth Steel Co.
Fig. 2680.

CASTINGS, BRASS AND BRONZE.
Adams & Westlake Co.
Bethlehem Shipbuilding Corp., Ltd.
Howard & Co., Jas. L.

CASTINGS, BRASS AND BRONZE—Continued.
St. Louis Car Co.

CASTINGS, IRON AND STEEL.
American Brake Shoe & Foundry Co.
American Car & Foundry Co.
American Steel Foundries.
Bethlehem Shipbuilding Co.
Buckeye Jack Mfg. Co.
Buckeye Steel Castings Co.
Page 632.
Canadian Car & Foundry Co., Ltd.
Page 1122.
Chicago Railway Equipment Co.
Gould Coupler Co.
Gregg Co., Ltd.
Magor Car Corp.
McConway & Torley Co.
National Malleable Castings Co.
Pressed Steel Car Co.
Standard Steel Works Co.
Page 1070.
St. Louis Car Co.
Union Spring & Mfg. Co.

CASTINGS, WHITE METAL.
Adams & Westlake Co.

CENTER BEARINGS AND PLATES.
Chicago Railway Equipment Co.
Magor Car Corp.
Miner, W. H.
Figs. 1468, 1469.
National Railway Appliance Co.
Symington Co., T. H.
Figs. 1466, 1467.
Standard Forgings Co.
Page 968.
Woods, Edwin, S. & Co.
Page 656; also Fig. 1465.

CENTER PINS.
Magor Car Corp.
Miner, W. H.
Fig. 1469.

CENTER PLATE SHIMS.
Miner, W. H.
Fig 1468.

CENTER PLATES.
(See Center Bearings and Plates.)

CENTERING DEVICE, COUPLER.
(See Coupler Centering Device.)

CHAINS, COUPLING.
Magor Car Corp.

CHAIR CARS.
(See Cars, Passenger: Chair.)

CHAIRS, REVOLVING AND STATIONARY.
(See Car Seats.)

CHAIRS, DINING AND PARLOR CAR.
(See Car Seats.)

CHANDELIERS.
(See Lighting Fixtures.)

CIRCUIT BREAKERS.
General Electric Co.
Fig. 537.

CLAMPS, HOSE.
(See Hose Clamps.)

CLOSETS, FLUSH OR DRY.
Adams & Westlake Co.
Figs. 1080, 1083.
Dayton Mfg. Co.
Page 956.
Duner Co.
Page 495; also Figs. 1072 to 1075.
Howard & Co., Jas. L.
Fig. 1082.

COAL AND ORE HANDLING MACHINERY.
McMyler Interstate Co.

COCKS, BRAKE AND SIGNAL.
Westinghouse Air Brake Co.
Westinghouse Traction Brake Co.

COKE CARS.
(See Cars, Freight: Stock and Coke.)

COMPRESSORS, AIR (SHOP).
General Electric Co.
Westinghouse Air Brake Co.
Westinghouse Traction Brake Co.

COMPRESSORS, AIR BRAKE.
(See Air Compressors.)

CONNECTIONS, FLEXIBLE.
Barco Mfg. Co.
Page 859; also Figs. 2107-2111.
International Couplers Co.
Page 861; also Figs. 2116-2121.
Vapor Car Heating Co.
Page 877; also Fig. 2192.

CONNECTORS, AUTOMATIC.
Westinghouse Air Brake Co.
Page 854; also Figs. 2080-2088.
Westinghouse Traction Brake Co.

CONTACT SHOES.
General Electric Co.
Fig. 511.

CONTROLLERS, MOTOR AND CRANE.
General Electric Co.
Figs. 512, 513, 515, 522-524 inc., 526.

COTTER PINS AND SPLIT KEYS.
Columbia Nut & Bolt Co.

COUPLER CENTERING DEVICE.
Gould Coupler Co.
Page 935; also Fig. 1327.
Miner, W. H.
Fig. 1324.
National Malleable Castings Co.
Fig. 1325.
Waugh Draft Gear Co.
Figs. 1326, 1328.

COUPLERS.
A. R. A. Standard "D" Coupler.
Pages 570 to 573.
American Steel Foundries.
Pages 570 to 573, 575; also Figs. 1266 to 1269.
Buckeye Steel Castings Co.
Pages 570 to 573, 599; also Figs. 1304, 1305.
Canadian Car & Foundry Co., Ltd.
Page 1122.
Gould Coupler Co.
Pages 570 to 573, 955; also Figs. 1274 to 1276, 1303, 1320.
Gregg Co., Ltd.
Magor Car Corp.
McConway & Torley Co.
Pages 570 to 573, 579, 580, 583, 585; also Figs. 1277, 1278, 1287 to 1289, 1297, 1298, 1300, 1301.
National Malleable Castings Co.
Pages 570 to 573, 591; also Figs, 1307, 1308, 1309, 1312 to 1318.
St. Louis Car Co.
Standard Coupler Co.
Symington Co., T. H.
Fig. 1319.

COUPLERS, A. R. A. STANDARD "D."
American Steel Foundries.
Pages 570 to 573; also Figs. 1246, 1247.
Buckeye Steel Castings Co.
Pages 570 to 573, 599; also Figs. 1246, 1247.
Gould Coupler Co.
Pages 570 to 573; also Figs. 1246, 1247.
McConway & Torley Co.
Pages 570 to 573; also Figs. 1246, 1247.
National Malleable Castings Co.
Pages 570 to 573; also Figs. 1246, 1247.

COUPLINGS, FLEXIBLE.
Barco Mfg. Co.
Page 859; also Figs. 2107-2111.
International Couplers Co.
Page 861; also Figs. 2116-2121.

COUPLINGS, HOSE AND STEAM.
(See Hose Couplers, Steam and Air.)

COVERING, CAR SEATS.
(See Seat Coverings.)

CRANE WHEELS.
Griffin Wheel Co.

CRANES, BRIDGE, DOCK; FLOATING; GANTRY; PILLAR PORTAL; SHOP.
Brown Hoisting Machinery Co.
McMyler Interstate Co.
Niles-Bement-Pond Co.

CRANES, CONVERTIBLE.
Industrial Works.
Page 991.

CRANES, INDUSTRIAL.
Brown Hoisting Machinery Co.
Industrial Works.
McMyler Interstate Co.
Niles-Bement-Pond Co.

CRANES, LOCOMOTIVE.
Brown Hoisting Machinery Co.
Pages 985, 987; also Figs. 2647, 2648, 2652-2655.
Industrial Works.
Pages 989, 991; also Fig. 2660.
McMyler Interstate Co.
Pages 993, 994; also Figs. 2668, 2669, 2672.

CRANES, TRACTOR.

Industrial Works.
Page 989.

CRANES, WRECKING.

Industrial Works.
Page 989; also Figs. 2631, 2659.

CURTAIN GUIDES.

Edwards Co., Inc., The O. M.

CURTAIN HANDLES, FOR VESTIBULE DIAPHRAGMS.

Morton Mfg. Co.
Figs. 792 to 795.

CURTAIN FIXTURES, WINDOW.

Morton Mfg. Co.
Page 463; also Fig. 882.
National Lock Washer Co.
Page 467; also Figs. 899-903 inc.

CURTAIN MATERIAL.

Pantasote Co.
Page 963.
Standard Textile Products Co.
Page 969.

CURTAIN ROLLERS.

National Lock Washer Co.
Page 467; also Figs. 899, 900.

CURTAINS, CAR.

Morton Mfg. Co.
National Lock Washer Co.
Page 467.
St. Louis Car Co.

CURTAINS, DIAPHRAGM FOR VESTIBULES.

Morton Mfg. Co.
Fig. 791.

CUSPIDORS.

Adams & Westlake Co.

CYLINDERS, AIR BRAKE.

Westinghouse Air Brake Co.
Pages 783, 785; also Figs. 1887 to 1893, 1899, 1906 to 1914, 1924 to 1926, 1933, 1935, 1947 to 1950, 1952 to 1954, 1964, 1965.
Westinghouse Traction Brake Co.

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DAY COACHES.

(See Cars, Passenger: Coaches.)

DEAD LEVER GUIDES.

National Malleable Castings Co.

DECK LIGHT.

Adams & Westlake Co.
Fig. 935.

DECK SASH FIXTURES.

Adams & Westlake Co.
Figs. 941 to 943, 945, 946.
Dayton Mfg. Co.
Figs. 922, 930, 936, 937.
Howard & Co., Jas. L.
Fig. 944.
Tuco Products Corporation.
Page 471.

DECK SASH OPENERS.

Adams & Westlake Co.
Figs. 938, 940.
Dayton Mfg. Co.

DIAPHRAGMS, VESTIBULE.

(See Vestibule Diaphragms.)

DIRT COLLECTORS, CENTRIFUGAL (AIR BRAKE SYSTEMS).

Westinghouse Air Brake Co.
Figs. 1911, 1912, 1914.
Westinghouse Traction Brake Co.

DOOR OPERATING MECHANISMS, BOX, HOPPER AND GONDOLA CARS.

Camel Co.
Pages 401, 403, 405.
Enterprise Railway Equipment Co.
Pages 121, 144, 145, 166, 167.

DOOR SHIELD, PASSENGER CAR.

Morton Mfg. Co.
Page 959.

DOOR STOPS, FREIGHT CAR.

Camel Co.
Page 405.
National Malleable Castings Co.
Fig. 692.

DOORS AND FIXTURES, FREIGHT CAR.

(See also Dumping Apparatus.)

American Car & Foundry Co.
Fig. 676.
Camel Co.
Pages 401, 403, 405; also Figs. 660, 661, 664, 665, 668, 669.
Damascus Brake Beam Co.
Fig. 685.
Magor Car Corp.
Miner, W. H.
Page 235; also Fig. 255.
National Malleable Castings Co.
Figs. 688-693.
National Railway Appliance Co.
Page 962.
Ralston Steel Car Co.
Fig. 680.

DOORS AND FIXTURES, PASSENGER CAR.

Adams & Westlake Co.
Fig. 712.
American Motor Body Corp.
(See Hale & Kilburn Corp.)
Dayton Mfg. Co.
Dahlstrom Metallic Door Co.
Page 419; also Figs. 721, 722.
Edwards Co., Inc., O. M.
Hale & Kilburn Corp.
Figs. 715, 719, 720.
Howard, Jas. L., & Co.
Figs. 709, 710.
Morton Mfg. Co.
Page 959; also Figs. 716-718 inc.

DOORS, DUMPING APPARATUS FOR FREIGHT CAR.

(See Dumping Apparatus.)

DOORS, GRAIN.

Enterprise Railway Equipment Co.
Page 121.

DOORS, REFRIGERATOR CAR.

Miner, W. H.
Page 235; also Fig. 255.

DRAFT ARMS.

American Steel Foundries.
Pages 542, 543; also Fig. 1176.
Bradford Draft Gear Co.
Page 509.
Universal Draft Gear Attachment Co.
Page 541; also Figs. 1175, 1180 to 1182.

DRAFT GEAR ATTACHMENTS.

Pullman Co.
Standard Forgings Co.
Page 968.
Symington Co., T. H.
Page 549; also Figs. 1204-1206 inc.
Universal Draft Gear Attachment Co.
Pages 553, 555; also Figs. 1214, 1217, 1218, 1221, 1222, 1224, 1225.

DRAFT GEARS.

Bradford Draft Gear Co.
Page 509; also Figs. 1102 to 1104.
Commonwealth Steel Co.
Page 511; also Figs. 1106 to 1109.
Gould Coupler Co.
Page 955; also Fig. 1136.
Gregg Co., Ltd.
Keyoke Railway Equipment Co.
Page 513; also Figs. 1113, 1115, 1116, 1117.
Miner, W. H.
Pages 501, 517, 519; also Figs. 1123, 1124, 1125, 1128 to 1130.
National Malleable Castings Co.
Figs. 1098 to 1101, 1147 to 1155.
Standard Coupler Co.
Pages 521, 523; also Figs. 1133, 1137, 1138.
Standard Forgings Co.
Page 535; also Fig. 1162.
Union Draft Gear Co.
Pages 525, 527; also Figs. 1140, 1141, 1144, 1145, 1220.
Waugh Draft Gear Co.
Page 533; also Figs. 1156, 1158 to 1160.
Westinghouse Air Brake Co.
Page 537; also Figs. 1165, 1170, 1171, 1219, 1224, 1225.

DRAFT RIGGING, SPRING.

(See Draft Gear Attachments.)

DRAG LINE SCRAPER.

(See Excavators.)

DRILLS.

Niles-Bement-Pond Co.

DRIP TRAYS.

Howard & Co., Jas. L.
Fig. 1033.

DUMP CARS.

(See Cars, Freight: Dump.)

DUMPING APPARATUS, CAR DOOR.

Bettendorf Co.
Fig. 698.
Enterprise Railway Equipment Co.
Pages 121, 144, 145, 166, 167; also Figs. 77, 82, 83.
Magor Car Corp.
National Railway Appliance Co.
Page 962; also Fig. 699.
Pressed Steel Car Co.
Figs. 696, 697.
Standard Steel Car Co.
Figs. 694, 695, 700, 701.
Wine Railway Appliance Co.
Page 415; also Figs. 702-704 inc.

DUMPING MACHINES, CAR.

Brown Hoisting Machinery Co.
McMyler Interstate Co.
Page 997.

DUST GUARDS.

Magor Car Corp.
Symington Co., T. H.
Page 673; also Fig. 1563.

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ELECTRIC APPARATUS AND SUPPLIES.

(See names of Specific Equipment.)

END FRAMES.

Commonwealth Steel Co.
Page 377; also Fig. 621.

END REINFORCEMENTS; FREIGHT CAR.

Chicago Cleveland Car Roofing Co.
Page 385; also Figs. 626-629 inc.
Hutchins Car Roofing Co.
Fig. 634.

ENDS, STEEL, FOR FREIGHT CARS.

Hutchins Car Roofing Co.
Page 387; also Fig. 632.

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Brown Hoisting Machinery Co.
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FANS, ELECTRIC.

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American Car & Foundry Co.
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Pressed Steel Car Co.
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FULCRUMS, BRAKE LEVER.
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G

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Westinghouse Air Brake Co.
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GAGES, PRESSURE FOR STEAM.
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HEATING SYSTEMS, PASSENGER TRAIN.
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HOPPER CAR DOOR DEVICES.
Enterprise Railway Equipment Co.
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HOPPERS, FLUSH AND DRY.
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HOSE NIPPLES, STEAM.
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Fig. 2161.

HOSE PROTECTORS.
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McConway & Torley Co.
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INTERIOR FINISH.
Dahlstrom Metalic Door Co.
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Hale & Kilburn Corp.
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International Couplers Co.

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Gregg Co., Ltd.
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KEYS, SPRING AND RIVETED.
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LAMPS AND LANTERNS.

(See also Lighting Fixtures.)

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LANTERNS AND ACCESSORIES, KEROSENE BURNING.

Adams & Westlake Co.

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Dayton Mfg. Co.
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LEAD BURNERS, ELECTRIC.

General Electric Co.

LEVER CONNECTIONS, TRUCK AND BRAKE.

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Adams & Westlake Co.
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Boss Nut Co.
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Columbia Nut & Bolt Co.
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(See Nut Locks and Lock Nuts.)

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Adams & Westlake Co.
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Hickman Lumber Co., W. R.
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MACHINE TOOLS AND DRIVES.

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Brown Hoisting Machinery Co.
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MOHAIR VELVETS FOR CAR SEAT COVERING.

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Dalstrom Metallic Door Co.
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MOTOR PASSENGER CARS.

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MOTORS, PASSENGER CAR.

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MOTORS, SHOP.

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NUT LOCKS.

(See Lock Nuts and Nut Locks.)

NUTS, GIB.

Columbia Nut & Bolt Co.
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O

OILS, PAINT.

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ORE CARS.

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Safety Car Heating & Lighting Co.
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PACKING CUPS, AIR CYLINDER.

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PINS, BRAKE LEVER.

National Malleable Castings Co.

PINS, COUPLING.

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PINTSCH GAS LIGHTING EQUIPMENT.

Safety Car Heating & Lighting Co.
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PIPE AND PIPE FITTINGS.

Magor Car Corp.
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PIPE CLAMPS AND HANGERS.

National Malleable Castings Co.
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PIPE FLANGES, STEEL.

Bethlehem Shipbuilding Corp., Ltd.

PIPE HANGERS.

National Malleable Castings Co.

PLANING MACHINERY, METAL AND WOOD.

Niles-Bement-Pond Co.

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Gould Coupler Co.
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POUCH RACKS AND FITTINGS FOR POSTAL CARS.

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General Electric Co.

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St. Louis Car Co.

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General Electric Co.
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(See Cars, Repaired and Rebuilt.)

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Westinghouse Air Brake Co.
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RESISTOR, FOR MOTOR PASSENGER CARS.

General Electric Co.
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RHEOSTATS.

General Electric Co.

RIVET HEATERS.

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RIVETS.

American Car & Foundry Co.
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RODS, BOTTOM CONNECTING.

Magor Car Corp.

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ROLLER BEARINGS FOR CAR TRUCKS.

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RUNNING BOARDS.

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SADDLES, RUNNING BOARD.

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SAFETY DEVICES, CAR DOOR LOWERING.

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SAFETY TREADS.

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National Malleable Castings Co.

SHEET METAL SPECIALTIES.

American Nut & Bolt Fastener Co.

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SIDE BEARINGS.

American Steel Foundries.
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Vapor Car Heating Co., Inc.
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Westinghouse Air Brake Co.
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Gold Car Heating & Lighting Co.
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Allegheny Steel Company 669
Main Office:—Brackenridge, Pa.
Domestic Branches:—
Detroit, Mich., J. Allen Armstrong, Dime Bank Bldg.
New York, N. Y., Chandler & Floyd, Inc., 501 Fifth Avenue.

American Brake Company 841
Main Office:—St. Louis, Mo.

American Brake Shoe & Foundry Company 749
Main Office:—New York, N. Y.
Domestic Branches:—
Chicago, Ill.; Chattanooga, Tenn.; San Francisco, Cal.

American Car and Foundry Company 266, 267, 704, 1121, 1142, 1143, 1164, 1172
Main Office:—New York, N. Y.
Domestic Branches:—
Chicago, Ill.; Huntington, W. Va.; Jeffersonville, Ind.; St. Louis, Mo.

American Motor Body Company
See Hale & Kilburn Corp.

American Nut & Bolt Fastener Company 1084
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Detroit, Mich.; New Orleans, La.; San Francisco, Calif.

American Steel Foundries 542, 543, 570 to 573, 575, 631, 697, 713, 766
Main Office:—Chicago, Ill.
Domestic Branches:—
Philadelphia, Pa.; New York, N. Y.; Washington, D. C.; Pittsburgh, Pa.; Cleveland, Ohio; St. Louis, Mo.; St. Paul, Minn.; Denver, Col.

Association of Manufacturers of Chilled Car Wheels 695
Main Office:—Chicago, Ill.

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Barco Manufacturing Company 859
Main Office:—Chicago, Ill.
Domestic Branches:—
Montreal, Que.; Toronto, Ont.; Vancouver, B. C.; Winnipeg, Manitoba; The Holden Company, Ltd.
Foreign Branches:—
Central America—J. E. Hall, Apartado 313, Guatemala.
Cuba—George E. Knight, Depto. 114, Edificio Calle, Havana.
Japan and China—B. B. Milner, Imperial Hotel, Tokio.
Mexico—J. H. Cooper, Apartado Postal 2129, Edificio Oliver, Mexico D. F.
Philippine Islands—Pacific Commercial Company, Manila.

Bethlehem Shipbuilding Corporation, Ltd. 314
Main Office:—Bethlehem, Pa.
Domestic Branches:—
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Bradford Draft Gear Company 509
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Brill Company, The J. G. 355
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Domestic Branches:—
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Springfield, Mass., Wason Mfg. Company.
St. Louis, Mo., American Car Company.
Canada, Canadian Brill Co., Preston, Ont.
Foreign Branches:—
Argentine, Paraguay and Uruguay—P. B. Goldsworthy. Chacabucho 271, Buenos Aires, Argentine.
Australasia—Noyes Brothers, Melbourne, Sydney, Brisbane; J. R. W. Gardam, Perth.
Belgium and Holland—C. Dubbleman, 19 Rue du Parnasse, Brussels.
Bolivia—International Machinery Co., La Paz.
Chile—International Machinery Co., Calle Morande No. 530, Santiago.
China—Andersen, Meyer & Co., Ltd., 4 and 5 Yuen Ming, Yuen Road, Shanghai.
Colombia and Venezuela—Wesselhoeft & Poor, Bogota, Barranquilla and Medellin, Colombia and Caracas, Venezuela.
Ecuador—Carlow Cordovez, c/o Guayaquil Agencies Co., Apartado 186, Guayaquil.
England—150 Southampton Row, London, W. C. I.
Finland—Finnish Electric O/Y, Boulevagatan No. 3, Helsingfors.
France—Cie. J. G. Brill, Paris.
Italy—Giovanni Chechetti, Plaza Sicilia 1, Milan.
Natal, Transvaal and Orange River Colony—Thomas Barlow & Sons (S. A.), Ltd., Durban, Natal.
Norway—Energi II Elektrisk Aktieselskap, 9 Skippergaten, Kristiania, Norway.
Peru—W. R. Grace & Co., Merced, 620, Lima.

Brown Hoisting Machinery Company 985, 987
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Domestic Branches:—
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Buckeye Jack Mfg. Company 1173
Main Office:—Alliance, Ohio.

Buckeye Steel Castings Company ..... 570 to 573, 599, 613, 632
Main Office:—Columbus, Ohio.
Domestic Branches:—
Chicago, Ill.; New York, N. Y.; St. Paul, Minn.; Louisville, Ky.
Foreign Branch:—
England, Davis & Lloyd, 26 Victoria Street, Westminster, London, S. W. 1.

Buffalo Brake Beam Company 747
Main Office:—New York, N. Y.
Domestic Branches:—
Washington, D.C.; St. Paul, Minn.; St. Louis, Mo.; Canada—Hamilton, Ont.; Montreal, Que.

Buffalo Steel Car Company 1166, 1167
Main Office:—Buffalo, N. Y.

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Camel Company 401, 403, 405
Main Office:—Chicago, Ill.

Canadian Car & Foundry Company, Ltd. 1122, 1123, 1124, 1125
Main Office:—Montreal, Canada.
Domestic Branches:—
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Foreign Branch:—
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Chicago Railway Equipment Company 731, 761
Main Office:—Chicago, Ill.
Domestic Branches:—
New York, N. Y.; St. Louis, Mo.; San Francisco, Cal.; New Birks Bldg., Montreal, Que., Canada.
Foreign Branches:—
England—32 Victoria Street, London, S. W. 1.
Japan—Imperial Hotel, Tokio.

Clark Car Company 188, 189
Main Office:—Pittsburgh, Pa.

Columbia Nut & Bolt Company, Inc.....1086
Main Office:—Bridgeport, Conn.

Commonwealth Steel Company 376, 377, 511, 619
Main Office:—St. Louis, Mo.
Foreign Branch:—
France, 15 Boulevard des Italiens, Paris.

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Main Office:—Jamestown, N. Y.
Domestic Branches:—
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Baltimore, Md., W. S. Brauns, Munsey Bldg.
Binghamton, N. Y., Babcock, Hinds & Underwood.
Boston, Mass., Seeley & Lawson, 73 Tremont St.
Buffalo, N. Y., Chautauqua Bldrs. Supply, Jamestown, N. Y.
Chattanooga, Tenn., T. T. Wilson & Co., 721-723 E. 9th St.
Cincinnati, Ohio, L. D. Zellner, Mercantile Libr. Bldg.
Charleston, W. Va., Standard Brick & Supply Co.
Charlotte, N. C., Luke Seawell, P. O. Box 462.
Cleveland, Ohio, C. A. Carlson Co., Swetland Bldg.
Dallas, Texas, Gilbert Manufacturing Co., 1209½ Main St.
Davenport, Ia., Cement Products Co., 207 W. 4th St.
Dayton, Ohio, G. H. Condit, Mutual Home Bldg.
Decatur, Ill., C. J. Gandy, Standard Life Bldg.
Denver, Colo., Hine Desk & Fixture Co., 1640 California St.
Des Moines, Ia., F. R. Hubbard, 202 Hubbell Bldg.
Duluth, Minn., Dunlop-Moore Co., 22 Third Ave., West.
El Paso, Texas, C. C. Gaines, First Natl. Bank Bldg.
Evansville, Ind., Evansville Strl. Supply Co.
Grand Rapids, Mich., Chas. Vandervelde, 757 Hawthorne St.
Helena, Mont., Raymond C. Grant, Power Block Annex.
Indianapolis, Ind., Vonnegut Hardware Co.
Kansas City, Mo., Carter-Waters Corp., Finance Bldg.
Los Angeles, Calif., W. C. Lea, 653 So. Clarence St.
Memphis, Tenn., Alvin W. Pannel, 11 So. Second St.
Minneapolis, Minn., Geo. Hauenstein, 654 Builders Exchange.
Montreal, Canada, Mason Regulator & Eng. Co.
Nashville, Tenn., Geo. W. Ruth, Arcade Building.
New Orleans, La., Ole K. Olsen, 822 Perdido St.
Norfolk, Va., L. W. Tazewell & Co., Dickson Bldg.
Okla. City, Okla., Bissell Builders Supply Co., Colcord Bldg.
Omaha, Neb., Sunderland Bros. Co., 17th & Harney Sts.
Peoria, Ill., H. F. Kircher & Co., Lehmann Bldg.
Philadelphia, Pa., Building Prod. Sales Co., Bulletin Bldg.
L. F. Kedzie, Specialty Only, Bulletin Bldg.
Pittsburgh, Pa., Wm. A. Covert Co., Fulton Bldg.
Reading, Pa., Daniel F. Yost, Baer Bldg.
Richmond, Va., J. S. Archer, 203 Real Estate Exch.
Roanoke, Va., C. C. Jacobs, Terry Bldg.
Rochester, N. Y., Francis Metal Door & Window Corp., 46-48 Cortland St.
San Francisco, Calif., Edwin C. Dehn, Hearst Bldg.
Scranton, Pa., LaBar, Parsons & Pierce, Scranton Life Bldg.
Seattle, Wash., E. H. Camp, 515 Bell St.
Sioux City, Ia., H. C. McNeil & Son, 308 Jackson St.
St. Louis, Mo., Sears & Piou, Arcade Bldg.
Walter G. Clark, Specialty Only, 106 N. 3rd St.
St. Paul, Minn., O. W. Burmeister, Pioneer Bldg.
Syracuse, N. Y., Francis Metal Door & Window Corp., 423 So. Salina St.
Toledo, Ohio, S. L. Everitt, Ohio Bldg.
Washington, D. C., R. V. LaDow, Natl. Metro. Bk. Bldg.
Wilkes-Barre, Pa., Labar, Parsons & Pierce, 2d Nat'l Bank Bldg.
Winnipeg, Manitoba, Canada, Western Steel Products Co.
Foreign Branches:—
Australia—Anglo-Saxon Trading Company, 120 Broadway, New York, U. S. A.
England—Art Metal Equipment Company, 186-188 Shaftesbury Ave., London.
Hawaii—The Waterhouse Company, Ltd., Box 438, 1309 Bishop Street, Honolulu.

Damascus Brake Beam Company 390, 748
Main Office:—Cleveland, Ohio.
Domestic Branch:—
New York, N. Y.

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Dayton Manufacturing Company 956, 957
Main Office:—Dayton, Ohio.
Domestic Branches:—
Cleveland, Ohio; Houston, Texas.
Los Angeles and San Francisco, Calif.
Denver, Col., B. C. Watts & Co., 407 14th Street.
Richmond, Va., Stewart & Stevens, American Nat'l Bank Bldg.
St. Paul, Minn., Rank & Goodell, Merchants Bank Bldg.
Canada—International Equipment Co., Ltd., Transportation Bldg., Montreal, Que.
Foreign Branches:—
England—G. D. Peters & Company, 3 A Dean's Yard, Westminster, London, S. W. 1.
Mexico—J. L. Copper, Av. 16 De Septiembre, Num. 5, Apartado Postal Num. 2129, Mexico, D. F.

Duner Company 495
Main Office:—101 South Clinton St., Chicago, Ill.

E

Edison Storage Battery Company 912, 913
Main Office:—Orange, N. J.
Domestic Branches:—
Atlanta, Ga.; Chicago, Ill.; Cleveland, Ohio; Boston, Mass.; Detroit, Mich.; Montreal, Que.; New Orleans, La.; New York, N. Y.; Pittsburgh and Philadelphia, Pa.; San Francisco and Los Angeles, Calif.; Seattle, Wash.; St. Louis, Mo.; Washington, D. C.
Foreign Branch:—
Edison Storage Battery Co., New York, N. Y.

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Main Office:—Syracuse, N. Y.
Domestic Branches:—
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Electric Storage Battery Company.....909, 911
Main Office:—Philadelphia, Pa.
Domestic Branches:—
Atlanta, Ga.; Boston, Mass.; Chicago, Ill.; Cincinnati and Cleveland, Ohio; Denver, Col.; Detroit, Mich.; Kansas City, Mo.; St. Louis, Mo.; Minneapolis, Minn.; New York City and Rochester, N. Y.; Pittsburgh, Pa.; San Francisco, Calif.; Seattle, Wash.; Washington, D. C.; Canada—Exide Batteries of Canada, Ltd., 135-137 Dufferin St., Toronto, Ont.
Foreign Branches:—
Export Sales Dept., The Electric Storage Battery Co., 23-31 West 43d St., New York, N. Y.

Enterprise Railway Equipment Company 121, 144, 145, 166, 167
Main Office:—Chicago, Ill.

F

Forged Steel Wheel Company 699
Main Office:—Pittsburgh, Pa.

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General Electric Company 1174
Main Office:—Schenectady, N. Y.
Domestic Branches:—
Alabama; Birmingham.
*Arizona; Phoenix.
Arkansas; Little Rock.
California; Los Angeles, San Francisco.
Colorado; Denver.
Connecticut; Hartford, New Haven.
District of Columbia; Washington.
Florida; Jacksonville.
Georgia; Atlanta.
Illinois; Chicago.
Indiana; Fort Wayne, Indianapolis, Terre Haute.
Iowa; Des Moines.
Kentucky; Louisville.
Louisiana; New Orleans.
Maryland; Baltimore.
Massachusetts; Boston, Springfield, Worcester.
Michigan; Detroit, Grand Rapids, Jackson.
Minnesota; Duluth, Minneapolis.
Missouri; Joplin, Kansas City, St. Louis.
Montana; Butte.
Nebraska; Omaha.
New Jersey; Harrison, Newark, Trenton.
New York; Buffalo, Elmira, New York City, Niagara Falls, Rochester, Schenectady, Syracuse.
North Carolina; Charlotte.
Ohio; Akron, Cincinnati, Cleveland, Columbus, Dayton, Toledo, Youngstown.
*Oklahoma; Oklahoma City, Tulsa.
Oregon; Portland.
Pennsylvania; Erie, Philadelphia, Pittsburgh.
Rhode Island; Providence.
Tennessee; Chattanooga, Knoxville, Memphis, Nashville.
*Texas; Dallas, El Paso, Houston, San Antonio.
Utah; Salt Lake City.
Virginia; Richmond.
Washington; Seattle, Spokane, Tacoma.
West Virginia; Bluefield, Charleston.
Wisconsin; Milwaukee.
*Southwest General Electric Co.
Foreign Branches:—
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Main Office:—Troy, N. Y.

Gold Car Heating & Lighting Company 869
Main Office:—Brooklyn, N. Y.

Gould Coupler Company ..... 570 to 573, 955
Main Office:—New York, N. Y.
Domestic Branches:—
Chicago, Ill.; Depew, N. Y.

Greenville Steel Car Company 1165
Main Office:—Greenville, Pa.

Gregg Company, Ltd., The 1144
Main Office:—Hackensack, N. J.
Domestic Branches:—
New York, N. Y.
Foreign Branches:—
Cuba, The Gregg Company, Habana.
Hawaii, The Gregg Company, Honolulu.
Porto Rico, The Gregg Company, San Juan.

Griffin Wheel Company 701
Main Office:—Chicago, Ill.
Domestic Branches:—
Detroit, Mich.; Denver, Col.; St. Paul, Minn.; South Tacoma, Wash.; Kansas City, Kansas; Boston, Mass.; San Francisco, Cal.; Council Bluffs, Iowa.

Grip Nut Company 1087
Main Office:—Chicago, Ill.

H

Hale & Kilburn Corporation 482, 483
Main Office:—Philadelphia, Pa.
Domestic Branches:—
New York, N. Y.; Chicago, Ill.; St. Louis, Mo.; Louisville, Ky.; Atlanta, Ga.; Washington, D. C.; San Francisco, Calif.
Foreign Branch:—
England, G. D. Petters & Co., Ltd., Westminster, London, S. W. 1.

Heywood-Wakefield Company 485
Main Office:—Wakefield, Mass.
Domestic Branches:—
Chicago, Ill.; Houston, Texas; New York, N. Y.; San Francisco, Calif.; Washington, D. C.; Canada, Toronto, Ont.; Montreal, Que.

Hickman Lumber Company, The W. R. 1056
Main Office:—Cleveland, Ohio.
Domestic Branches:—
Hattiesburg, Miss.; W. R. Hickman Lumber Co.
House Station, Ky., Kentucky Lumber Co.
Seattle, Wash., L. S. Vincent Co.

Howard & Company, Jas. L. 958
Main Office:—Hartford, Conn.

Hutchins Car Roofing Company 387, 425, 427, 429
Main Office:—Detroit, Mich.
Domestic Branches:—
New York, N. Y.; Chicago, Ill.; St. Louis, Mo.; St. Paul, Minn.; Montreal, Canada.

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Industrial Works 989, 991
Main Office:—Bay City, Mich.
Domestic Branches:—
Chicago, Ill.; Detroit, Mich.; New York, N. Y.; Philadelphia, Pa.
Birmingham, Ala., C. B. Davis Engineering Company.
El Paso, Texas, El Paso Bridge & Iron Company.
Kansas City, Mo., S. R. Toucy.
Minneapolis, Minn., Copeland & Klingel.
Portland, Ore., Northwestern Equipment Company.
San Francisco, Cal., N. B. Livermore & Company.
Seattle, Wash., Northwestern Equipment Company.
St. Louis, Mo., J. G. Miller, Commonwealth Trust Bldg.
Canada, Montreal, Que., F. H. Hopkins & Co., Ltd.
Toronto, Ont., F. H. Hopkins & Co., Ltd.
Foreign Branches:—
New York, N. Y., Asia Engineering Corporation.
Belgium, Brussels, A. Hennuy, 116 Rue Hotel Des Monnaies.
Chile, Santiago, J. L. Donner, Casilla 7577.
China, Hong Kong and Shanghai, Bradley & Company.
China, Tientsin, American Machinery & Export Company.
Japan, Osaka, Kobe, Yokohama, Tokyo, International Trading Corp., Ltd. (Chyagai Boyeki Kabushiki Kaisha).
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Manchuria, Dairen, K. Nishikawa Company, No. 1 Nishi-Koen-Cho.
New South Wales, Sydney, J. E. Toole & Company, 70 Hunter Street.

International Couplers Company 861
Main Office:—Pittsburgh, Pa.

International General Electric Company, Inc.
Domestic Offices:—New York, N. Y.; Schenectady, N. Y.
Foreign Branches:—
Argentina—General Electric, S. A., Buenos Aires.
Australia—Australian General Electric Co., Ltd., Sydney and Melbourne.
Belgium and Colonies—Societe D'Electricite et de Mecanique Procedes Thomson-Houston & Carels Societe Anonyme, Brussels.
Brazil—General Electric, S. A., Rio de Janeiro and Sao Paulo.
Canada—Canadian General Electric Co., Ltd., Toronto.
Chile—International Machinery Company, Santiago, Valparaiso and Antofagasta.
China—Andersen, Meyer & Co., Ltd., Shanghai; International General Electric Co., Inc., Shanghai (General office for the Far East excluding Japan and China).
Colombia—Wesselhoeft & Poor, Medelin, Bogota and Baranquilla.
Cuba—General Electric Company of Cuba, Havana and Santiago.
Dutch East Indies—International General Electric Company, Inc., Soerabaia, Java.
Ecuador—Carlos Cordovez, Guayaquil.
Egypt—British Thomson-Houston Co., Ltd., Cairo.
France and Colonies—Compagnie Francaise Thomson-Houston, Paris, France.
Great Britain and Ireland—British Thomson-Houston Co., Ltd., Rugby; International General Electric Co., Inc., London.
Greece and Colonies—Cie. Hellenique d'Electricite, Athens.
Holland—Philips Gloeilampen Frabrieken, Eindhoven.
India—British Thomson-Houston Co., Ltd., Calcutta and Bombay; International General Electric Company, Inc., Calcutta.
Italy and Colonies—Compania Generale Di Elettricita, Milan.
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Mexico—Mexican General Electric Company, Mexico City, Guadalajara and Monterey.
New Zealand—The National Electrical and Engineering Company, Ltd., Christchurch, Auckland, Dunedin and Wellington.
Paraguay—General Electric, S. A., Buenos Aires, Argentina.
Peru—W. R. Grace & Company, Lima.
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Porto Rico—International General Electric Co., Inc., San Juan.
Portugal and Colonies—Sociedad Iberica De Construcciones Electricas, Madrid, Spain.
Russia—Wseobshtchaea Electricheskaia Kompania, Petrograd and Vladivostok.
South Africa—South African General Electric Company, Ltd., Johannesburg and Capetown.
Spain and Colonies—Sociedad Iberica de Construcciones Electricas, Madrid, Spain.
Uruguay—General Electric, S. A., Montevideo.
Venezuela—Wesselhoeft & Poor, Caracas.

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Johnson & Company, J. R. 679
Main Office:—Richmond, Va.
Domestic Branch:—
New York, N. Y., Atkinson & Utech, 111 Broadway.

Joliet Railway Supply Company
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Kerite Insulated Wire & Cable Company 943
Main Office:—New York, N. Y.
Domestic Branch:—
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Keyoke Railway Equipment Company 513
Main Office:—Chicago, Ill.
Domestic Branches:—
New York, N. Y., Federal Railway Devices Co.
Montreal, Quebec, Canada, Keyoke Railway Equipment Co.

Kilbourne & Jacobs Manufacturing Company 191
Main Office:—Columbus, Ohio.
Domestic Branch:—
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Magor Car Corporation 960, 1126
Main Office:—New York, N. Y.
Foreign Branch:—
England, Magor & Leith, 8 Caxton House, London, S. W. 1.

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Main Office:—Boston, Mass.
Domestic Branch:—
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McConway & Torley Company 570 to 573, 579, 580, 583, 585
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Detroit, Mich.; Chicago, Ill.; New York, N. Y.; San Francisco, Cal.; St. Louis, Mo.
Foreign Branch:—
Mexico—J. H. Cooper, Edificio "Oliver," Mexico City.

McMyler Interstate Company 993, 995, 996, 997
Main Office:—Bedford, Cleveland, Ohio.
Domestic Branches:—
Birmingham, Ala.; Boston, Mass.; Chicago, Ill.; Denver, Col.; New Orleans, La.; New York, N. Y.; San Francisco, Cal.; Seattle, Wash.

Middletown Car Company .. 1127, 1128, 1129, 1130, 1131
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Miner, W. H. 235, 501, 517, 519, 649, 843
Main Office:—667 Rookery Bldg., Chicago, Ill.

Morton Manufacturing Company 441, 451, 463, 959
Main Office:—Chicago, Ill.
Domestic Branches:—
New York, N. Y.; St. Louis, Mo.; St. Paul, Minn.; San Francisco, Cal.; Washington, D. C.; Canada, Montreal, Que.
Foreign Branch:—
England, Sheffield.

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Main Office:—Buffalo, N. Y.
Domestic Branch:—
Montreal, Que., Can., Libby Tube & Supply Co., Ltd.

National Car Equipment Company 961
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National Dump Car Company 183
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National Malleable Castings Company 570-573, 591, 671
Main Office:—Cleveland, Ohio.

National Railway Appliance Company 962
Main Office:—New York, N. Y.
Domestic Branches:—
Boston, Mass.; Washington, D. C.; Harrisburg, Pa.; Chicago, Ill., Hegeman-Castle Corp., Railway Exchange.

National Steel Car Corporation, Ltd., ... 960, 1126
Main Office:—Hamilton, Ont., Canada.

Niles-Bement-Pond Company 1175, 1176
Main Office:—New York, N. Y.
Domestic Branches:—
Boston, Mass.; Birmingham, Ala.; Chicago, Ill.; Cincinnati and Cleveland, Ohio; Detroit, Mich.; Hartford, Conn.; Philadelphia and Pittsburgh, Pa.; Los Angeles and San Francisco, Cal.; Rochester, N. Y.; St. Louis, Mo.; St. Paul, Minn.
Canada, The John Bertram & Sons Co., Ltd.:—Dundas and Toronto, Ont.; Halifax, Nova Scotia; Montreal, Que.; Winnipeg, Manitoba; British Columbia Equipment Co., Vancouver, B. C.
Foreign Branch:—
England, 25 Victoria Street, London, S. W. 1.

P

Pantasote Company 963
Main Office:—New York, N. Y.
Domestic Branches:—
Boston, Mass.; Chicago, Ill.; Detroit, Mich.; Houston, Texas; San Francisco, Cal.; Canada, Holden & Company, Toronto, Montreal, Winnipeg, Vancouver.

Pittsburgh Spring & Steel Company 714
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Chicago, Ill.; New York, N. Y.; Washington, D. C.

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Pressed Steel Car Company 966
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Chicago, Ill.; New York, N. Y.; St. Paul, Minn.

Pullman Company 964, 965
Main Office:—Chicago, Ill.
Domestic Branch:—
New York, N. Y.

R

Railway Steel Spring Company 716, 717
Main Office:—New York, N. Y.
Domestic Branches:—
Chicago, Ill.; Dallas, Tex.; Denver, Col.; Louisville, Ky.; Norfolk, Va.; St. Louis, Mo.; St. Paul, Minn.

Ralston Steel Car Company 277, 1168
Main Office:—Columbus, Ohio.
Domestic Branches:—
New York, N. Y.; Pittsburgh, Pa.

Republic Railway Equipment Co., Inc. 637, 743, 745
Main Office:—Chicago, Ill.

Rodger Ballast Car Company 149
Main Office:—Chicago, Ill.

Ryan Car Company 1169
Main Office:—Chicago, Ill.

S

Safety Car Heating and Lighting Company 917, 935
Main Office:—New York, N. Y.

Schaefer Equipment Company 755, 756, 757
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Boston, Mass.; Chicago, Ill.; New Orleans, La.; St. Louis, Mo.; Canada, Montreal, Que.

Service Motor Truck Company 359
Main Office:—Wabash, Indiana.

Southern Pine Association 1057
Main Office:—New Orleans, La.

St. Louis Car Company 967
Main Office:—St. Louis, Mo.

Stafford Roller Bearing Car Truck Corp. 607
Main Office:—Lawton, Mich.

Standard Car Truck Company 609
Main Office:—Chicago, Ill.
Domestic Branches:—
Chicago, Ill.; New York, N. Y.; St. Paul, Minn.; Montreal, Que.

Standard Coupler Company 503, 521, 523
Main Office:—New York, N. Y.
Domestic Branch:—
Chicago, Ill.

Standard Forgings Company 535, 968
Main Office:—Chicago, Ill.
Domestic Branches:—
Denver, Col.; Houston, Texas; Milwaukee, Wis.; New York, N. Y.; Portland, Ore.; Richmond, Va.; St. Louis, Mo.; St. Paul, Minn.; Salt Lake City, Utah; Seattle, Wash.; A. M. Castle & Co., Los Angeles, Calif., and San Francisco, Calif.

Standard Railway Equipment Company 431
Main Office:—Chicago, Ill.
Domestic Branches:—
New York, N. Y.; Philadelphia, Pa.; Richmond, Va.; Washington, D. C.; Chicago, Ill.; St. Louis, Mo.; Houston, Texas; Kansas City, Mo.; Denver, Colo.; San Francisco, Cal.; Canada, P. H. Murphy Co. of Canada, Ltd., Montreal, Quebec.

Standard Safety Nut Corp. 1088
Main Office:—New York, N. Y.

Standard Steel Car Company 109, 137, 1127, 1128, 1129, 1130, 1131
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Chicago, Ill.; New York, N. Y.
Foreign Branches:—
Argentina, 46, Reconquista, Buenos Aires.
Brazil, 109 Avenida Rio Branco, Rio de Janeiro.
England, Salisbury House, Finsbury Circus, London, E. C. 2.
France, Entreprises Industrielles Charentaises (Middletown Car Co.), 5, Rue Newton, Paris (16 é)
Middletown Car Co. (Entreprises Industrielles Charentaises) 5, Rue Newton, Paris (16 é).

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Standard Steel Works Company 680, 703, 715, 1070, 1132
Main Office:—Philadelphia, Pa.
Domestic Branches:—
New York, N. Y.; Richmond, Va.; Chicago, Ill.; St. Louis, Mo.; Portland, Ore.; Houston, Tex.; Pittsburgh, Pa.; Boston, Mass.; St. Paul, Minn.
Foreign Offices:—
Argentine Republic, Paseo Colon 185, Buenos Aires.
Brazil, Rua da Alfandega 5, Rio de Janeiro.
Chile, Edificio Aristia, Santiago.
Cuba and Jamaica, 520 National Bank of Cuba Bldg., Havana.
Dutch East Indies, Nillmy Bldg., Bandoeng, Java.
France, 14 Rue Duphot, Paris.
Great Britain, 34 Victoria St., London.
India, Temple Chambers, Old Post Office St., Calcutta.
Northeastern Europe, Krolewska 1, Warsaw, Poland.
Peru, Calle de Espaderos 569, Lima.
Porto Rico and Santo Domingo, Bank of Nova Scotia Bldg., San Juan.
Siberia, 14 Pochtovaya St., Harbin, Manchuria.
Southern Africa, Loveday House, Johannesburg.
Southeastern Europe, 19 Strada Brezoiano, Bucharest.
Foreign Agencies:—
Brazil, Cory Bros. & Co., Ltd., Bahia.
Brazil, Edward C. Holden, Para.
China, Andersen, Meyer & Co., Ltd., Shanghai.
Hawaii, C. Brewer & Co., Ltd., Honolulu.
Japan, Sale & Frazar, Ltd., Tokyo.
Mauritius, Stafford, Mayer & Co., Port Louis.
Mexico, P. G. Cheatham, 2A, Capuchinas 48, Mexico, D. F.
New South Wales, R. Towns & Co., Sydney, Australia.
New Zealand, Philips & Pike, Wellington.
Philippines and French Indo China, Pacific Commercial Co., Ltd., Manila.
Portugal, E. Pinto Basto & Co., Ltd., Lisbon.
Portuguese East Africa, Vines & Co., Lourenco Marques.
Scandinavia, Olav Belsheim, Toldbogaden 8, Christiania, Norway.
Victoria, Newell & Co., Melbourne, Australia.
West Australia, Leslie & Co., Perth.

Standard Textile Products Company 969
Main Office:—New York, N. Y.

Stucki Company, A. 651
Main Offices:—Pittsburgh, Pa.

Symington Company, The T. H. 549, 629, 673
Main Office:—Rochester, N. Y.
Domestic Branches:—
New York, N. Y.; Chicago, Ill.; Baltimore, Md.; St. Paul, Minn.; Boston, Mass.; Canada, Canadian Appliance Co., Ltd., Montreal, Quebec.

T

Talmage Manufacturing Company 849
Main Office:—Cleveland, Ohio.
Domestic Branch:—
Chicago, Ill., L. C. Sprague, Great Northern Bldg.

Tuco Products Corporation 435, 449, 457, 458, 471
Main Office:—New York, N. Y.
Domestic Branches:—
Boston, Mass., F. A. Barbey, 683 Atlantic Ave.
Dallas, Tex., W. D. Jenkins, Praetorian Bldg.
Houston, Tex., W. D. Jenkins, Carter Bldg.
Louisville, Ky., T. C. Coleman & Son, Starks Bldg.
San Francisco, Calif., Edw. S. Sullivan Co., Monadnock Bldg.
St. Louis, Mo., H. B. Wilson Co., 915 Olive St.
St. Paul, Minn., Minnesota Supply Co., Pioneer Bldg.
Washington, D. C., F. N. Grigg, 630 Louisiana Ave.
Canada, Consolidated Equipment Co., 26 Victoria Sq., Montreal, Que.

U

Union Draft Gear Company 525, 527
Main Office:—Chicago, Ill.
Domestic Branches:—
Washington, D. C.; St. Louis, Mo.; Canada, Montreal, Que.

Union Spring & Manufacturing Company 675, 718
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Philadelphia and New Kensington, Pa.; New York, N. Y.; Chicago, Ill.; Baltimore, Md.; Louisville, Ky.; Richmond, Va.

U. S. Light & Heat Corporation 925
Main Office:—Niagara Falls, N. Y.
Domestic Branches:—
Chicago, Ill.; Detroit, Mich.; New York, N. Y.; San Francisco, Calif.
Foreign Branch:—
England, Palace Chambers, Bridge St., London, S. W. 1.

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Universal Draft Gear Attachment Company 337, 541, 553, 555, 970
Main Office:—Chicago, Ill.
Domestic Branch:—
Canada, Transportation Bldg., Montreal, Que.

V

Vapor Car Heating Company, Inc. 877
Main Office:—Chicago, Ill.
Domestic Branches:—
Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; St. Paul, Minn.; San Francisco, Calif.; Washington, D. C.; Canada, 61 Dalhousie St., Montreal, Que.

W

Waugh Draft Gear Company 505, 533
Main Office:—Chicago, Ill.

Weierbach Brake Shoe Company 751
Main Office:—Scranton, Pa.
Domestic Branch:—
Los Angeles, Cal., Al. H. Hoffman, American Bank Bldg.
Foreign Branch:—
Fox Brothers, 126-130 Lafayette Street, New York, N. Y.

Western Wheeled Scraper Company 193
Main Office:—Aurora, Ill.
Domestic Branches:—
Chicago, Ill.; Kansas City and St. Louis, Mo.; San Francisco, Calif.; Pittsburgh, Pa.; Omaha, Nebr.; New York, N. Y.; Dallas, Texas; Atlanta, Ga.; St. Paul, Minn.; Memphis, Tenn.; Canada, Toronto, Ont.
Foreign Branches:—
Argentina, Allied Machinery Co., Venezuela, 691, Buenos Aires.
Chile, Allied Machinery Co., Calle Bandera 780, Santiago.
China, Allied Machinery Co., 111 Ave. Edouard VII, Shanghai.
Cuba, Allied Machinery Co., Obrapia 23 Altos.
England, Geo. F. West & Co., Iddlesleigh House, Westminster, London, S. W. 1.
France, Allied Machinery Co., 19 Rue de Rocroy, Paris.
India, Allied Machinery Co., P. O. Box No. 4, Karachi.
Italy, Allied Machinery Co., Corso Dante 40, Turin.
Peru, Allied Machinery Co., Calle Filipinas 559, Lima.
Spain, Allied Machinery Co., S. A. E. Plaza de Cataluna 8, Barcelona.

Westinghouse Air Brake Company 537, 783, 785, 791, 793, 812, 813, 818, 854
Main Office:—Pittsburgh, Pa.
Domestic Branches:—
Atlanta, Ga.; Boston, Mass.; Chicago, Ill.; Columbus, O.; Denver, Col.; Houston, Tex.; Los Angeles, Cal.; New York, N. Y.; St. Louis, Mo.; St. Paul, Minn.; Salt Lake City, Utah; San Francisco, Cal.; Seattle, Wash.; Topeka, Kan.; Washington, D. C.
Canada:—Canadian Westinghouse Company, Ltd., Hamilton, Ontario, Canada.
Foreign Branches:—
Australia, Westinghouse Brake Company of Australasia, Ltd., Concord West, New South Wales.
England, The Westinghouse Brake & Saxby Signal Company, Ltd., London.
France, Compagnie Des Freins Westinghouse, Sevran.
Germany, Westinghouse Bremsen Gesellschaft, m. b. h., Hanover.
Italy, Compagnia Italiana Westinghouse, Dei Freni, Turin.
Russia, Societe Anonyme Westinghouse, Petrograd.

Wine Railway Appliance Company 237, 389, 415, 653
Main Office:—Toledo, Ohio.
Domestic Branches:—
New York, N. Y.; Chicago, Ill.

Woods & Company, Edwin S. 656
Main Office:—Chicago, Ill.
Domestic Branches:—
Denver, Col., Arthur T. Herr, United States National Bank Bldg.
Detroit, Mich., Frost Railway Supply Company, Penobscot Bldg.
New York, N. Y., Tuttle Railway Supply Company, Woolworth Bldg.
St. Louis, Mo., W. J. Roehl, Railway Exchange Bldg.
Canada—International Equipment Co., Ltd., Transportation Bldg., Montreal, Quebec.
Foreign Branch:—
China—Chinese Engineering & Development Co., Tientsin.

Y

Youngstown Steel Car Company 1170, 1171
Main Office:—Niles, Ohio.
Domestic Branches:—
Richmond, Va.; Washington, D. C.